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GLOBAL INNOVATION INDEX 2020

Who Will Finance Innovation?

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GLOBAL INNOVATION INDEX 2020

Who Will Finance Innovation?

13TH EDITION

Soumitra Dutta, Bruno Lanvin, and **Sacha Wunsch-Vincent**
Editors

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PREFACE

RELEASING THE GLOBAL INNOVATION INDEX 2020: WHO WILL FINANCE INNOVATION?

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We are pleased to present the 13th edition of the Global Innovation Index (GII) while commemorating a decade long partnership between the Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO).

For more than 10 years, the GII has fostered innovation debates and policies. Again, the GII 2020 report presents global innovation trends and the innovation performance of 131 economies.

As this report goes to press, the world is struggling to cope with the economic and social implications of the coronavirus disease (COVID-19) crisis. Now more than ever, innovation—primarily in finding treatments and a vaccine—is humanity's best hope to overcome the economic lockdown. Echoing our call to support medical innovation in the GII 2019 report, this pandemic is a potent reminder that health-related research and development (R&D) and health system innovations are not a luxury, but a necessity.

The amplitude of the crisis created by COVID-19 has engulfed many countries in a wave of emergencies. In the years to come, financial resources will be strained. Risk aversion will be high. As a result, countries and corporations alike will find it harder to pursue investments and innovation.

It may be tempting to defer the pursuit of longer-term goals. Yet, as in the financial crisis of 2008–2009, we are calling on business and policy leaders around the world to continue to innovate beyond healthcare, despite the economic downturn.

With growing attention on innovation as the way to build a sustainable and inclusive future, now is a particularly relevant time for this year's special theme: *Who Will Finance Innovation*?

As long as innovation has existed, a central challenge facing innovators worldwide is the mobilization of stable and accessible financing mechanisms. Financing affects all stages of an innovation cycle, from ideation to commercialization, expansion, and, eventually, long-term business sustainability.

Even before the crisis, a range of new actors, such as sovereign wealth funds, and not-for-profit organizations, has been supporting innovation. Innovative mechanisms, such as corporate venturing, intellectual property (IP) marketplaces, crowdfunding, and fintech solutions, were present before the crisis and will not vanish. At the same time, public support schemes remain essential vehicles of innovation financing.

To conclude, every crisis brings opportunities and room for creative disruption. One side effect of the current crisis has been to stimulate interest in innovative solutions for health, naturally, but also for areas such as remote work, distance education, e-commerce, and mobility solutions. Unleashing these positive forces may well support societal goals, including reducing or reversing long-term climate change.

For this GII edition, we thank our Knowledge Partners; the Confederation of Indian Industry (CII); Dassault Systèmes, The 3DEXPERIENCE Company; and the National Confederation of Industry Brazil (CNI) for their support. We also thank the Competence Centre on Composite Indicators and Scoreboards of the Joint Research Centre at the European Commission.

Likewise, we recognize the contributions of our Advisory Board members, who have been joined by two members this year: Ms. C. Akamanzi, CEO of the Rwanda Development Board (Rwanda) and Mr. H. Takenaka, Director, Center for Global Innovation Studies, Toyo University and former Minister (Japan).

We—Soumitra Dutta and Bruno Lanvin—shall, in a break from tradition, have the last word in this preface, so that we may underline and pay tribute to the vital role played by Francis Gurry in the remarkable success of the GII over the last 10 years. Thanks to his vision and leadership, WIPO has become the central pillar of the GII. Thank you, Francis, and as you complete your second six-year mandate at the helm of WIPO, we wish you the best of luck in your future endeavors!

Soumitra Dutta
Professor of Management and Former Founding Dean, SC Johnson College of Business, Cornell University; President, Portulans Institute

Francis Gurry
Director General, World Intellectual Property Organization (WIPO)

Bruno Lanvin
Executive Director for Global Indices, INSEAD; Director, Portulans Institute

FOREWORD

FINANCING INNOVATION IN INDIA

India has embarked on a journey towards creating an enabling environment by putting in place an ecosystem that breeds innovation. The Government of India has launched several significant initiatives for propelling innovation, such as the Start-up India initiative, Accelerating Growth of New India's Innovations (AGNIi), Atal Tinkering Labs, new intellectual property rights (IPR) policy, Smart City Mission, Uchchatar Avishkaar Yojana, etc. All these initiatives, coupled with phenomenal research and innovation from the institutions, industry, and society, are cementing India's position as an innovation and knowledge hub. However, the financial dimension plays a critical role in fructifying these innovation efforts.

Various fiscal incentives are offered by the Government of India's Department of Scientific and Industrial Research (DSIR) for R&D activities performed by institutions, academia, and industry for supporting, nurturing, and leading their innovations towards fruition. Technology Development Board (TDB), an important stakeholder in the Indian innovation ecosystem, provides soft loans and promotes the equity of Indian industry through the development and commercialization of indigenous technology and by adapting imported technology for domestic applications. Biotechnology Industry Research Assistance Council (BIRAC) supports high-risk, early starters from academia, start-ups, or incubators that have exciting ideas in the nascent or planning stage. In India, there has been phenomenal growth of the private and foreign-owned private equity/venture capital (PE/VC) industry. The government has also played an important role in establishing and nurturing the industry segment by various fiscal concessions.

Financial institutions such as the Industrial Development Bank of India (IDBI) and the Small Industries Development Bank of India (SIDBI) lend support for innovation and commercialization of innovative technologies, in addition to entrepreneurship. SIDBI manages the India Innovation Fund—a registered venture capital fund that invests in innovation-led, early-stage Indian firms.

Despite the availability of several instruments, many brilliant ideas from entrepreneurs—especially at the grassroots level—do not come to fruition due to their inability to access the appropriate level of funding. Therefore, it is imperative that all potential ideas, even from the remotest corners of the world, have the opportunity to be harnessed and fostered. This era of globalization calls for developing a robust technology screening and funding mechanism through which the top 5000 ideas across the globe could be selected and nurtured from concept to commercialization. In addition, there is an ardent need for a large-scale government grant for supporting high-risk innovations with strong business potential.

This year's Global Innovation Index (GII) report provides valuable insight into country innovation models and each country's position on various innovation indicators. The Global Innovation Index has been instrumental to India in shaping its policies and designing an actionable agenda for innovation excellence. Last year, it was both a privilege and honor for the Confederation of Indian Industry (CII) to host, for the first time, the historic global launch of the Global Innovation Index in collaboration with the Department for Promotion of Industry and Internal Trade, the Government of India, and the World Intellectual Property Organization. The worldwide launch of the GII in India was a significant milestone for the country and a phenomenal recognition of our standing in innovation.

The coronavirus disease (COVID-19) pandemic has caused widespread disruption by adversely impacting global businesses and economies. As the world adjusts to its new normal, business leaders need to harness the most innovative technologies to help drive resilience and emerge from the crisis stronger. Governments across the world are in overdrive, designing fiscal incentives by slashing interest rates, tweaking taxes, and offering a moratorium on credit periods. The Government of India is also busy devising incentives for start-ups, entrepreneurs, and other high-risk businesses to help ease the impact of the coronavirus outbreak. All such initiatives will go a long way in assuaging the disruption of the Indian innovation ecosystem.

The GII report could be India's one-stop reference to plan and accelerate our journey toward the future we imagine for our people. I encourage you to refer to this report, discuss it with others, and consider the ways we can improve as individual nations and as a global community.

Chandrajit Banerjee
Director General
Confederation of Indian Industry (CII)

FOREWORD

BUILDING VIRTUAL INFRASTRUCTURES FOR THE AGE OF EXPERIENCE

Today, new categories of innovators create new categories of solutions for new categories of customers, citizens, and patients. *Industry Renaissance* is emerging worldwide with new ways of inventing, learning, producing, healing, and trading. It comes with a new logic for financing the economy and supporting innovation. The large majority of investments are now intangible, in the form of intellectual property, data, and knowledge. Even tangible physical investments, such as bridges, buildings, factories, and hospitals, come with their *virtual twins*, opening new possibilities for the operations of these assets through their full lifecycle. Investments are shaping the unknown because the future is not just undefined: it has to become possible, we need to create it, and virtual reality is the key to it. The new assets for the 21st century are virtual ones because they connect the dots between domains and usages. Improving global health requires a holistic approach, which includes cities, food, and education. Developing global wealth in a sustainable manner involves new ways to connect data and territories. Dealing with ecological challenges requires an all-inclusive view of the balance between what we take (footprint) and what we give (handprint) to our planet.

Collaborative experience platforms are the infrastructures enabling this change. They provide a continuum of transformational disciplines to imagine, create, produce, and operate experiences from end to end. This is one of the primary values of Dassault Systèmes' **3D**EXPERIENCE platform. In addition to cross-disciplinary collaboration, the platform empowers teams to conduct in-silico 3D experiments, produce multiscale and multidisciplinary digital models, simulate scenarios, and turn big data into smart data. It connects biology, material sciences, multiscale, and multiphysics simulation with model data and communities. This translates into continuous improvements in industrial processes, enhanced and customized treatments, and the development of new services from the lab to the hospital nearby or the street outside. For example, a city platform like *Virtual Singapore* is useful not only in city management but also in developing new approaches for healthcare or innovating transportation services. In the not too distant future, we will be able to create the virtual twin of the human body—not just any body, but each individual's own body.

In the 21st century, our societies can now leverage the tremendous power of virtual universes, empowering the workforce of the future with knowledge and know-how. Because they remove the gap between experimentation and learning, virtual universes give everyone access to actionable knowledge and skills. Virtual worlds are revolutionizing our relationship with science and industry, just as the printing press did in the 15th century. The new book is the virtual experience.

Therefore, investing in virtual universes is the most valuable way to create sustainable paths for the future. Virtual twins are generative. They provide human organizations with a new level of agility and fluidity. They are game changers in providing shared representations and supporting large-scale cooperative behaviors. While our societies often seem to face sacrificial dilemmas, such intangible assets allow for opening new possibilities—creating additional value in spaces that were constrained by zero-sum games. In front of increasing pressure, such as resource scarcity and climate change, our societies invent new solutions, caring for future generations.

This new economy develops on ecosystems in territories. Public authorities can help to regulate and set the right conditions—those that allow for efficient use of data and real-life testing while reinforcing trust. These are new responsibilities that industry must take on in accordance with societies and policymakers. Moving forward, governments and industry will have to work together to jointly invent a new way of living in the era of massive personal data, automated transportation, and virtual reality. A new public-private relationship will emerge, where "investing together" will be the keyword. New measurements will become more and more necessary, like the Global Innovation Index. In order to make the right investments and invest right in the age of experience, we need virtual universes to make the invisible become visible.

Bernard Charlès
Vice-Chairman & Chief Executive Officer
Dassault Systèmes

FOREWORD

CHALLENGES AND OPPORTUNITIES IN FINANCING INNOVATION IN BRAZIL

Technology and innovation are among the primary engines of a nation's growth and economic development. To boost the development of countries that are distant from the technological frontier, such as Brazil, it is essential to count on the use of foreign technologies as well as on the development of endogenous ones.

The challenges for Brazil are large. We have a diverse and uneven economy. Historically, islands of efficiency and prosperity have existed side by side with poverty and other social problems, such as access to quality education, health, and several basic public services. In a country with these characteristics, science, technology, and innovation often are considered secondary issues.

However, it is precisely because of its shortcomings and weaknesses that the country should reinforce its bets on scientific and technological development. New technologies can reduce chronic problems by improving public services and allowing the more efficient use of natural resources, for instance.

For that to happen, the country must ensure expressive, stable, and continuous investments in science and technology (S&T). The private sector must expand its investments in research and development (R&D) as well. The creation of Entrepreneurial Mobilization for Innovation (MEI) in 2008, under the coordination of the National Confederation of Industry–Brazil (CNI), aimed to incorporate innovation in the strategy of companies operating in Brazil, as well as to improve the effectiveness of innovation policies.

In 2004, CNI—through the National Service of Industrial Training (SENAI) and the Social Service for Industry (SESI)—launched the Edital de Inovação para a Indústria (Innovation Call for Industry), which aims to finance the development of innovations and increase the performance of Brazilian industrial companies. In March 2020, CNI created new calls that allocated 30 million Brazilian reais (R$) for solutions across categories, including problems generated by the coronavirus disease (COVID-19) pandemic.

Despite the importance of private investment, any country financing innovation demands direct and indirect participation of the public sector. Nations around the world invest public resources in research activities carried out by universities, research institutes, and companies. Public resources are essential to generate new knowledge and to share the risks of private research. In addition, there are also indirect mechanisms aimed to foster private R&D investment.

Over the past 20 years, Brazil has established several public policies and instruments for financing and supporting innovation. The government has created credit programs, tax incentives, grants for research projects in companies, seed capital lines, and equity investments in startups, in addition to traditional grants for research in universities and public institutes.

In health, for instance, Brazil has built a wide system of public research laboratories, such as the Oswaldo Cruz Foundation (Fiocruz), the Adolfo Lutz Institute, and the Butantan Institute, among others. This system has made the country an important center for epidemiological research, which has been critical in tackling the COVID-19 crisis.

Currently, the fiscal crisis jeopardizes the progress made by different governments in recent decades. The level of public investment in R&D is lower than it was 20 years ago, and many of the public policies for financing innovation are decreasing or at risk of suspension.

This year's Global Innovation Index has as its theme "Who will finance innovation?", which presents the current state and evolution of financial support mechanisms while exploring needed advances and remaining challenges. The discussion of the theme is of fundamental importance for business innovation efforts and for guiding public policies.

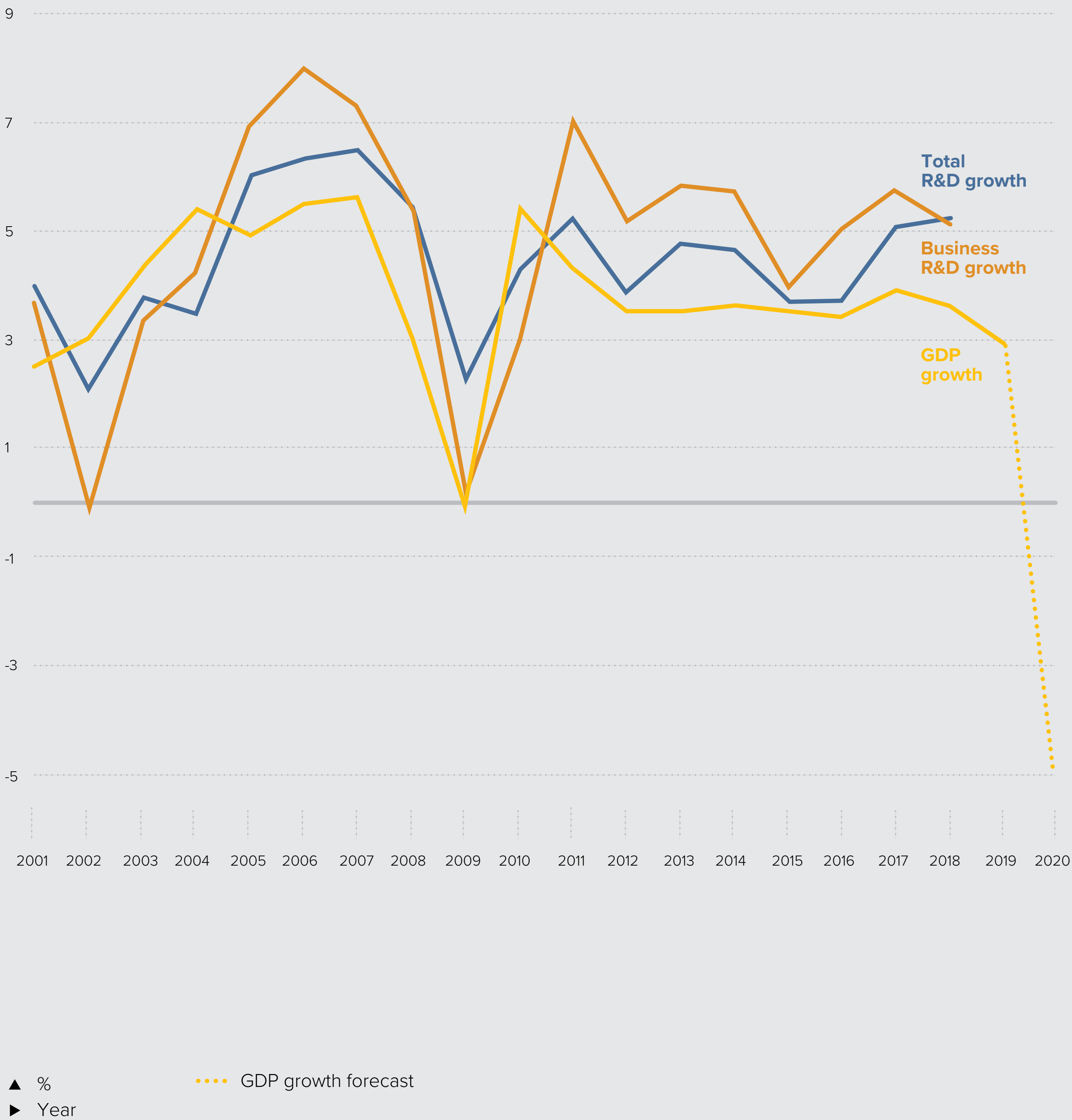
With the support of MEI leaders, CNI remains committed to ensuring resources for innovation and guaranteeing that public policies in the area are evaluated based on evidence and results. That is the only way to improve policies and make innovation the basis of the country's inclusive and sustainable development.

Robson Braga de Andrade
CNI President

KEY FINDINGS

FIGURE A

Bracing for a downturn? Cyclical R&D investments, 2001–2020



Source: Figure 1.1 in Chapter 1.

KEY FINDINGS 2020

These are the six key findings of the Global Innovation Index (GII) 2020.

1: The COVID-19 crisis will impact innovation—leaders need to act as they move from containment to recovery

The coronavirus disease (COVID-19) pandemic has triggered an unprecedented global economic shutdown. At the time of finalizing the GII 2020 edition, restrictive measures are only starting to be relaxed, while fears of a possible "second wave" remain high.

The current crisis hit the innovation landscape at a time when innovation was flourishing. In 2018, research and development (R&D) spending grew by 5.2%, i.e., significantly faster than global GDP growth, after rebounding strongly from the financial crisis of 2008-2009. Venture capital (VC) and the use of intellectual property (IP) were at an all-time high. In recent years, political determination to foster innovation has been strong, including in developing countries; this is a relatively new and promising trend toward democratizing innovation beyond a select number of top economies and clusters only.

Now that global economic growth will fall deeply in 2020, the question becomes—will R&D, VC, IP, and the political determination to foster innovation also slump (Figure A)?

As innovation is now central to corporate strategy and national economic growth strategies, there is hope ahead that innovation will not slump as deeply as foreshadowed.

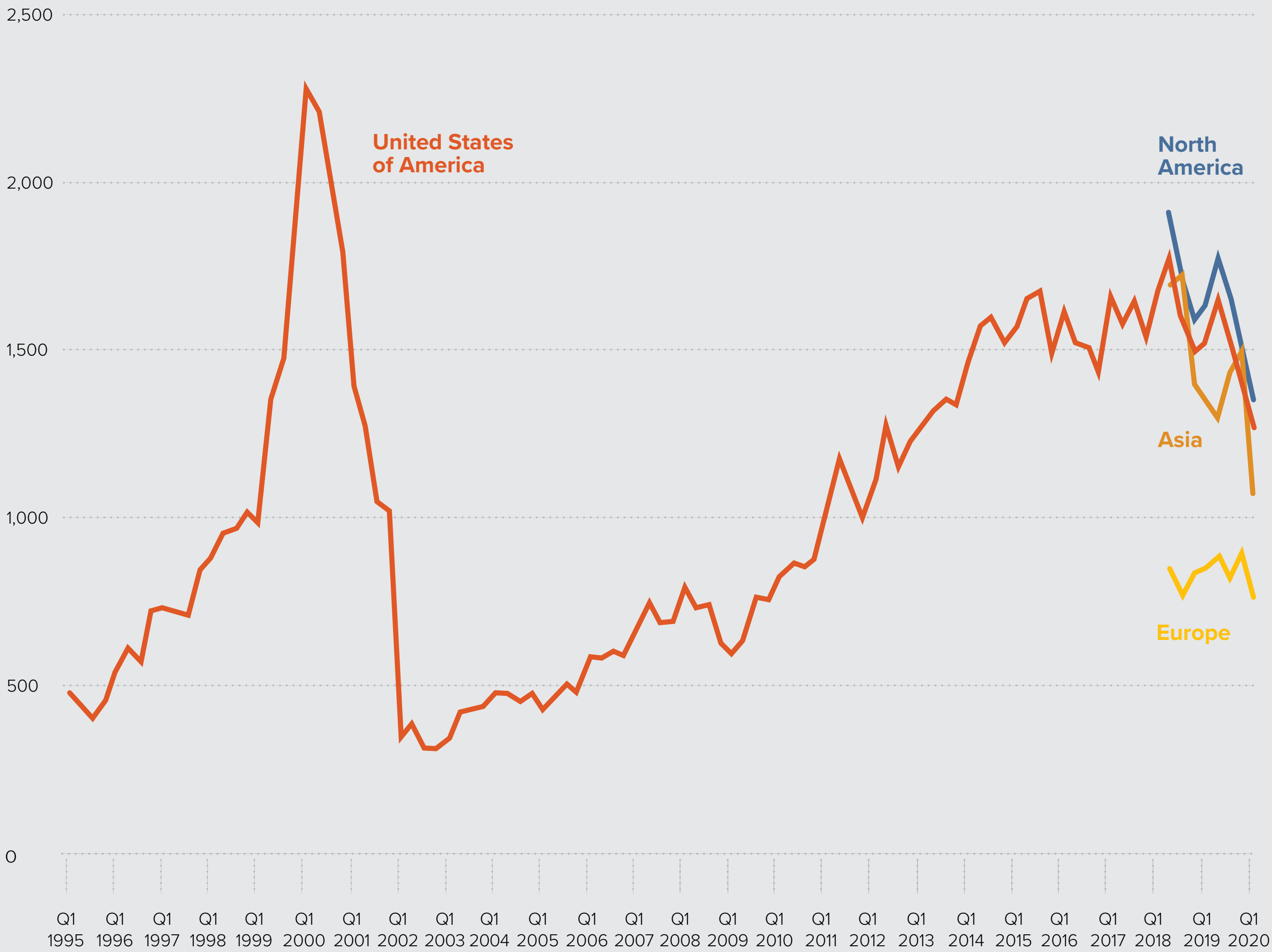
Fundamentally, the pandemic has not changed the fact that the potential for breakthrough technologies and innovation continues to abound. Clearly, the top companies and R&D spenders would be ill-advised to drop R&D, IP, and innovation in their quest to secure competitiveness in the future. Many top R&D firms in the information technology sector, for example, hold vast cash reserves, and the push to digitalization will fortify innovation. The pharmaceuticals and biotechnology sector, another top R&D spender, is likely to experience R&D growth boosted by the renewed focus on health R&D. Other key sectors, such as transport, will have to adapt faster as the quest for "clean energy" is receiving renewed interest. Further, the COVID-19 crisis might well catalyze innovation in many traditional sectors, such as tourism, education, and retail. It may also spark innovation in how work is organized at the firm- and at the individual level, and how production is (re)organized locally and globally.

Unleashing the above potential is now essential and requires government support as well as collaborative models and continued private sector investment in innovation.

What are policymakers doing to mitigate the possible negative effects of the COVID-19 crisis on innovation?

FIGURE B

Bracing for impact: venture capital decline in North America, Asia, and Europe, Q1 1995–Q1 2020



▲ Number of deals
▶ Year

Source: Figure 1.3 in Chapter 1.

Governments at the head of the largest economies worldwide are setting up emergency relief packages to cushion the impact of the lockdown and face the looming recession. These packages aim to prevent short- to medium-term harm to economies. This is sensible. The immediate focus is on supporting businesses via loan guarantees, for example.

Yet, these emergency relief measures are not explicitly directed to financing innovation and start-ups. Start-ups are facing hurdles as they try to access the above emergency measures.

Moreover, so far, governments have not made innovation and R&D a priority in current stimulus packages. There is one exception—health. Countries have injected large and unprecedented sums of money into the search for a coronavirus vaccine. Naturally, governments are first and foremost responsible for the well-being of their people, and the emphasis on health is understandable and commendable.

However, once the pandemic is brought under control, it is crucial that support for innovation becomes more broad and that it is conducted in a countercyclical way—i.e., as business innovation expenditures slump, governments strive to counteract that effect with their own expenditure boosts to innovation, even in the face of higher public debt.

In tandem, the impacts of the pandemic on the science and innovation systems have to be monitored. Some aspects are positive, such as the unexpected level of international collaboration in science and the reduction of red tape for scientists. Some aspects, however, are alarming, such as the standstill of major research projects and the possible (and uneven) reduction of R&D expenditures in some fields.

2: Innovation finance declines in the current crisis, but there is hope too

In the context of the GII 2020 theme "Who Will Finance Innovation?", a key question is the impact of the current crisis on start-ups, VC, and other sources of innovation financing.

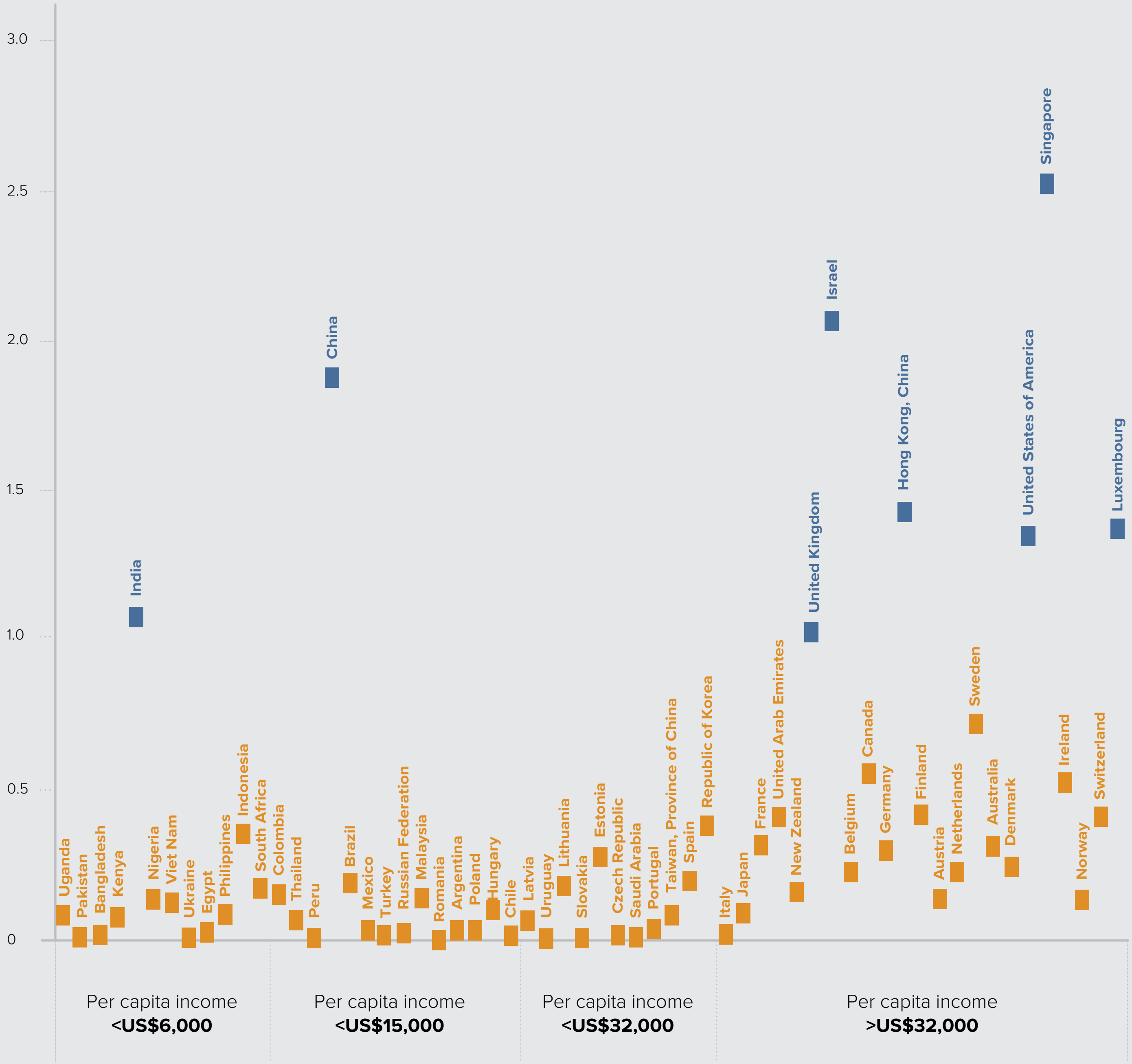
In contrast to 2009, the good news is that the financial system is sound so far. The bad news is that money to fund innovative ventures is drying up (Figure B). VC deals are in sharp decline across North America, Asia, and Europe. There are few initial public offerings (IPOs) in sight, and the start-ups that survive may grow less attractive to—and profitable for—venture capitalists, as exit strategies such as IPOs are compromised in 2020.

Interestingly, the crisis has only reinforced the decline in VC deals that had started before the pandemic. Rather than financing novel, small, and diverse start-ups, venture capitalists began focusing on so-called "mega-deals"—boosting a select number of large firms rather than giving fresh money to a broader base of start-ups. These investments, and the pursuit of so-called "unicorns", did not play out as positively as expected. What will happen to innovation finance in the near and longer term? The likely answer is that VC will take longer to recover than R&D spending. The impact of this shortage in innovation finance will be uneven, with the negative effects felt more heavily by early-stage VCs, by R&D-intensive start-ups with longer-term research interests in fields such as life sciences, and by ventures outside of the top VC hotspots. Indeed, current VC investments are concentrated in a few VC hot spots in the world, and only a few of those hot spots are in emerging economies—notably in China and India (Figure C and the Theme Section elaborate on the geographic and sectoral bias of VC).

Yet, there is hope here too. The key VC hot spots—Singapore, Israel, China, Hong Kong (China), Luxembourg, the United States of America (U.S.), India, and the United Kingdom (U.K.)—will continue to be magnets for VC. They are likely to bounce back quickly, in part due to the thirst for return on capital worldwide. Chinese VC deals, which halved earlier this year, are already rebounding strongly. Importantly, the direction of VC and innovation seems to have been redirected towards health, online education, big data, e-commerce, and robotics.

FIGURE C

Venture capital penetration in selected economies, 2016-2018



▲ %, Venture capital investments/GDP

Source: Figure 2.3 in Chapter 2 and Figure T-1.1 in Theme Section.

FIGURE D

Global leaders in innovation in 2020

Every year, the Global Innovation Index ranks the innovation performance of more than 130 economies around the world.

Top 3 innovation economies by region

EUROPE

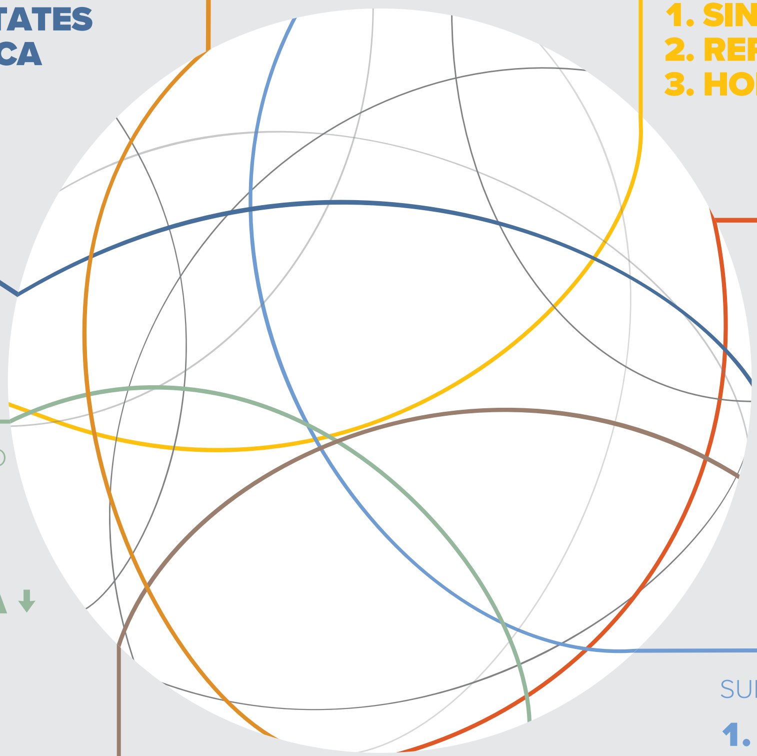
1. SWITZERLAND
2. SWEDEN
3. UNITED KINGDOM ★

NORTHERN AMERICA

1. UNITED STATES OF AMERICA
2. CANADA

SOUTH EAST ASIA, EAST ASIA, AND OCEANIA

1. SINGAPORE
2. REPUBLIC OF KOREA
3. HONG KONG, CHINA



NORTHERN AFRICA AND WESTERN ASIA

1. ISRAEL
2. CYPRUS
3. UNITED ARAB EMIRATES

LATIN AMERICA AND THE CARIBBEAN

1. CHILE
2. MEXICO ↑
3. COSTA RICA ↓

SUB-SAHARAN AFRICA

1. SOUTH AFRICA / MAURITIUS *↑
2. KENYA
3. UNITED REPUBLIC OF TANZANIA ★

CENTRAL AND SOUTHERN ASIA

1. INDIA
2. IRAN (ISLAMIC REPUBLIC OF)
3. KAZAKHSTAN

* Mauritius is ranked above South Africa this year but with wide significant data variability as compared to last year.
↑↓ indicates the movement of rank within the top 3 relative to 2019, and ★ indicates a new entrant into the top 3 in 2020.

Top 3 innovation economies by income group

HIGH-INCOME GROUP

1. SWITZERLAND
2. SWEDEN
3. UNITED STATES OF AMERICA

UPPER MIDDLE-INCOME GROUP

1. CHINA
2. MALAYSIA
3. BULGARIA

LOWER MIDDLE-INCOME GROUP

1. VIET NAM
2. UKRAINE
3. INDIA★

LOW-INCOME GROUP

1. UNITED REPUBLIC OF TANZANIA ↑
2. RWANDA ↓
3. NEPAL ★

Source: Figure 1.4 in Chapter 1.

TABLE A

10 best-ranked economies by income group (rank)

Rank	Global Innovation Index 2020
High-income economies (49 in total)	
1	Switzerland (1)
2	Sweden (2)
3	United States of America (3)
4	United Kingdom (4)
5	Netherlands (5)
6	Denmark (6)
7	Finland (7)
8	Singapore (8)
9	Germany (9)
10	Republic of Korea (10)

Rank	Global Innovation Index 2020
Upper middle-income economies (37 in total)	
1	China (14)
2	Malaysia (33)
3	Bulgaria (37)
4	Thailand (44)
5	Romania (46)
6	Russian Federation (47)
7	Montenegro (49)
8	Turkey (51)
9	Mauritius (52)
10	Serbia (53)

Rank	Global Innovation Index 2020
Lower middle-income economies (29 in total)	
1	Viet Nam (42)
2	Ukraine (45)
3	India (48)
4	Philippines (50)
5	Mongolia (58)
6	Republic of Moldova (59)
7	Tunisia (65)
8	Morocco (75)
9	Indonesia (85)
10	Kenya (86)

Rank	Global Innovation Index 2020
Low-income economies (16 in total)	
1	United Republic of Tanzania (88)
2	Rwanda (91)
3	Nepal (95)
4	Tajikistan (109)
5	Malawi (111)
6	Uganda (114)
7	Madagascar (115)
8	Burkina Faso (118)
9	Mali (123)
10	Mozambique (124)

Source: Table 1.2 in Chapter 1.

3: The global innovation landscape is shifting; China, Viet Nam, India, and the Philippines are consistently on the rise

This year, the geography of innovation is continuing to shift, as evidenced by the GII rankings. Over the years, China, Viet Nam, India, and the Philippines are the economies with the most significant progress in their GII innovation ranking over time. All four are now in the top 50.

Switzerland, Sweden, and the U.S. lead the innovation rankings (Figure D and Figure 1.5 in Chapter 1), followed by the U.K. and the Netherlands. This year marks the first time a second Asian economy—the Republic of Korea—cracks the top 10, next to Singapore.

The top-performing economies in the GII are still almost exclusively from the high-income group (Table A). China is the only exception, ranking 14th for the 2nd time in a row and remaining the only middle-income economy in the GII top 30. Malaysia (33rd) is the second-most innovative middle-income economy. India (48th) and the Philippines (50th) make it to the top 50 for the first time. India now ranks 3rd among the lower middle-income group—a new milestone (Figure D). The Philippines achieves its best rank ever—in 2014, it still ranked 100th. Viet Nam ranks 42nd for the second consecutive year—it ranked 71st in 2014. In the lower middle-income group, Indonesia (85th) joins the top 10.

The United Republic of Tanzania tops the low-income group (88th) (Figure D).

4: Stellar innovation performance found in developing economies

Beyond GII top-level rankings, innovation performance reveals itself in a few other ways, highlighting that some top innovation performance takes place in emerging markets too.

First, the GII 2020 assesses which economies consistently hold the top global spots on particular GII innovation facets, such as VC, R&D, entrepreneurship, or high-tech production. Hong Kong (China) and the U.S. lead on this count; Israel, Luxembourg, and China tie for 3rd place; Cyprus ranks 4th; and Singapore, Denmark, Japan, and Switzerland tie for 5th place (Figure E).

Some top spots on selected innovation indicators are not held by high-income economies. In South East Asia, for example, Thailand is 1st in business R&D globally, and Malaysia is top in High-tech net exports globally. In Sub-Saharan Africa, Botswana ranks 1st in Education spending globally and Mozambique leads in Investment globally. In Latin America, Mexico is the largest creative goods exporter worldwide.

Second, the GII 2020 assesses the balance of the innovation system within GII economies. Twelve economies boast top performance across all GII pillars (Table 1.1 in Chapter 1); this is rare. Even among the top 35, many economies have pillars in which they lag. For instance, Australia, Norway, and the United Arab Emirates (UAE) rank lower in Knowledge and technology outputs; and Israel and China are weaker in Infrastructure. The reverse is also true: several economies outside the top ranks are among the top performers in specific innovation pillars. For example, India's high ranks in Knowledge and technology outputs and Market sophistication far exceed its other GII rankings.

Third, the "GII Bubble Chart" continues to be the GII's most conspicuous means to identify innovation outperformance relative to an economy's level of development (Table B and Figure 1.6 in Chapter 1). Regionally, Africa shines on this count. Out of the 25 economies identified as outperformers, 8 are from Sub-Saharan Africa. India, Kenya, Moldova, and Viet Nam hold the record of being innovation achievers for 10 consecutive years (Table 1.3 in Chapter 1).

FIGURE E

GII economies with the most top-ranked GII indicators, 2020

Innovation indicators in which economies score best worldwide

Economy	Inputs	Outputs	Total
Hong Kong, China	7	5	12
United States of America	3	6	9
Israel	6	2	8
Luxembourg	6	2	8
China	3	5	8
Cyprus	4	3	7
Singapore	5	1	6
Denmark	4	2	6
Japan	3	3	6
Switzerland	2	4	6

Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2020.
Note: The GII methodology allows for multiple economies to rank first in an indicator; see Appendix II and Appendix IV.

TABLE B

Innovation performance at different income levels, 2020

	High-income group	Upper middle-income group	Lower middle-income group	Low-income group
Above expectations for level of development	Switzerland Sweden United States of America United Kingdom Netherlands Denmark Finland Singapore Germany Republic of Korea Hong Kong, China France Israel Ireland Japan Canada	China Armenia South Africa Georgia North Macedonia Thailand Serbia Jamaica Costa Rica Bulgaria	Viet Nam Ukraine India Philippines Republic of Moldova Mongolia Tunisia Kenya Morocco	Malawi Rwanda United Republic of Tanzania Niger Madagascar Mozambique
In line with level of development	Luxembourg Austria Norway Iceland Belgium Australia Czech Republic Estonia New Zealand Portugal Italy Cyprus Spain Malta Latvia Hungary Slovenia Croatia Poland Greece	Montenegro Brazil Colombia Malaysia Jordan Mexico Bosnia and Herzegovina Iran (Islamic Republic of) Peru Albania Belarus Mauritius Romania Lebanon	Kyrgyzstan Senegal Indonesia El Salvador Zimbabwe Uzbekistan Honduras Cabo Verde	Nepal Burkina Faso Tajikistan Uganda Togo Mali
All other economies	Chile Slovakia Lithuania Uruguay United Arab Emirates Panama Saudi Arabia Qatar Brunei Darussalam Trinidad and Tobago Bahrain Kuwait Oman	Ecuador Azerbaijan Turkey Argentina Paraguay Russian Federation Sri Lanka Guatemala Namibia Botswana Dominican Republic (the) Algeria Kazakhstan	Cambodia Côte d'Ivoire Pakistan Ghana Egypt Cameroon Bolivia (Plurinational State of) Bangladesh Zambia Nigeria Lao People's Democratic Republic Myanmar	Ethiopia Guinea Benin Yemen

Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2020.

5: Regional divides persist, yet some economies harbor significant innovation potential

Despite some innovation "catch-up", regional divides exist with respect to national innovation performance: Northern America and Europe lead, followed by South East Asia, East Asia and Oceania, and more distantly by Northern Africa and Western Asia, Latin America and the Caribbean, Central and Southern Asia, and Sub-Saharan Africa, respectively.

Latin America and the Caribbean continues to be a region with significant imbalances (Figure 1.12 in Chapter 1). The region is characterized by its low investments in R&D and innovation, its incipient use of IP systems, and a disconnect between the public and private sectors in the prioritization of R&D and innovation. With low innovation inputs, the region also struggles to translate these efficiently into outputs. Only Chile, Uruguay, and Brazil produce high levels of Scientific and technical articles, and only Brazil ranks high in Patents by origin.

The African continent—comprising Sub-Saharan Africa and Northern Africa—has one of the most heterogeneous innovation performances across continents (Figure F). While some economies rank in the top 75 (e.g., South Africa, Tunisia, and Morocco), others rank much lower.

Innovation systems in Africa are broadly characterized by having low levels of science and technology activities, high reliance on government or foreign donors as a source of R&D, limited science-industry linkages, low absorptive capacity of firms, limited use of IP, and a challenging business environment.

But these are broad regional generalizations. Some economies within regions stand out because they harbor significant innovation potential.

For example, the typical innovation leader in Africa usually has higher expenditure on education (Botswana, Tunisia) and R&D (South Africa, Kenya, Egypt), strong financial market indicators such as venture capital deals (South Africa), openness to technology adoption and inward knowledge flows, an improving research base (Tunisia, Algeria, Morocco), active use of information and communication technologies (ICTs) and organizational model creation (Kenya), as well as a stronger use of their IP systems (Tunisia and Morocco). Innovation is also more pervasive in Africa than what existing innovation data suggest.

6: Innovation is concentrated at the level of science and technology clusters in select high-income economies, plus mainly China

Divides also exist as to the ranking of the global science and technology (S&T) clusters (Special Section: Cluster Rankings).

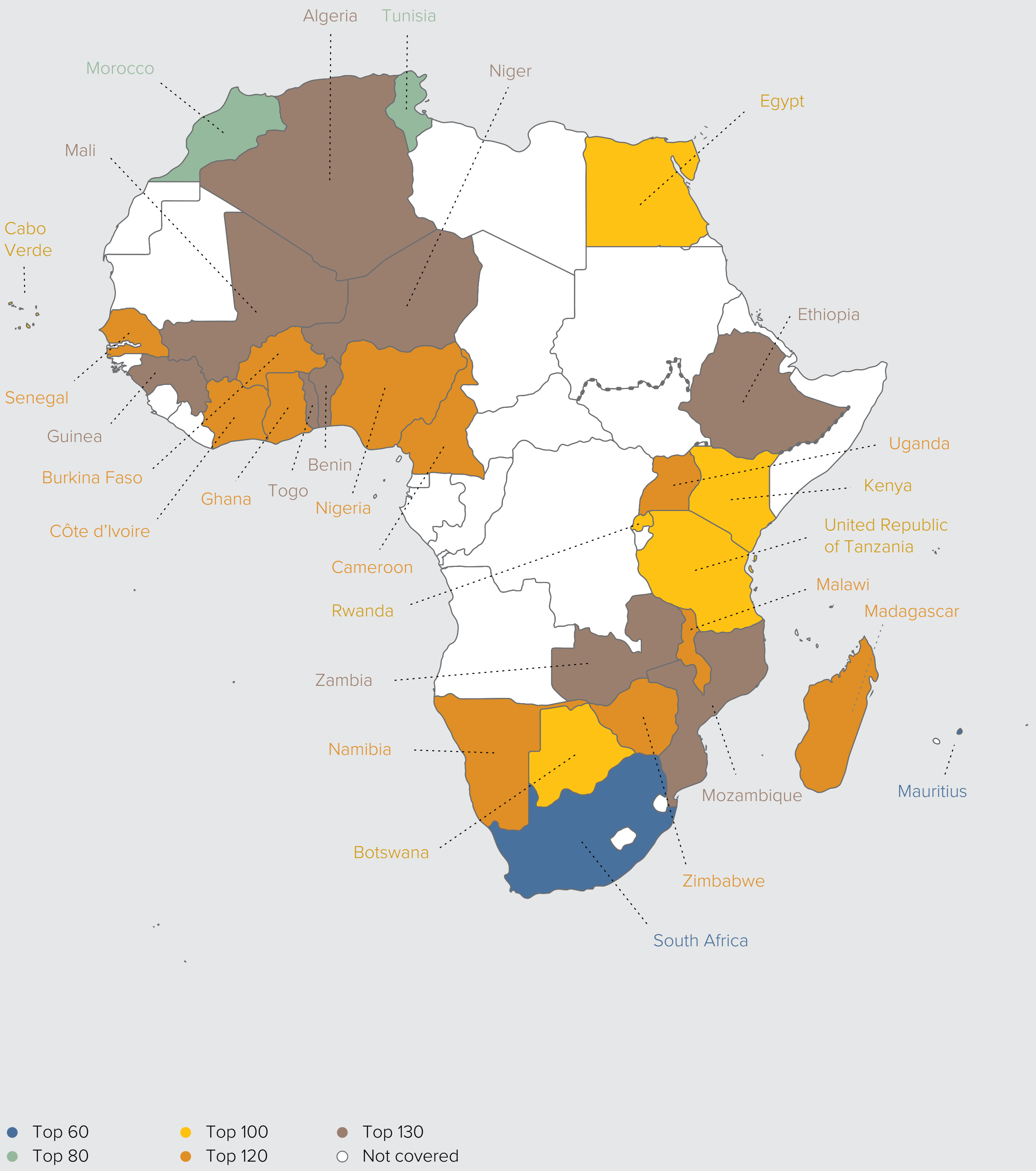
The top 100 clusters are located in 26 economies, of which 6—Brazil, China, India, Iran, Turkey, and the Russian Federation—are in middle-income economies. The U.S. continues to host the largest number of clusters (25), followed by China (17), Germany (10), and Japan (5).

In 2020, Tokyo-Yokohama is the top-performing cluster again, followed by Shenzhen-Hong Kong-Guangzhou, Seoul, Beijing, and San Jose-San Francisco (Table C).

For the first time, the GII 2020 presents the top 100 clusters ranked by their S&T intensity—that is, the sum of their patent and scientific publication shares divided by population. Through this fresh lens, many European and U.S. clusters show more intense S&T activity than their Asian counterparts. Cambridge and Oxford in the U.K. emerge as the most S&T-intensive clusters. These two clusters are followed by Eindhoven (the Netherlands) and San Jose-San Francisco (U.S.).

FIGURE F

GII 2020 rankings in Northern Africa and Sub-Saharan Africa



Source: Figure 1.11 in Chapter 1.

TABLE C

Top S&T cluster of each economy or cross-border regions, 2020

GII cluster rank	Cluster name	Economy	Rank change from GII 2019 to GII 2020
1	Tokyo-Yokohama	JP	0
2	Shenzhen-Hong Kong-Guangzhou	CN / HK	0
3	Seoul	KR	0
4	Beijing	CN	0
5	San Jose-San Francisco, CA	US	0
10	Paris	FR	-1
15	London	GB	0
18	Amsterdam-Rotterdam	NL	0
19	Cologne	DE	1
24	Tel Aviv-Jerusalem	IL	-1
27	Taipei-Hsinchu	TW	16
28	Singapore	SG	0
32	Moscow	RU	1
33	Stockholm	SE	-1
34	Eindhoven	BE / NL	-3
35	Melbourne	AU	0
39	Toronto, ON	CA	0
41	Brussels	BE	-1
43	Tehran	IR	3
45	Madrid	ES	-3
48	Milan	IT	0
49	Zürich	CH / DE	1
51	Istanbul	TR	3
54	Copenhagen	DK	1
60	Bengaluru	IN	5
61	São Paulo	BR	-2
68	Helsinki	FI	0
70	Vienna	AT	-1
89	Lausanne	CH / FR	-3
95	Basel	CH / DE / FR	-4
99	Warsaw	PL	1

Source: WIPO Statistics Database, March 2020.

Conclusion

In conclusion, the GII continues to support and foster innovation across changing times. The aim of the GII is to provide insightful data on innovation and, in turn, to assist policymakers in evaluating their innovation performance and making informed innovation policy decisions. The GII 2020 edition—with its main conclusions on innovation developments generally, in the context of COVID-19 currently, and with respect to innovation finance specifically—makes a contribution to this effect.

At this juncture, when we face an increase of unilateralism and nationalism, it is important to remember that most economies that have moved up the ranks in the GII over time have strongly benefited from their integration in global value chains and innovation networks. China, Viet Nam, India, and the Philippines are prime examples.

There are now genuine risks to international openness and collaboration on innovation, however. Yet, if anything, the joint search for medical solutions during the pandemic has demonstrated how powerful cooperation can be. The speed and efficacy of this collaboration shows that internationally coordinated R&D missions can effectively counteract the tendency for increased isolationism and address important societal topics—now and in the future.

Future editions of the GII will track this phenomenon closely and continue the journey towards enabling policy and business leaders by fostering a better understanding and measurement of innovation.

RANKINGS

Global Innovation Index 2020 rankings

Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Median 30.94
Switzerland	66.08	1	HI	1	EUR	1	
Sweden	62.47	2	HI	2	EUR	2	
United States of America	60.56	3	HI	3	NAC	1	
United Kingdom	59.78	4	HI	4	EUR	3	
Netherlands	58.76	5	HI	5	EUR	4	
Denmark	57.53	6	HI	6	EUR	5	
Finland	57.02	7	HI	7	EUR	6	
Singapore	56.61	8	HI	8	SEAO	1	
Germany	56.55	9	HI	9	EUR	7	
Republic of Korea	56.11	10	HI	10	SEAO	2	
Hong Kong, China	54.24	11	HI	11	SEAO	3	
France	53.66	12	HI	12	EUR	8	
Israel	53.55	13	HI	13	NAWA	1	
China	53.28	14	UM	1	SEAO	4	
Ireland	53.05	15	HI	14	EUR	9	
Japan	52.70	16	HI	15	SEAO	5	
Canada	52.26	17	HI	16	NAC	2	
Luxembourg	50.84	18	HI	17	EUR	10	
Austria	50.13	19	HI	18	EUR	11	
Norway	49.29	20	HI	19	EUR	12	
Iceland	49.23	21	HI	20	EUR	13	
Belgium	49.13	22	HI	21	EUR	14	
Australia	48.35	23	HI	22	SEAO	6	
Czech Republic	48.34	24	HI	23	EUR	15	
Estonia	48.28	25	HI	24	EUR	16	
New Zealand	47.01	26	HI	25	SEAO	7	
Malta	46.39	27	HI	26	EUR	17	
Italy	45.74	28	HI	27	EUR	18	
Cyprus	45.67	29	HI	28	NAWA	2	
Spain	45.60	30	HI	29	EUR	19	
Portugal	43.51	31	HI	30	EUR	20	
Slovenia	42.91	32	HI	31	EUR	21	
Malaysia	42.42	33	UM	2	SEAO	8	
United Arab Emirates	41.79	34	HI	32	NAWA	3	
Hungary	41.53	35	HI	33	EUR	22	
Latvia	41.11	36	HI	34	EUR	23	
Bulgaria	39.98	37	UM	3	EUR	24	
Poland	39.95	38	HI	35	EUR	25	
Slovakia	39.70	39	HI	36	EUR	26	
Lithuania	39.18	40	HI	37	EUR	27	
Croatia	37.27	41	HI	38	EUR	28	
Viet Nam	37.12	42	LM	1	SEAO	9	
Greece	36.79	43	HI	39	EUR	29	
Thailand	36.68	44	UM	4	SEAO	10	
Ukraine	36.32	45	LM	2	EUR	30	
Romania	35.95	46	UM	5	EUR	31	
Russian Federation	35.63	47	UM	6	EUR	32	
India	35.59	48	LM	3	CSA	1	
Montenegro	35.39	49	UM	7	EUR	33	
Philippines	35.19	50	LM	4	SEAO	11	
Turkey	34.90	51	UM	8	NAWA	4	
Mauritius	34.35	52	UM	9	SSF	1	
Serbia	34.33	53	UM	10	EUR	34	
Chile	33.86	54	HI	40	LCN	1	
Mexico	33.60	55	UM	11	LCN	2	
Costa Rica	33.51	56	UM	12	LCN	3	
North Macedonia	33.43	57	UM	13	EUR	35	
Mongolia	33.41	58	LM	5	SEAO	12	
Republic of Moldova	32.98	59	LM	6	EUR	36	
South Africa	32.67	60	UM	14	SSF	2	
Armenia	32.64	61	UM	15	NAWA	5	
Brazil	31.94	62	UM	16	LCN	4	
Georgia	31.78	63	UM	17	NAWA	6	
Belarus	31.27	64	UM	18	EUR	37	
Tunisia	31.21	65	LM	7	NAWA	7	
Saudi Arabia	30.94	66	HI	41	NAWA	8	

CONTINUED

Global Innovation Index 2020 rankings, continued

Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Median 30.94
Iran (Islamic Republic of)	30.89	67	UM	19	CSA	2	
Colombia	30.84	68	UM	20	LCN	5	
Uruguay	30.84	69	HI	42	LCN	6	
Qatar	30.81	70	HI	43	NAWA	9	
Brunei Darussalam	29.82	71	HI	44	SEAO	13	
Jamaica	29.10	72	UM	21	LCN	7	
Panama	29.04	73	HI	45	LCN	8	
Bosnia and Herzegovina	28.99	74	UM	22	EUR	38	
Morocco	28.97	75	LM	8	NAWA	10	
Peru	28.79	76	UM	23	LCN	9	
Kazakhstan	28.56	77	UM	24	CSA	3	
Kuwait	28.40	78	HI	46	NAWA	11	
Bahrain	28.37	79	HI	47	NAWA	12	
Argentina	28.33	80	UM	25	LCN	10	
Jordan	27.79	81	UM	26	NAWA	13	
Azerbaijan	27.23	82	UM	27	NAWA	14	
Albania	27.12	83	UM	28	EUR	39	
Oman	26.50	84	HI	48	NAWA	15	
Indonesia	26.49	85	LM	9	SEAO	14	
Kenya	26.13	86	LM	10	SSF	3	
Lebanon	26.02	87	UM	29	NAWA	16	
United Republic of Tanzania	25.57	88	LI	1	SSF	4	
Botswana	25.43	89	UM	30	SSF	5	
Dominican Republic	25.10	90	UM	31	LCN	11	
Rwanda	25.06	91	LI	2	SSF	6	
El Salvador	24.85	92	LM	11	LCN	12	
Uzbekistan	24.54	93	LM	12	CSA	4	
Kyrgyzstan	24.51	94	LM	13	CSA	5	
Nepal	24.35	95	LI	3	CSA	6	
Egypt	24.23	96	LM	14	NAWA	17	
Paraguay	24.14	97	UM	32	LCN	13	
Trinidad and Tobago	24.14	98	HI	49	LCN	14	
Ecuador	24.11	99	UM	33	LCN	15	
Cabo Verde	23.86	100	LM	15	SSF	7	
Sri Lanka	23.78	101	UM	34	CSA	7	
Senegal	23.75	102	LM	16	SSF	8	
Honduras	22.95	103	LM	17	LCN	16	
Namibia	22.51	104	UM	35	SSF	9	
Bolivia (Plurinational State of)	22.41	105	LM	18	LCN	17	
Guatemala	22.35	106	UM	36	LCN	18	
Pakistan	22.31	107	LM	19	CSA	8	
Ghana	22.28	108	LM	20	SSF	10	
Tajikistan	22.23	109	LI	4	CSA	9	
Cambodia	21.46	110	LM	21	SEAO	15	
Malawi	21.44	111	LI	5	SSF	11	
Côte d'Ivoire	21.24	112	LM	22	SSF	12	
Lao People's Democratic Republic	20.65	113	LM	23	SEAO	16	
Uganda	20.54	114	LI	6	SSF	13	
Madagascar	20.40	115	LI	7	SSF	14	
Bangladesh	20.39	116	LM	24	CSA	10	
Nigeria	20.13	117	LM	25	SSF	15	
Burkina Faso	20.00	118	LI	8	SSF	16	
Cameroon	19.98	119	LM	26	SSF	17	
Zimbabwe	19.97	120	LM	27	SSF	18	
Algeria	19.48	121	UM	37	NAWA	18	
Zambia	19.39	122	LM	28	SSF	19	
Mali	19.15	123	LI	9	SSF	20	
Mozambique	18.70	124	LI	10	SSF	21	
Togo	18.54	125	LI	11	SSF	22	
Benin	18.13	126	LI	12	SSF	23	
Ethiopia	18.06	127	LI	13	SSF	24	
Niger	17.82	128	LI	14	SSF	25	
Myanmar	17.74	129	LM	29	SEAO	17	
Guinea	17.32	130	LI	15	SSF	26	
Yemen	13.56	131	LI	16	NAWA	19	

Notes: World Bank Income Group Classification (July 2019): LI = low income; LM = lower-middle income; UM = upper-middle income; and HI = high income. Regions are based on the United Nations Classification: EUR = Europe; NAC = Northern America; LCN = Latin America and the Caribbean; CSA = Central and Southern Asia; SEAO = South East Asia, East Asia, and Oceania; NAWA = Northern Africa and Western Asia; SSF = Sub-Saharan Africa.

Innovation Input Sub-Index 2020 rankings

Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Median 41.39
Singapore	70.20	1	HI	1	SEAO	1	
Switzerland	69.42	2	HI	2	EUR	1	
Sweden	69.19	3	HI	3	EUR	2	
United States of America	68.84	4	HI	4	NAC	1	
Denmark	66.77	5	HI	5	EUR	3	
United Kingdom	65.97	6	HI	6	EUR	4	
Hong Kong, China	65.79	7	HI	7	SEAO	2	
Finland	65.57	8	HI	8	EUR	5	
Canada	64.84	9	HI	9	NAC	2	
Republic of Korea	64.83	10	HI	10	SEAO	3	
Netherlands	64.45	11	HI	11	EUR	6	
Japan	63.59	12	HI	12	SEAO	4	
Australia	62.86	13	HI	13	SEAO	5	
Germany	62.71	14	HI	14	EUR	7	
Norway	62.67	15	HI	15	EUR	8	
France	61.43	16	HI	16	EUR	9	
Israel	61.36	17	HI	17	NAWA	1	
Austria	61.15	18	HI	18	EUR	10	
New Zealand	60.95	19	HI	19	SEAO	6	
Ireland	59.72	20	HI	20	EUR	11	
Belgium	59.62	21	HI	21	EUR	12	
United Arab Emirates	58.29	22	HI	22	NAWA	2	
Iceland	57.27	23	HI	23	EUR	13	
Luxembourg	57.23	24	HI	24	EUR	14	
Estonia	56.11	25	HI	25	EUR	15	
China	55.51	26	UM	1	SEAO	7	
Spain	54.85	27	HI	26	EUR	16	
Czech Republic	54.74	28	HI	27	EUR	17	
Slovenia	54.09	29	HI	28	EUR	18	
Cyprus	53.17	30	HI	29	NAWA	3	
Malta	52.63	31	HI	30	EUR	19	
Portugal	52.52	32	HI	31	EUR	20	
Italy	52.41	33	HI	32	EUR	21	
Malaysia	52.23	34	UM	2	SEAO	8	
Latvia	49.60	35	HI	33	EUR	22	
Lithuania	49.38	36	HI	34	EUR	23	
Hungary	49.25	37	HI	35	EUR	24	
Poland	49.09	38	HI	36	EUR	25	
Brunei Darussalam	48.16	39	HI	37	SEAO	9	
Greece	48.04	40	HI	38	EUR	26	
Chile	46.97	41	HI	39	LCN	1	
Russian Federation	46.64	42	UM	3	EUR	27	
Slovakia	46.54	43	HI	40	EUR	28	
Croatia	46.30	44	HI	41	EUR	29	
Bulgaria	45.98	45	UM	4	EUR	30	
North Macedonia	45.90	46	UM	5	EUR	31	
Mauritius	45.77	47	UM	6	SSF	1	
Thailand	45.45	48	UM	7	SEAO	10	
South Africa	44.85	49	UM	8	SSF	2	
Saudi Arabia	44.49	50	HI	42	NAWA	4	
Romania	44.44	51	UM	9	EUR	32	
Turkey	44.36	52	UM	10	NAWA	5	
Montenegro	44.17	53	UM	11	EUR	33	
Georgia	43.89	54	UM	12	NAWA	6	
Peru	43.82	55	UM	13	LCN	2	
Colombia	43.67	56	UM	14	LCN	3	
India	43.51	57	LM	1	CSA	1	
Serbia	43.41	58	UM	15	EUR	34	
Brazil	42.94	59	UM	16	LCN	4	
Kazakhstan	42.78	60	UM	17	CSA	2	
Mexico	42.40	61	UM	18	LCN	5	
Viet Nam	42.08	62	LM	2	SEAO	11	
Bahrain	42.05	63	HI	43	NAWA	7	
Qatar	42.00	64	HI	44	NAWA	8	
Mongolia	41.47	65	LM	3	SEAO	12	
Costa Rica	41.40	66	UM	19	LCN	6	

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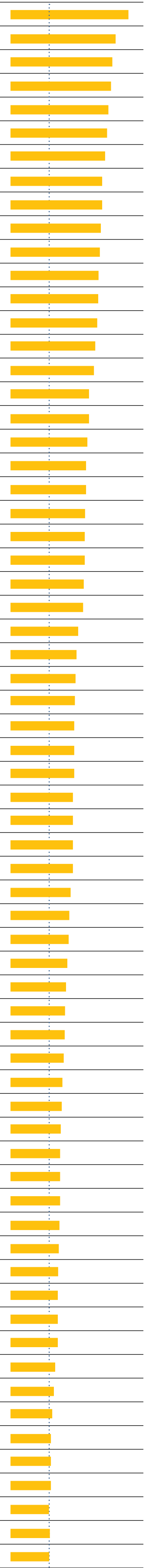
Innovation Input Sub-Index 2020 rankings, continued

Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Median 41.39
Belarus	41.32	67	UM	20	EUR	35	
Oman	41.15	68	HI	45	NAWA	9	
Uruguay	40.75	69	HI	46	LCN	7	
Philippines	40.75	70	LM	4	SEAO	13	
Ukraine	40.14	71	LM	5	EUR	36	
Bosnia and Herzegovina	39.98	72	UM	21	EUR	37	
Kuwait	39.63	73	HI	47	NAWA	10	
Albania	39.62	74	UM	22	EUR	38	
Republic of Moldova	39.18	75	LM	6	EUR	39	
Azerbaijan	39.17	76	UM	23	NAWA	11	
Jordan	39.01	77	UM	24	NAWA	12	
Tunisia	38.98	78	LM	7	NAWA	13	
Rwanda	38.59	79	LI	1	SSF	3	
Argentina	38.26	80	UM	25	LCN	8	
Uzbekistan	38.24	81	LM	8	CSA	3	
Panama	38.13	82	HI	48	LCN	9	
Armenia	38.13	83	UM	26	NAWA	14	
Botswana	38.09	84	UM	27	SSF	4	
Morocco	37.52	85	LM	9	NAWA	15	
Jamaica	37.19	86	UM	28	LCN	10	
Trinidad and Tobago	36.67	87	HI	49	LCN	11	
Kyrgyzstan	36.62	88	LM	10	CSA	4	
Nepal	36.17	89	LI	2	CSA	5	
Iran (Islamic Republic of)	35.92	90	UM	29	CSA	6	
Indonesia	35.13	91	LM	11	SEAO	14	
Kenya	35.03	92	LM	12	SSF	5	
Lebanon	34.96	93	UM	30	NAWA	16	
Dominican Republic	34.75	94	UM	31	LCN	12	
El Salvador	34.45	95	LM	13	LCN	13	
Ecuador	34.27	96	UM	32	LCN	14	
Bolivia (Plurinational State of)	33.87	97	LM	14	LCN	15	
Paraguay	33.82	98	UM	33	LCN	16	
Cabo Verde	33.09	99	LM	15	SSF	6	
Honduras	32.92	100	LM	16	LCN	17	
Namibia	32.20	101	UM	34	SSF	7	
Senegal	32.03	102	LM	17	SSF	8	
Uganda	32.01	103	LI	3	SSF	9	
Egypt	31.91	104	LM	18	NAWA	17	
Côte d'Ivoire	31.31	105	LM	19	SSF	10	
Burkina Faso	31.27	106	LI	4	SSF	11	
Sri Lanka	31.25	107	UM	35	CSA	7	
Tajikistan	31.04	108	LI	5	CSA	8	
Zambia	30.73	109	LM	20	SSF	12	
Guatemala	30.56	110	UM	36	LCN	18	
Algeria	30.46	111	UM	37	NAWA	18	
United Republic of Tanzania	30.41	112	LI	6	SSF	13	
Ghana	30.20	113	LM	21	SSF	14	
Malawi	30.02	114	LI	7	SSF	15	
Nigeria	29.81	115	LM	22	SSF	16	
Benin	29.78	116	LI	8	SSF	17	
Cambodia	29.63	117	LM	23	SEAO	15	
Pakistan	29.53	118	LM	24	CSA	9	
Bangladesh	29.48	119	LM	25	CSA	10	
Cameroon	29.18	120	LM	26	SSF	18	
Togo	29.03	121	LI	9	SSF	19	
Mozambique	28.84	122	LI	10	SSF	20	
Zimbabwe	28.00	123	LM	27	SSF	21	
Niger	27.94	124	LI	11	SSF	22	
Madagascar	27.40	125	LI	12	SSF	23	
Mali	27.34	126	LI	13	SSF	24	
Lao People's Democratic Republic	27.12	127	LM	28	SEAO	16	
Guinea	25.11	128	LI	14	SSF	25	
Myanmar	24.98	129	LM	29	SEAO	17	
Ethiopia	24.38	130	LI	15	SSF	26	
Yemen	19.85	131	LI	16	NAWA	19	

Notes: World Bank Income Group Classification (July 2019): LI = low income; LM = lower-middle income; UM = upper-middle income; and HI = high income. Regions are based on the United Nations Classification: EUR = Europe; NAC = Northern America; LCN = Latin America and the Caribbean; CSA = Central and Southern Asia; SEAO = South East Asia and Oceania; NAWA = Northern Africa and Western Asia; SSF = Sub-Saharan Africa.

Innovation Output Sub-Index 2020 rankings

Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Median 20.74
Switzerland	62.75	1	HI	1	EUR	1	
Sweden	55.75	2	HI	2	EUR	2	
United Kingdom	53.59	3	HI	3	EUR	3	
Netherlands	53.08	4	HI	4	EUR	4	
United States of America	52.28	5	HI	5	NAC	1	
China	51.04	6	UM	1	SEAO	1	
Germany	50.39	7	HI	6	EUR	5	
Finland	48.47	8	HI	7	EUR	6	
Denmark	48.30	9	HI	8	EUR	7	
Republic of Korea	47.40	10	HI	9	SEAO	2	
Ireland	46.38	11	HI	10	EUR	8	
France	45.89	12	HI	11	EUR	9	
Israel	45.73	13	HI	12	NAWA	1	
Luxembourg	44.45	14	HI	13	EUR	10	
Singapore	43.02	15	HI	14	SEAO	3	
Hong Kong, China	42.68	16	HI	15	SEAO	4	
Czech Republic	41.95	17	HI	16	EUR	11	
Japan	41.80	18	HI	17	SEAO	5	
Iceland	41.18	19	HI	18	EUR	12	
Estonia	40.45	20	HI	19	EUR	13	
Malta	40.14	21	HI	20	EUR	14	
Canada	39.68	22	HI	21	NAC	2	
Austria	39.10	23	HI	22	EUR	15	
Italy	39.06	24	HI	23	EUR	16	
Belgium	38.64	25	HI	24	EUR	17	
Cyprus	38.17	26	HI	25	NAWA	2	
Spain	36.35	27	HI	26	EUR	18	
Norway	35.91	28	HI	27	EUR	19	
Portugal	34.50	29	HI	28	EUR	20	
Bulgaria	33.98	30	UM	2	EUR	21	
Australia	33.85	31	HI	29	SEAO	6	
Hungary	33.80	32	HI	30	EUR	22	
New Zealand	33.06	33	HI	31	SEAO	7	
Slovakia	32.86	34	HI	32	EUR	23	
Latvia	32.63	35	HI	33	EUR	24	
Malaysia	32.61	36	UM	3	SEAO	8	
Ukraine	32.49	37	LM	1	EUR	25	
Viet Nam	32.17	38	LM	2	SEAO	9	
Slovenia	31.73	39	HI	34	EUR	26	
Poland	30.81	40	HI	35	EUR	27	
Philippines	29.62	41	LM	3	SEAO	10	
Lithuania	28.98	42	HI	36	EUR	28	
Croatia	28.24	43	HI	37	EUR	29	
Thailand	27.91	44	UM	4	SEAO	11	
India	27.66	45	LM	4	CSA	1	
Romania	27.47	46	UM	5	EUR	30	
Armenia	27.15	47	UM	6	NAWA	3	
Republic of Moldova	26.79	48	LM	5	EUR	31	
Montenegro	26.62	49	UM	7	EUR	32	
Iran (Islamic Republic of)	25.86	50	UM	8	CSA	2	
Costa Rica	25.63	51	UM	9	LCN	1	
Greece	25.54	52	HI	38	EUR	33	
Turkey	25.44	53	UM	10	NAWA	4	
Mongolia	25.35	54	LM	6	SEAO	12	
United Arab Emirates	25.28	55	HI	39	NAWA	5	
Serbia	25.24	56	UM	11	EUR	34	
Mexico	24.80	57	UM	12	LCN	2	
Russian Federation	24.62	58	UM	13	EUR	35	
Tunisia	23.44	59	LM	7	NAWA	6	
Mauritius	22.94	60	UM	14	SSF	1	
Belarus	21.23	61	UM	15	EUR	36	
Jamaica	21.00	62	UM	16	LCN	3	
North Macedonia	20.96	63	UM	17	EUR	37	
Brazil	20.94	64	UM	18	LCN	4	
Uruguay	20.92	65	HI	40	LCN	5	
Chile	20.74	66	HI	41	LCN	6	



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Innovation Output Sub-Index 2020 rankings, continued

Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Median 20.74
United Republic of Tanzania	20.73	67	LI	1	SSF	2	
South Africa	20.48	68	UM	19	SSF	3	
Morocco	20.42	69	LM	8	NAWA	7	
Panama	19.95	70	HI	42	LCN	7	
Georgia	19.66	71	UM	20	NAWA	8	
Qatar	19.62	72	HI	43	NAWA	9	
Argentina	18.40	73	UM	21	LCN	8	
Colombia	18.02	74	UM	22	LCN	9	
Bosnia and Herzegovina	18.00	75	UM	23	EUR	38	
Indonesia	17.85	76	LM	9	SEAO	13	
Saudi Arabia	17.40	77	HI	44	NAWA	10	
Kenya	17.22	78	LM	10	SSF	4	
Kuwait	17.17	79	HI	45	NAWA	11	
Lebanon	17.07	80	UM	24	NAWA	12	
Jordan	16.57	81	UM	25	NAWA	13	
Egypt	16.55	82	LM	11	NAWA	14	
Sri Lanka	16.32	83	UM	26	CSA	3	
Senegal	15.46	84	LM	12	SSF	5	
Dominican Republic	15.44	85	UM	27	LCN	10	
Azerbaijan	15.29	86	UM	28	NAWA	15	
El Salvador	15.25	87	LM	13	LCN	11	
Pakistan	15.08	88	LM	14	CSA	4	
Bahrain	14.69	89	HI	46	NAWA	16	
Cabo Verde	14.64	90	LM	15	SSF	6	
Albania	14.61	91	UM	29	EUR	39	
Paraguay	14.46	92	UM	30	LCN	12	
Ghana	14.35	93	LM	16	SSF	7	
Kazakhstan	14.34	94	UM	31	CSA	5	
Lao People's Democratic Republic	14.18	95	LM	17	SEAO	14	
Guatemala	14.14	96	UM	32	LCN	13	
Ecuador	13.94	97	UM	33	LCN	14	
Peru	13.76	98	UM	34	LCN	15	
Tajikistan	13.43	99	LI	2	CSA	6	
Madagascar	13.39	100	LI	3	SSF	8	
Cambodia	13.29	101	LM	18	SEAO	15	
Honduras	12.98	102	LM	19	LCN	16	
Malawi	12.86	103	LI	4	SSF	9	
Namibia	12.82	104	UM	35	SSF	10	
Botswana	12.77	105	UM	36	SSF	11	
Nepal	12.54	106	LI	5	CSA	7	
Kyrgyzstan	12.40	107	LM	20	CSA	8	
Zimbabwe	11.93	108	LM	21	SSF	12	
Oman	11.85	109	HI	47	NAWA	17	
Ethiopia	11.75	110	LI	6	SSF	13	
Trinidad and Tobago	11.60	111	HI	48	LCN	17	
Rwanda	11.52	112	LI	7	SSF	14	
Brunei Darussalam	11.48	113	HI	49	SEAO	16	
Bangladesh	11.29	114	LM	22	CSA	9	
Côte d'Ivoire	11.17	115	LM	23	SSF	15	
Mali	10.97	116	LI	8	SSF	16	
Bolivia (Plurinational State of)	10.95	117	LM	24	LCN	18	
Uzbekistan	10.83	118	LM	25	CSA	10	
Cameroon	10.78	119	LM	26	SSF	17	
Myanmar	10.51	120	LM	27	SEAO	17	
Nigeria	10.44	121	LM	28	SSF	18	
Guinea	9.53	122	LI	9	SSF	19	
Uganda	9.06	123	LI	10	SSF	20	
Burkina Faso	8.73	124	LI	11	SSF	21	
Mozambique	8.56	125	LI	12	SSF	22	
Algeria	8.51	126	UM	37	NAWA	18	
Togo	8.05	127	LI	13	SSF	23	
Zambia	8.04	128	LM	29	SSF	24	
Niger	7.70	129	LI	14	SSF	25	
Yemen	7.27	130	LI	15	NAWA	19	
Benin	6.47	131	LI	16	SSF	26	

Notes: World Bank Income Group Classification (July 2019): LI = low income; LM = lower-middle income; UM = upper-middle income; and HI = high income. Regions are based on the United Nations Classification: EUR = Europe; NAC = Northern America; LCN = Latin America and the Caribbean; CSA = Central and Southern Asia; SEAO = South East Asia and Oceania; NAWA = Northern Africa and Western Asia; SSF = Sub-Saharan Africa.

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In 2011, an Advisory Board was established to provide advice on the research underlying the Global Innovation Index (GII), generate synergies at its stages of development, and assist with the dissemination of its messages and results. The Advisory Board is a select group of leading international practitioners with expertise in the realm of innovation. Its members are from diverse geographical and institutional backgrounds and participate in their personal capacity. We extend our gratitude to all Advisory Board members for their continuous support and our collaboration.

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THE GLOBAL INNOVATION INDEX 2020

OVERVIEW OF RANKINGS

CHAPTER 1

THE GLOBAL INNOVATION INDEX 2020

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Bruno Lanvin, INSEAD

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The last edition of the Global Innovation Index (GII), released in July 2019, relayed an upbeat message on innovation worldwide. Since then, the world economy and innovation have been confronted with an unprecedented challenge: the coronavirus disease (COVID-19) pandemic.

The COVID-19 pandemic has been triggering a global economic shutdown, which is only partially being relaxed as the last sentences of this chapter are written.

This scene-setting chapter of the GII 2020 provides an account of innovation contexts thus far. In light of the above events, the GII theme this year—Who Will Finance Innovation?—discusses how the state of innovation finance is changing rapidly.

This chapter reveals and analyzes the annual GII innovation rankings—by top-performing economies, regions, and innovation components.

Innovation and growth before COVID-19

The last nine editions of the GII have described a global economy struggling to fully recover from the global financial crisis of 2008–2009.

While certain years looked better than others, the world economy was never quite able to resume a cruising speed comparable to before the crisis. Uncertainty remained high. Investment and productivity growth around the world—of which innovation is an engine—were mostly sluggish by historical standards.

This rather bleak account, however, was met with an upbeat innovation outlook. Over the last decade, average innovation expenditures worldwide have, in fact, been growing faster than GDP. According to our 2020 estimates, in 2017 and 2018, research and development (R&D) grew by 5.0% and 5.2% respectively—in line with the strong growth of the pre-crisis period and significantly stronger than global GDP growth (Figure 1.1). This growth in R&D expenditure—the highest over a six-year period—was sustained by growth in key emerging markets, such as China and India, and by leaders in high-income economies.

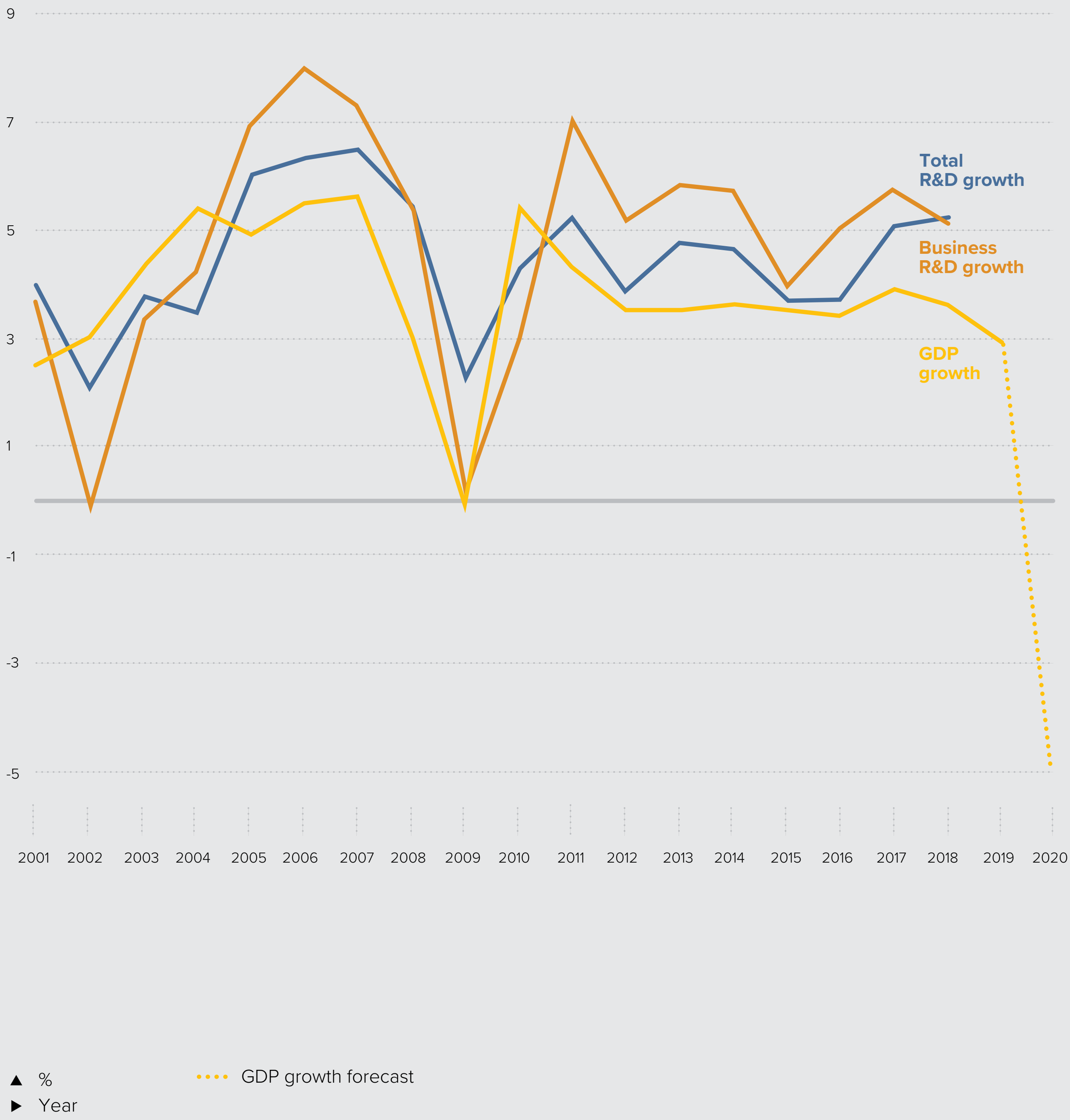
China's R&D expenditure grew 8.6% in 2018, higher than the prior year. India's R&D spending growth in 2018 is estimated at 5.5%. In high-income economies, real R&D expenditure grew 3.8% in 2018.[2] Expenditures grew 8.3% in the Republic of Korea, 3.4% in the United States of America (U.S.), 3.7% in Germany, and 2.4% in Japan.

Private sector funding drove much of this growth in innovation expenditure as governments phased out the innovation stimulus measures they set up after 2009.[3] The top 2,500 R&D companies invested 823 billion euros (EUR) in R&D in 2018, an increase of 8.9% with respect to the previous period.[4]

Before the pandemic, global intellectual property (IP) filing activity also grew at a rapid pace, setting new records in 2018

FIGURE 1.1

Bracing for a downturn? Cyclical R&D investments, 2001–2020



Sources: Authors' estimates based on the UNESCO Institute for Statistics database, OECD Main Science and Technology Indicators, Eurostat, the National Bureau of Statistics of China, and the IMF World Economic Outlook.

and 2019.[5] Worldwide patent filings grew by 5.2% in 2018; strong growth was also experienced in trademarks, industrial designs, and other forms of IP. The use of WIPO's IP systems also grew for the past decade, reaching a new peak in 2019.[6]

As described in the theme section, before the crisis, venture capital (VC) and other sources of innovation financing were at an all-time high (Figure 1.2). Venture capital deal activity in North America, Asia, and Europe was healthy, with aggregate deal values climbing. Novel innovation financing mechanisms, including sovereign wealth funds, IP marketplaces, crowdfunding, and financial technology (fintech) solutions, contributed to the spike in innovation finance.

Formal innovation statistics aside, political determination across the globe to foster innovation and related policies on the ground has been significant and growing. The practical work and policy advances stemming from the GII between 2010 and 2020 has indeed shown that both developed and developing economies increasingly monitor their innovation performance and work on improving it—through expenditures and a sustained willingness to remove roadblocks to strong national innovation systems. In short, formal and informal innovation has been blossoming globally.

What are the likely impacts of the pandemic recession on financing innovation and R&D?

According to the June forecast by the International Monetary Fund (IMF), global GDP will shrink by 4.9% in 2020, hitting the top global innovation actors—including high-income economies and China—particularly hard.[7] With quasi certainty, this forecast will be revised downward around and after the launch date of the GII.

Estimates of the speed of recovery from the COVID-19 pandemic are speculative.[8] Many forecasts are based on the assumption that the "pandemic fades in the second half of 2020", with short-lived declines in GDP for major economies. A recovery in 2021 is foreseen.[9] Other economists, however, suggest a decade-long slowdown, high unemployment rates, and lasting damage to globalized supply and value chains.[10]

What, if any, toll will the COVID-19 crisis take on innovation?

Effects on R&D, IP, and innovation

The impacts of the crisis on innovation are uncertain and highly dependent on recovery scenarios and the business and innovation practices and policies in place.

In any scenario, financial resources—both private and public—will be strained. Countries and corporations alike might find it harder to pursue investments and innovation. Historically, pandemics have been followed by sustained periods of depressed investment.[11] Investment rates are already low to date, including foreign direct investment, which is now expected to drop sharply in 2020 and 2021.[12]

As global economic growth declines in 2020, the question is whether R&D expenditures will fall or remain resilient despite the economic cycle?

Historically, business R&D expenditure, IP filings, and VC have moved in parallel with GDP, slowing markedly during the economic downturns of the early 1990s, early 2000s, and 2009 (Figure 1.1).[13] The main reasons for reduced innovation expenditure at the corporate level are reduced revenue and cash flow, across-the-board cost cutting, and more risk-averse investors and banks. Firms then face difficulties tapping into external sources of funding to support their investments in R&D.

Mirroring the economic downturn, R&D and other innovation expenditures are likely to fall in 2020. In line with historical trends, one should also expect a drop in all forms of IP in 2020—in particular, trademarks and, to a somewhat lesser extent, patents—both at national patent offices and via WIPO's Patent Co-operation Treaty (PCT).[14]

However, the short-term effect on R&D and IP will not be seen in data or corporate reports until the second or third quarter of 2020. Given the delays in R&D reporting, nationwide data documenting the extent of this effect won't truly be available until early 2022. In the case of IP filings, the little data that is available in the first quarter of 2020 is—for most countries—not a good predictor of the fall in IP filings.

Yet, based on the willingness of governments and firms to innovate independent of short-term economic cycles after the financial crisis of 2008–2009, the news might not be too alarming.

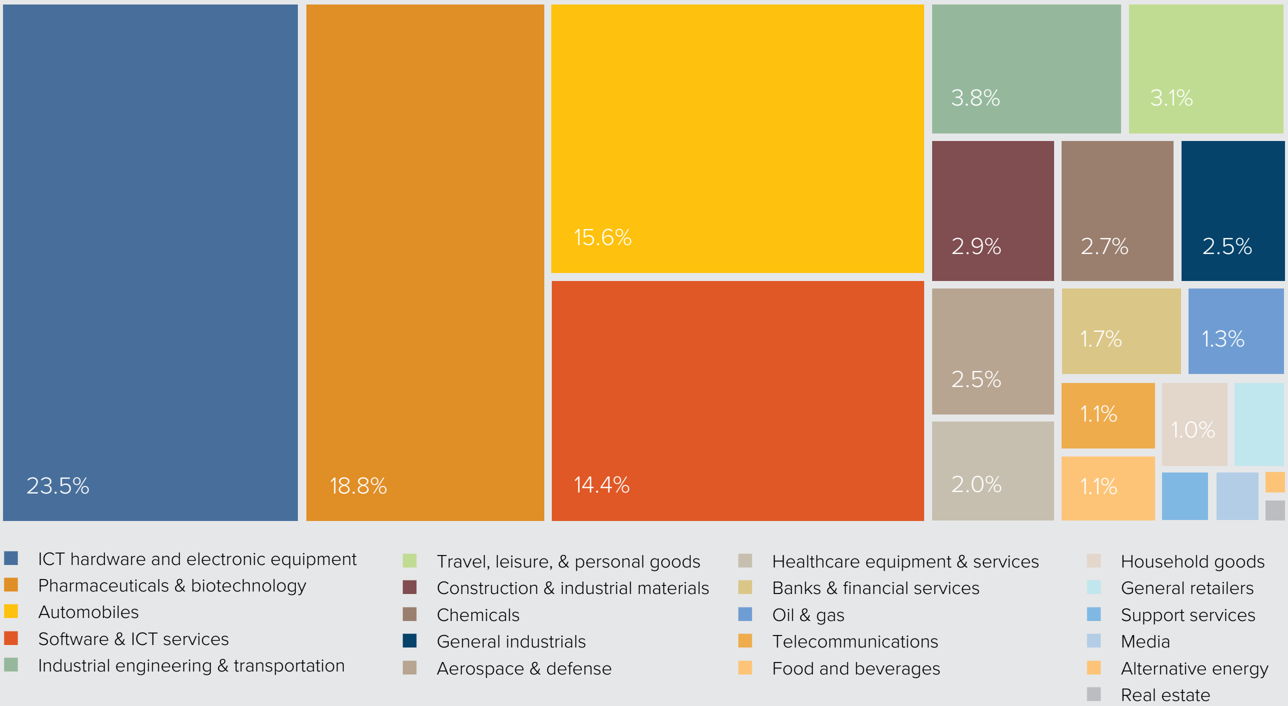
Following the 2008–2009 financial crisis, a number of economies never experienced aggregate R&D declines, including Argentina, China, Costa Rica, Egypt, France, India, the Republic of Korea, Mexico, Poland, and Turkey.[15] For other economies, including Brazil, Chile, Germany, Israel, the United Kingdom (U.K.), the U.S., Singapore, and South Africa, the fall was only short lived.[16] Judging by past crises, the impact of economic downturns on IP filings have been rather short lived too, underlining the central role that IP now plays.[17]

The medium-term impact on innovation activity will depend on the speed of economic recovery, whether R&D and IP filings will continue to mirror economic cycles or decouple, and on the public and corporate innovation policies which are adopted in the aftermath of the crisis.

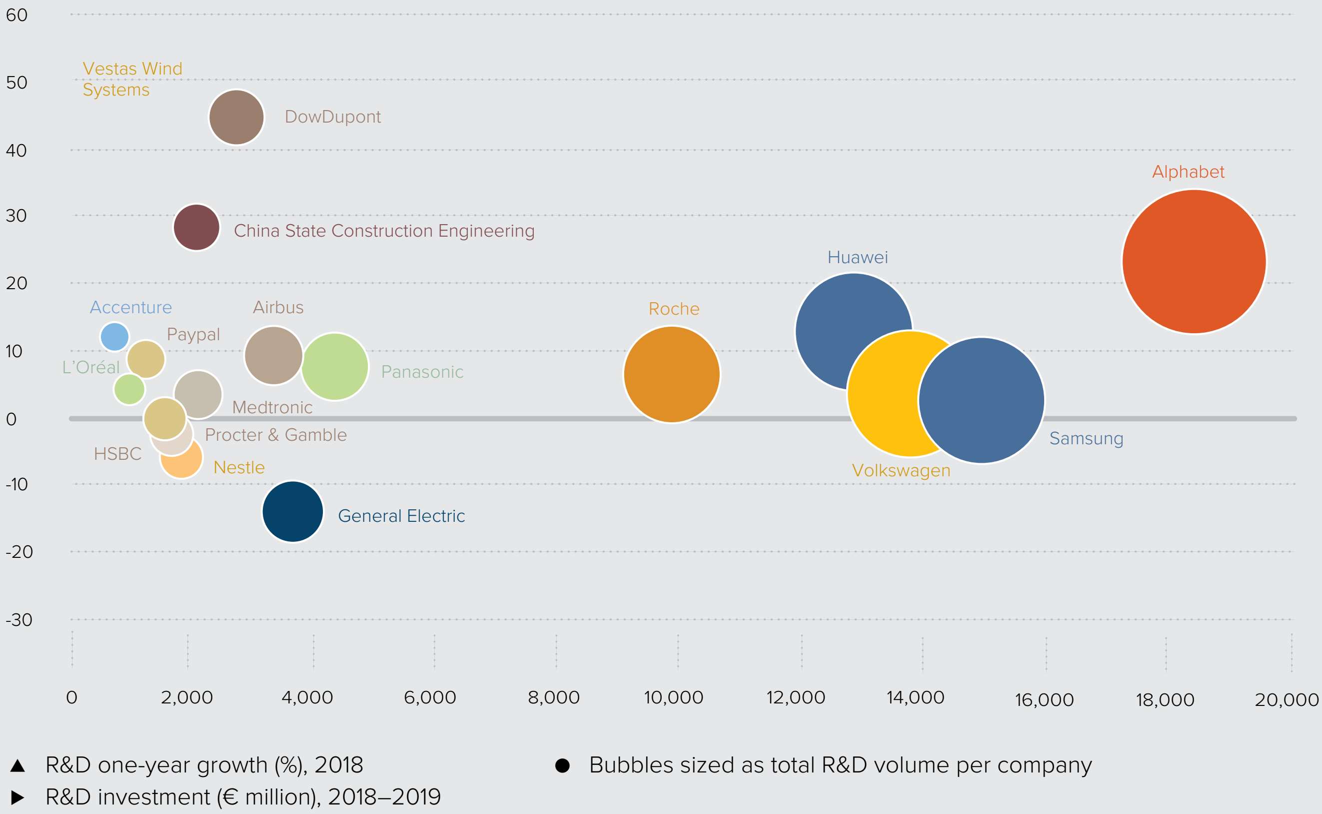
Past crises have had very heterogeneous effects on different sectors and countries, with some increasing innovation and others decreasing innovation and related expenditures after an economic downturn.[18] This is possible again today.

FIGURE 1.2

Top R&D-spending sectors as share of global top R&D spenders, 2018–2019



Top R&D-spending firm in each sector, 2018-2019



Sources: Authors' calculations based on the EU Industrial R&D Investment Scoreboard dataset, see also Hernández et al. (2020).
Notes: ALPHABET, Software & ITC services; SAMSUNG ELECTRONICS, ITC hardware & electrical equipment; VOLKSWAGEN, Automobiles; HUAWEI, ITC hardware & electrical equipment; ROCHE, Pharmaceuticals & biotechnology; PANASONIC, Travel, leisure, & personal goods; GENERAL ELECTRIC, General industrials; AIRBUS, Aerospace & defense; DOWDUPONT, Chemicals; MEDTRONIC, Healthcare equipment & services; CHINA STATE CONSTRUCTION ENGINEERING, Construction & industrial materials; NESTLE, Food and beverages; PROCTER & GAMBLE, Household Goods; HSBC, Banks & financial services; PAYPAL, Banks & financial services; L'ORÉAL, Travel, leisure, & personal goods; ACCENTURE, Support services; VESTAS WIND SYSTEMS, Alternative energy.

Indeed, R&D expenditures are heavily concentrated in a couple of thousand firms across the globe, with the top 2,500 R&D-spending companies responsible for 90% of the world's business funded R&D, and the top 100 R&D-spending companies accounting for more than 50% of all corporate global R&D expenditures (see GII indicator 2.3.3).[19] Figure 1.2 shows the distribution of global corporate R&D expenditures by sectors (top). It also shows the top spender in each sector and relative weight in overall R&D expenditure growth (bottom).

It is useful to note that, for most of these top R&D corporations, innovation is now a vital component of their business strategy in an internationally competitive environment.

Some top R&D spending firms are less negatively impacted by the COVID-19 crisis than others. An obvious example is software and ICT (information and communication technologies) services firms—the 4th ranked sector in Figure 1.2. Some of the top R&D spenders in this sector include ALPHABET (U.S.), Microsoft (U.S.), Facebook (U.S.), Oracle (U.S.), Alibaba (China), Tencent (China), Baidu (China), Softbank (Japan), and Ubisoft (France). These firms often hold vast cash reserves and, given the increased push to digitalization during this pandemic—namely the increase in Internet activity, cloud services, online gaming, and remote work—the revenue impact of the crisis on these firms might actually be positive. After the bursting of the dot-com bubble in the early 2000s and the financial crisis of 2008–2009, some of these firms reported strong growth in revenues and spent more on R&D—similar to reports in the first quarter of 2020.[20]

Yet software and ICT firms only represent about 15% of top spenders across all sectors.[21] The ICT hardware and electronic equipment sector, the largest spender of R&D (Figure 1.2), will see more direct revenue impact on its bottom line, due to falling consumer demand globally, and affects on its global supply chain. Firms such as Samsung (the Republic of Korea), Huawei (China), and Apple (U.S.) have seen their first quarter results impacted negatively with strong expected impacts in the second quarter of 2020.[22] Still, and in line with previous crises, most technology companies have significantly increased their first quarter 2020 R&D expenditures.

The pharmaceuticals and biotechnology sector is another top R&D spender, ranking 2nd in Figure 1.2. Judging by recent financial filings by top R&D spenders, such as Roche, this sector is also likely to experience resilient revenue and R&D growth in the current context, which is boosting health R&D.[23] The same is true for the alternative energy sector. While R&D volumes are comparatively low, growth is among the fastest across all R&D top spenders.

Some sectors are weighty in terms of R&D, but their future innovation propensity is more uncertain. A case in point is the automotive sector—the 3rd largest R&D spender—which was hit hard by the COVID-19 pandemic. Automotive firms expect R&D budgets to shrink with severe cuts in 2020 and 2021.[24] Yet, judging by existing surveys, automotive firms expect to be resilient R&D spenders over time, also in view of the transition to cleaner and safer vehicles. For example, Volkswagen, the carmaker spending the most on R&D so far, has increased R&D in the first quarter of 2020 in the context of steep revenue falls.[25]

All in all, the top corporate R&D firms by sector—such as Alphabet (software), Samsung (ICT hardware), Huawei (hardware & electrical equipment), Volkswagen (automotive), Roche (pharmaceuticals), DowDupont (chemicals), and alternative energy firms, such as Vestas, are unlikely to reduce their R&D expenditures anytime soon. The same is true for firms in more traditional sectors, such as construction (China State Construction Engineering) or financial services, where top spenders may be relatively young firms, such as PayPal.

The firms hit hardest by the economic lockdown, notably in household goods (retail and wholesale), travel & leisure (including restaurants), professional services, and real estate will see strong revenue falls and a temptation to cut R&D and other innovation expenditures. Yet, they are not among the most important actors with regard to formal innovation expenditures. These sectors—disproportionate to their economic weight—have a low propensity to use patents.[26] To weather the crisis and prepare for what is coming, these firms will strive to make greater, not less, use of digitization; those surviving could innovate more, not less.

One important question is how long the economic downturn will last, of course, and to what extent companies will adjust their expectations about future demand. The current upbeat scenario is that firms expect to become profitable again after the temporary downturn and once economic confidence returns. The downbeat scenario is that, if the downturn and the negative impact on demand last longer, future profitability expectations and corresponding corporate investment will be adjusted downward.

Effects on entrepreneurship and venture capital

In the context of the GII 2020 theme, another important question is the current impact on start-ups, venture capital (VC), and other sources of innovation financing.

The good news, in contrast to 2009, is that the current situation is not a crisis in the banking sector. The financial system is sound so far.

The bad news is that firms in general, and smaller ventures in particular, are penalized by declining revenue—if they have revenue in the first place. Initial evidence shows that young firms are seeing their access to capital stifled as risk aversion is growing. This corresponds to the economic literature showing that, over the last four decades, VC is pro-cyclical, particularly in early-stage VC investment.[27] Aggregate deal volume, capital investments, and deal size decline substantially in recessions.

Start-ups with fundraising cycles requiring them to raise money soon will be particularly concerned. New types of institutional investors and asset managers will hesitate to finance start-ups for a while.[28] Investors who specialize in early-stage deals are significantly more responsive to business cycles than later-stage investors.[29] It is likely that many young start-ups, in particular, will cease their activities as a result.

Indeed, indicators on VC show that money to fund innovative ventures is drying up (Figure 1.3).[30] The first quarter of private market funding in 2020, measured both in deal volume and value, is down significantly—a stark decline relative to the last ten years. Deal activity and funding saw year-over-year declines in North America, Asia, and Europe—with Asia, and understandably China, experiencing the largest drop in both funding and deal activity in the first quarter of 2020.

Interestingly, the crisis has only reinforced the decline in deals that had set in before the pandemic, following a peak in 2018. Rather than financing many new and diverse start-ups, venture capitalists had already focused on so-called "mega-rounds"—deals worth US$100 million and more—to boost a more selective number of high-growth businesses. Large investments in start-ups, such as Uber and WeWork, are facing challenges—causing large investors, including sovereign wealth funds, to be more cautious (Theme Section).

Exit strategies, such as initial public offerings (IPOs), were already compromised in 2019, but have become even more compromised due to the pandemic crisis, with hardly any initial public offerings in sight.

In sum, equity markets are plummeting, and fundraising prospects are heavily compromised.

Again, the natural question is, are these medium-term or long-term effects?

The likely answer is that VC investing will take longer to recover than R&D spending. The evidence also points to an uneven negative impact, more so for early-stage than for later-stage VC. Recessions also negatively impact the number and quality of innovative VC-backed firms with outstanding patent filings and citations—and those with longer-term research and science-backed projects.[31] As a result, the decline of innovation finance to these firms also tends to affect the future development of major breakthrough innovations negatively.

Today, most VC is focused on a few economies, sectors, and firms (Theme Section, which elaborates on the regional and sectoral VC divide; Chapter 5–Nanda; Chapter 2–Cornelius). It is largely absent from many middle- and low-income economies and from specific world regions outside North America, as well as certain European and Asian countries. Due to the current crisis, this divide in innovation finance will become worse before it gets better. VC and innovation finance will likely be scarcer for sectors and firms with longer research horizons.

At the same time, key high-income economies, such as the U.S. and China, are magnets for VC and likely to rebound quickly. The thirst for innovation and the supply of capital in search of returns is large. Chinese VC deals, for example, contracted by about half earlier this year due to the pandemic, but they are already rebounding strongly.[32] As suggested later in this chapter, the direction of innovation seems to have been impacted too. The rebound in Chinese VC, for example, is catalyzing innovation in online education, big data, software, and robotics.[33]

There is also one final twist regarding the crisis and its impact on the relationship between innovation and competition. Big tech companies—who are either not negatively affected by the crisis or hold huge cash reserves—are currently stepping up their acquisitions of smaller tech companies, benefiting from better bargaining power and lower acquisition prices.[34] This could be positive in the sense that it ensures financing for young tech companies, but also negative in the sense that it eliminates competition.

Make innovation central after the transition from containment to recovery

What are policymakers doing to counteract the effects of the crisis on economies and innovation?

Most governments in high- and middle-income economies are setting up emergency relief packages to cushion the impact of the lockdown and face the looming recession.

Generally, these measures are being deployed rapidly. Some governments, such as China, the U.S., and the Republic of Korea, are indeed on their second or third package while the crisis is still only unfolding. The stimulus packages of other economies are in the making. Already, the sums allocated are large: around US$9 trillion so far and growing by the minute.[35]

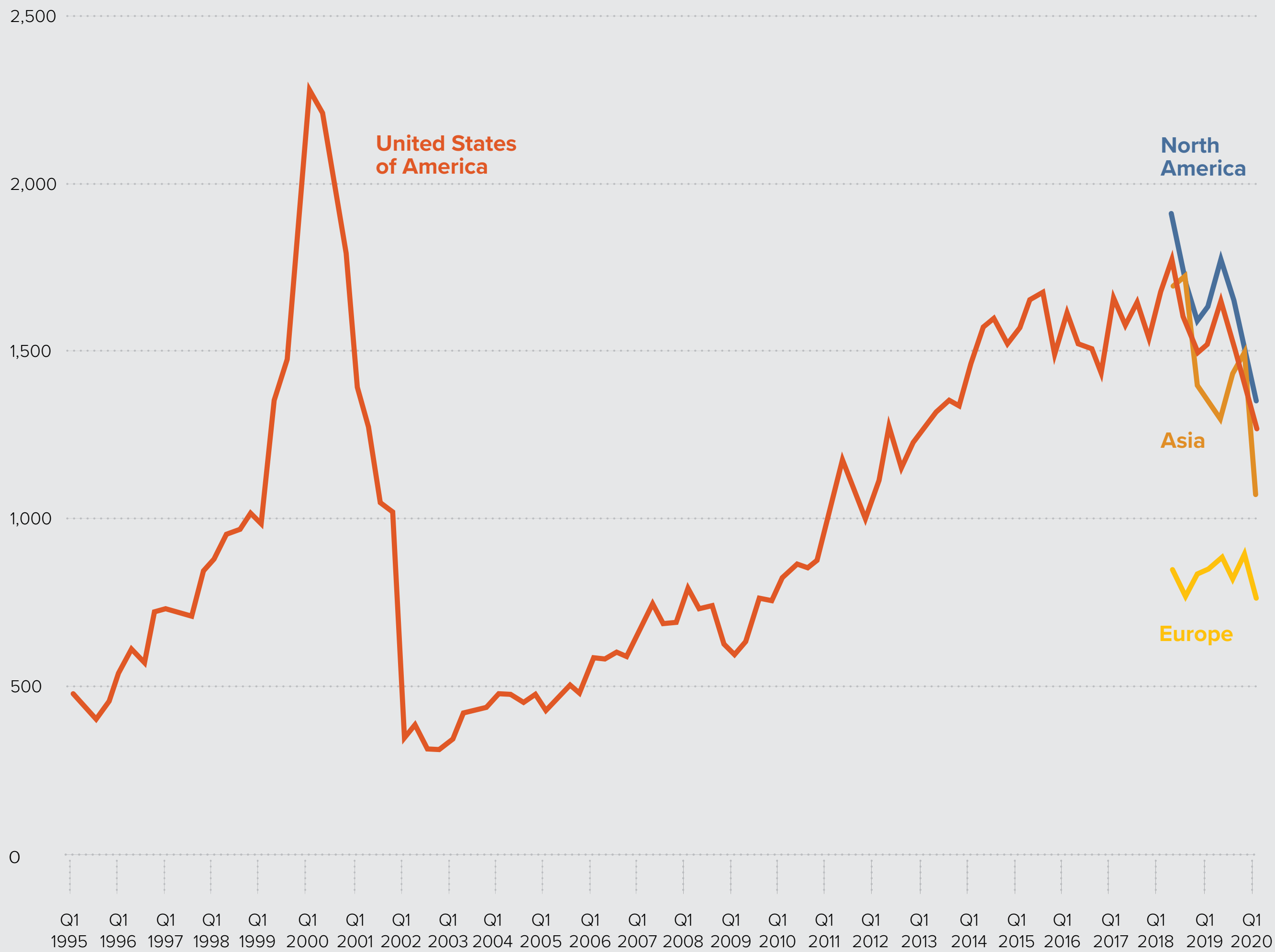
Most of the new spending packages are geared toward preventing short- to medium-term harm to economies. This is needed and sensible. The immediate focus is on 1) injecting liquidity, 2) supporting businesses via loan guarantees and other measures to avert bankruptcies, 3) helping households and workers via unemployment benefits, and 4) providing support to self-employed persons.[36] Some of these measures are similar to those deployed in 2009.

Mostly, however, these measures are not explicitly directed to financing innovation and start-ups. They are bridge loans or grants to pay salaries; they are not intended for innovation finance. Also, currently, many short-term measures to boost firm liquidity are not easily accessible to young firms without revenues; they do not meet the basic revenue or profitability criteria imposed.[37] Other measures depend on payroll expenses. And there are other hurdles for start-ups to access the funds too.[38] Governments might focus on these accessibility criteria to be inclusive of research-intensive and innovative start-ups. France, in turn, has already extended its liquidity scheme to start-ups.[39] The Chinese rescue package also includes guaranteed loans for start-ups.[40]

Some countries—mostly European—have started setting up special funds to support start-ups.

FIGURE 1.3

Bracing for impact: venture capital decline in North America, Asia, and Europe, Q1 1995–Q1 2020



▲ Number of deals
▶ Year

Source: Authors' calculations based on PwC/CBInsights MoneyTree data explorer.

- France is setting aside EUR 80 million, coupled with matched investments from the private sector to invest in start-ups and bridge the innovation finance gap.[41] This is complemented by EUR 1.5 billion to accelerate the reimbursement of allotted R&D tax credits, EUR 250 million to accelerate the payment of support for innovation, and an additional EUR 1.3 billion of support to innovating companies.[42]
- The U.K. has announced a boost of £40 million British pounds (US$50.3 million) for cutting-edge start-ups and, in particular, to fast-track the development of innovations born out of the COVID-19 crisis, such as virtual reality training platforms for surgeons, virtual farmers' markets, etc.[43]
- The Swiss government is launching a fund using government-guaranteed bank loans to help start-ups facing cash flow problems resulting from the coronavirus crisis. Swiss start-up companies are eligible to receive a maximum of 1 million Swiss francs (CHF), about US$ 1 million. In total, CHF 154 million are available as loans for start-ups.[44]

Understandably, ensuring innovation and R&D is not yet a priority in current stimulus packages—with one exception. Countries have donated large and unprecedented sums of money to inject into the search for a coronavirus vaccine. Health innovation—primarily in finding treatments and a COVID-19 vaccine—is essential to overcome the lockdown and to avoid a deeper recession. Echoing the Global Innovation Index 2019 report, *Creating Healthy Lives—The Future of Medical Innovation*, health-related innovation is key to the future.

To recall, in reaction to the 2009 financial crisis, governments put surprisingly forward-looking pro-growth policies in place.[45] To emerge stronger from that crisis, governments created post-2009 stimulus packages that contained integral innovation-related measures, including investments in infrastructure, research, green innovation, education, and support to innovation and innovative firms. These countercyclical innovation stimulus packages proved essential to stimulate R&D effectively and overcome shortages in innovation finance.[46] The same logic applies today. A crisis-induced decline in innovation expenditure will reduce opportunities for future long-term growth. After the worst scenarios of the lockdown have been averted, thanks to existing emergency measures, it will be crucial that support for innovation continues in an anti-cyclical way—even in the face of higher public debt.

Some countries are already anticipating the transition from containment to recovery measures. France has pledged to give 5 billion euros, a 25 % increase in its original R&D budget.[47] In addition, France is fast-tracking R&D tax credits—a measure which was effective in 2009. Germany has unveiled a second stimulus package of 50 billion euros on future-focused technologies.[48] The U.S. and China are considering spending large additional amounts of stimulus money geared to building infrastructure and boosting innovation.[49] China, for example, intends to focus on new fields of innovation and new forms of soft infrastructure, such as big data centers, 5G infrastructure, and new energy vehicles (NEVs).

Policy measures that stimulate investment, unlock future sources of growth, and encourage the pursuit of longer-term goals will be key going forward. This innovation orientation in future stimulus packages needs to be prioritized when the time is ripe—thus, when the most pernicious effects of the lockdown are averted by current short-term measures.[50]

Identifying which sectors or technologies need a boost will require work, however. As mentioned, the sectoral impact of the current crisis on innovation finance is uneven, with some sectors and firms doing well, whereas others are struggling. Evidence-based policymaking will need a clear understanding of these sectoral differences, to possibly act with sector-specific innovation support measures when required.

Finally, the impacts of the pandemic and the resulting economic crisis will also be uneven across countries. It will be important to closely monitor the innovation finance goals set as per the United Nations (UN) Sustainable Development Goals (SDGs) in that light (Box 1).

Moving forward post COVID-19—unleashing strong innovation potential

To conclude, we offer three main observations and possible pitfalls:

First, notwithstanding the current tragedy, crises are often a source of creativity and innovation, and, at times, industrial renewal. The COVID-19 crisis has already catalyzed innovation in many sectors, such as education, remote work, and retail. It might accelerate progress and industrial renewal more broadly. The opportunities for breakthrough technologies and innovation continue to abound. As described in other WIPO reports, abundant possibilities continue to exist in crosscutting innovation fields such as, for example, artificial intelligence, robotics, 3D printing, or nanotechnology.[54] Past editions of the GII have stressed the looming and sometimes pressing opportunities in fields such as agri-food, environmental technology, or medical technology. Hopefully, the pandemic will have a positive effect on how opportunities for such innovations—in particular, health innovations—are realized. Unleashing this new potential is key.

Second, to reduce damage and catalyze change, it will be essential to assess the short-term and longer-term impacts of the pandemic on the science and innovation systems. On the one hand, the crisis to date has halted ongoing research projects outside of COVID-19, including important clinical trials.[55] Universities, research institutes, and big science infrastructures are shut down. A survey of researchers has shown a decline in work hours, in particular for female researchers with children.[56] It will be important to kick-start dormant innovation projects and to assess the harm caused.[57] On the other hand, research teams worldwide have teamed up in an unprecedented effort to fight COVID-19. Research

BOX 1

Financing innovation—the United Nations Sustainable Development Goals in a post COVID-19 world

The 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs) set in motion the most ambitious global development agenda.[51] Intrinsic to the 2030 Agenda is the Addis Ababa Action Agenda (AAAA) adopted in 2015 as the internationally agreed framework for financing sustainable development. It also recognizes Science, Technology and Innovation (STI) as a key action area for the realization of the 2030 Agenda. The AAAA, which established a Technology Facilitation Mechanism to steer multi-stakeholder efforts to harness STI for SDGs, also touched on the question of financing innovation. Under its terms, Member States commit to set policies to incentivize the creation of new technologies and consider setting up innovation funds to support innovative enterprises.

Four years after the adoption of the 2030 Agenda, UN Member States gathered in 2019 to review progress. They adopted a Political Declaration renewing momentum for accelerated action, including action to promote innovation and to mobilize resources to close the financing gap to achieve the SDGs. In the same vein, the UN General Assembly (UNGA) adopted in December 2019 its bi-annual resolution on STI for sustainable development, which in turn recognized the need to mobilize and scale up financing for STI. As most of the SDGs rely on innovation for their achievement, financing innovation is not extraneous to the discussion on financing sustainable development.

The challenges in financing sustainable development have been the focus of much attention during the 2019 review process. In 2020, those challenges are compounded by the global crisis caused by the coronavirus disease (COVID-19) pandemic. In its resolution on International cooperation to ensure global access to medicines, vaccines, and medical equipment to face COVID-19, the UNGA encourages Member States to work in partnership to increase R&D funding for vaccines and medicines, for example.[52] The 2020 Economic and Social Council (ECOSOC) fora on Financing for Development also underlined the importance of investments for strengthening health systems.[53] And the 2020 High Level Political Forum for Sustainable Development will consider the impact of the COVID-19 pandemic, the response, and the recovery.

Against this backdrop, the GII continues to be relevant in the 2030 Agenda context to measure progress in innovation. The UNGA attested to this relevance in its 2019 resolution on STI for Sustainable Development by encouraging “ […] efforts to increase the availability of data to support the measurement of national innovation systems (such as the existing Global Innovation Index) and empirical research on innovation and development to assist policymakers in designing and implementing innovation strategies […]”.

collaboration, the sharing of research results, and the granting of open access to journals were part of the equation. Indeed, the increased coordination of health R&D around the world in the medical search for a COVID-19 vaccine has been exemplary. The speed and efficacy of this undertaking might well inspire internationally coordinated R&D missions on important societal topics in the future. The current effort has also led to the lifting of certain bureaucratic research and innovation finance procedures, allowing for shortened trials and testing cycles. It will be important to assess which adjustments made during this exceptional situation should become permanent.

Third, the crisis might further impact the international openness and knowledge flows so critical to the development of future innovation leaders from emerging economies and, more generally, to international innovation networks.[58] Restrictions in knowledge and technology diffusion, the unraveling of the global economy, and a return to nationalist policies are risks to innovation.[59] Policymakers are well advised to ensure that this scenario of more nationally-oriented innovation systems is averted.

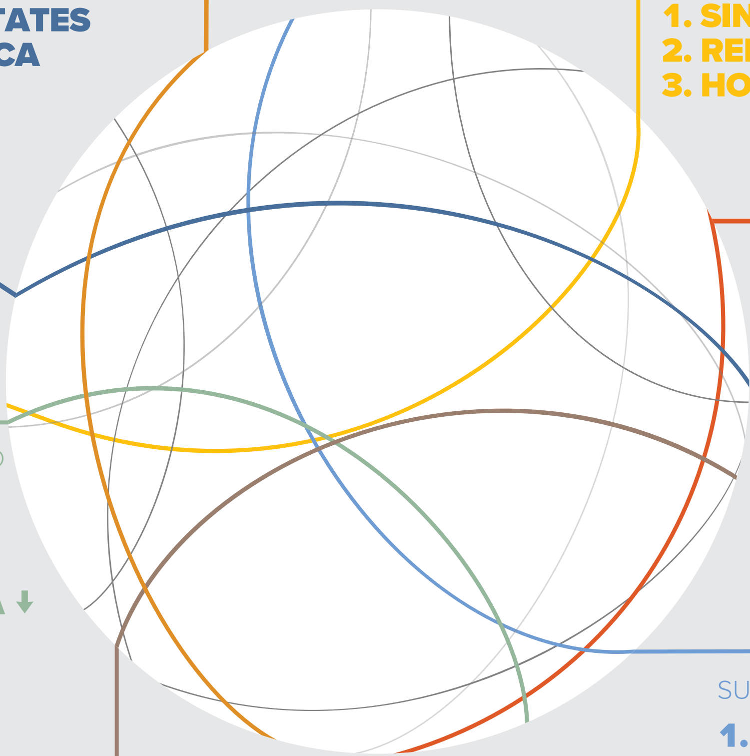
Now more than ever—in particular, as the world seeks a vaccine and/or treatment for COVID-19—innovation and the use of innovation policies in a countercyclical fashion is humanity’s best hope to overcome the economic lockdown.

FIGURE 1.4

Global leaders in innovation in 2020

Every year, the Global Innovation Index ranks the innovation performance of more than 130 economies around the world.

Top 3 innovation economies by region



EUROPE

1. SWITZERLAND
2. SWEDEN
3. UNITED KINGDOM ★

NORTHERN AMERICA

1. UNITED STATES OF AMERICA
2. CANADA

SOUTH EAST ASIA, EAST ASIA, AND OCEANIA

1. SINGAPORE
2. REPUBLIC OF KOREA
3. HONG KONG, CHINA

NORTHERN AFRICA AND WESTERN ASIA

1. ISRAEL
2. CYPRUS
3. UNITED ARAB EMIRATES

LATIN AMERICA AND THE CARIBBEAN

1. CHILE
2. MEXICO ↑
3. COSTA RICA ↓

SUB-SAHARAN AFRICA

1. SOUTH AFRICA / MAURITIUS *↑
2. KENYA
3. UNITED REPUBLIC OF TANZANIA ★

CENTRAL AND SOUTHERN ASIA

1. INDIA
2. IRAN (ISLAMIC REPUBLIC OF)
3. KAZAKHSTAN

* Mauritius is ranked above South Africa this year but with wide significant data variability as compared to last year.
↑↓ indicates the movement of rank within the top 3 relative to 2019, and ★ indicates a new entrant into the top 3 in 2020.

Top 3 innovation economies by income group

HIGH-INCOME GROUP

1. SWITZERLAND
2. SWEDEN
3. UNITED STATES OF AMERICA

UPPER MIDDLE-INCOME GROUP

1. CHINA
2. MALAYSIA
3. BULGARIA

LOWER MIDDLE-INCOME GROUP

1. VIET NAM
2. UKRAINE
3. INDIA★

LOW-INCOME GROUP

1. UNITED REPUBLIC OF TANZANIA ↑
2. RWANDA ↓
3. NEPAL ★

Source: Global Innovation Index Database; Cornell, INSEAD, and WIPO, 2020.
Notes: World Bank Income Group Classification (June 2019); Year-on-year GII rank changes are influenced by performance and methodological considerations; some economy data are incomplete (Appendix IV).

The Global Innovation Index 2020 results

Conceptual framework

The GII helps create an environment that evaluates innovation factors continuously. This year, it provides detailed innovation metrics for 131 economies. All economies covered represent 93.5% of the world's population and 97.4% of the world's GDP.[60]

The GII is composed of three indices: the overall GII, the Innovation Input Sub-Index, and the Innovation Output Sub-Index (Appendix I).

- The overall GII score is the average of the scores of the Input and Output Sub-Indices.
- The Innovation Input Sub-Index is comprised of five pillars that capture elements of the national economy that enable innovative activities: 1) Institutions, 2) Human capital and research, 3) Infrastructure, 4) Market sophistication, and 5) Business sophistication.
- The Innovation Output Sub-Index provides information about outputs that are the result of the innovative activities of economies. There are two output pillars: 6) Knowledge and technology outputs and 7) Creative outputs.

Each pillar has three sub-pillars, and each sub-pillar is composed of individual indicators, totaling 80 this year.[61]

Results

The main GII 2020 findings are discussed in the following sections. The Rankings Section presents the GII results in tabular form for all economies covered this year, for the GII, and for the Innovation Input and Output Sub-Indices.

As always, it must be noted that year-on-year comparisons of the GII ranks are influenced by various factors, such as changes in the underlying indicators at source, changes in data availability, and changes to the GII model and measurement framework (Appendix IV).

Highlights: Switzerland, Sweden, and the United States continue to lead; the Republic of Korea makes it to the top 10; India and the Philippines ramp into the top 50

In the top 10 of the GII, Switzerland, Sweden, and the United States continue to lead the innovation ranking. Switzerland holds the number one position for the 10th consecutive year. The Republic of Korea ranks 10th, tapping into the top group of the GII for the first time, up from 11th in 2019. This makes it the second Asian country to enter the top 10.

Figure 1.5 shows movement in the top 10 ranked economies in the period 2016–2020.

In the top 25, there are three notable movers: France, Hong Kong (China), and Austria. France ranks 12th this year, a positive jump of four positions from last year, resulting from a combination of performance improvements and model changes. Hong Kong (China) ranks 11th, up from 13th in 2019, and reaches its best rank since 2016. Austria ranks 19th and is back in the top 20. The Czech Republic (24th) makes it into the top 25. Five of the countries in the top 10, and 12 in the top 25, are European Union countries.

China keeps its 14th place in 2020, after breaking into the GII top 15 last year. China is still the only middle-income economy that makes it to the top 30 (Box 3). The United Arab Emirates (34th) makes it into the top 35 this year.

India (48th) and the Philippines (50th) make it to the top 50 for the first time. India now ranks 3rd among the lower middle-income economy group, a new milestone. The Philippines achieves a large rise and its best rank ever, after continued rank increases since 2014 when it ranked 100th.

Viet Nam ranks 42nd for the second consecutive year, a considerable improvement from its average rank of 68th in the period 2013–2015.

Over the past seven years, and taken together, China, the Philippines, India, and Viet Nam are the GII economies in the top 50 with the most significant rank progress over time, possibly due in part to methodological factors but certainly also due to improved innovation performance.

The Russian Federation declines by one spot to 47th but remains in the top 50, while Turkey slightly drops, moving out of the top 50 (51st).

Among the top 100, Belarus ranks 64th, increasing eight places, and Serbia gets closer to the top 50, ranking 53rd.

Uzbekistan makes a comeback to the GII. After five years of not being included in the rankings because of a lack of data, it achieves the 93rd place this year. Nepal (95th) scores its best rank ever, and it is a newcomer to the top three among low-income economies (3rd).

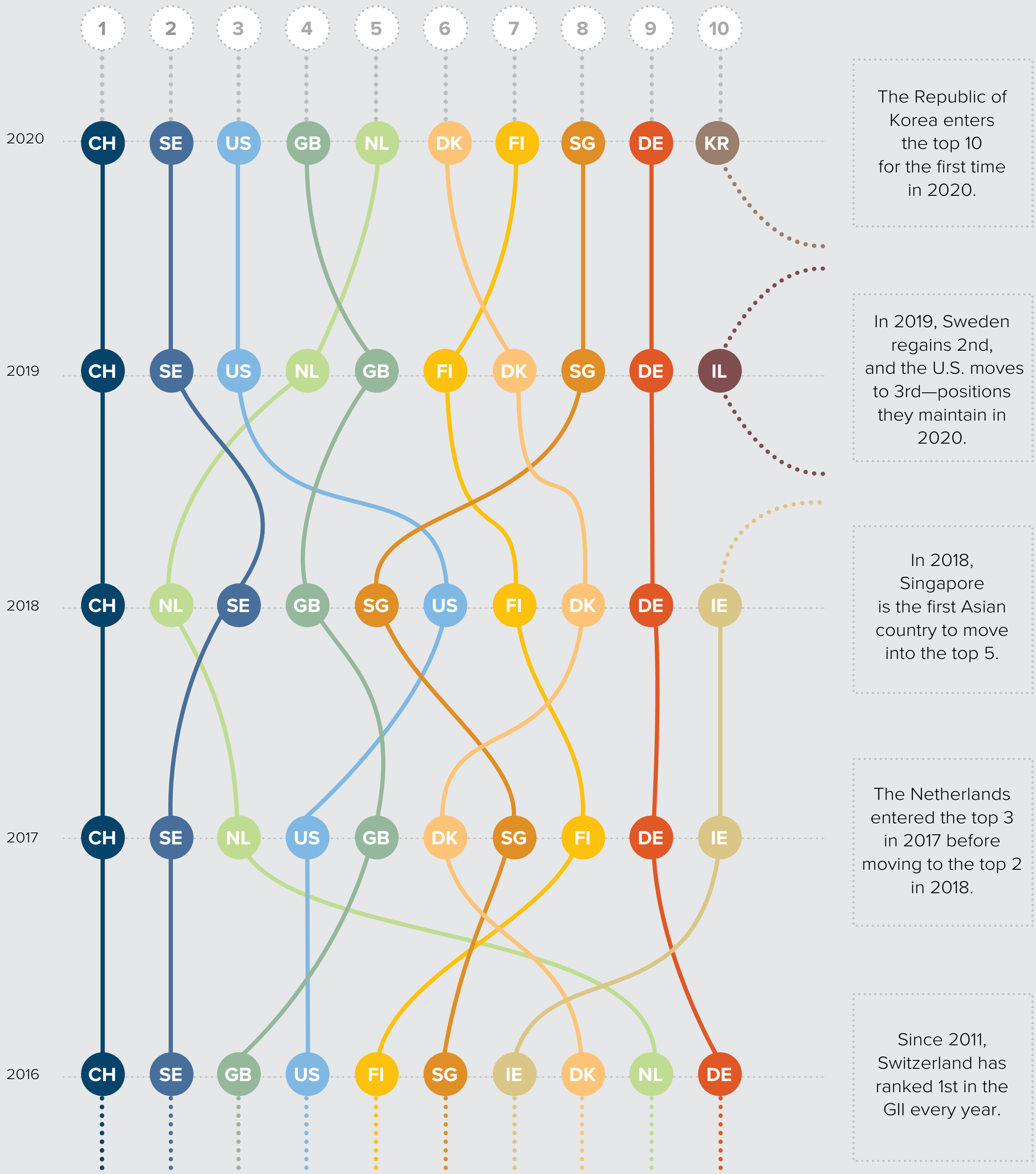
Some outlier rank movements, such as Mauritius (positive), Georgia (negative), and Kuwait (positive) are explained by a mix of new data availability, data revisions at the source, and performance effects.

Despite fast movers in terms of innovation "catch-up", the global innovation divide between income groups and regions remains (Box 3). The catching-up of economies from relatively emergent and fragmented innovation systems to more mature and functional ones is an arduous process.[62]

We share key insights on the characteristics and balance of innovation systems based on GII data for a selection of economies in the following sections.

FIGURE 1.5

Movement in the GII, top 10, 2016–2020



CH Switzerland
GB United Kingdom
SE Sweden
NL Netherlands
US United States of America
FI Finland
SG Singapore
IE Ireland
DK Denmark
DE Germany
IL Israel
KR Republic of Korea

Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2020.
Note: Year-on-year comparisons of the GII ranks are influenced by changes in the GII model and data availability.

The world's most innovative economies in the Global Innovation Index 2020

Movement in the top 10

The United Kingdom (U.K.) ranks 4th, increasing one spot since last year. It maintains its 6th position in the Innovation Input Sub-Index, and continues to increase its position in the Innovation Output Sub-Index to reach the 3rd rank worldwide (up by 1). The U.K. improves in two pillars: Infrastructure (6th) and Creative Outputs (5th). At the sub-pillar level, important increases are in General infrastructure (38th), Regulatory environment (8th), and Intangible assets (9th). The U.K.'s increase in Intangible assets (up by 3) is explained by a combination of performance improvements and changes to the GII model. The U.K. improves notably in the Industrial designs indicator (13th), and ranks 6th worldwide in the Global brands value indicator (new to the GII).

In addition, the country maintains its top three lead in the quality of its universities (2nd) and the quality of its scientific publications (1st). It ranks sixth in the quality of innovation, down by one ("Who is best in the quality of innovation?" in this chapter; Figure 1.7). In addition, the U.K. hosts four S&T clusters in the top 100: London (15th), Cambridge (57th), Oxford (71st) and Manchester (93rd). Cambridge and Oxford are also the world's most S&T-intensive clusters (Special Section: Cluster Rankings).

A frequent question these days is how the U.K.'s planned and now implemented withdrawal from the European Union (EU) is affecting the U.K.'s GII ranking. As noted in previous GII editions, the causal relations between the EU withdrawal and the U.K.'s innovation performance are complex and uncertain in size and direction.[63]

Denmark ranks 6th in the GII 2020, increasing by one rank from last year. It maintains its 5th spot in the Innovation Input Sub-Index and increases by three spots in the Innovation Output Sub-Index (9th). Denmark ranks in the top 12 in all GII pillars, and improves its position in five pillars: Human capital and research (2nd, up by 2), Infrastructure (4th, up by 2), Market sophistication (8th, up by 1), Knowledge and technology outputs (12th, up by 2), and Creative outputs (10th, up by 1). In Market sophistication, the Investment sub-pillar increases the most (16th), notably thanks to increases in the Ease of protecting minority investors (27th) indicator. In Knowledge and Technology outputs, the sub-pillar Knowledge creation increases by two spots (10th), thanks notably to increases in the productivity growth per worker (65th, up by 16). All sub-pillars in the Creative outputs pillar also increase. In addition, Denmark ranks 1st worldwide in a number of key indicators, including ICT use, Government's online service, E-participation, Environmental performance, and Scientific and technical articles. It continues to rank 2nd in Researchers.

The Republic of Korea ranks 10th, tapping into the top group of the GII for the first time, up from 11th in 2019. This makes Korea the second Asian economy to enter the top 10, after Singapore. It ranks 10th in both the Innovation Input and the Innovation Output (up from 13th) Sub-indices. On the input side, Korea improves the most in Business sophistication (7th, up by 3), and in Infrastructure (14th up by 1). In these pillars, the indicators that see the largest gains include Environmental performance (28th), Females employed with advanced degrees (31st), and State of cluster development (24th). Korea increases its rank in both of the innovation output pillars, and notably on the sub-pillars of Knowledge creation (7th), Knowledge diffusion (15th), and Creative goods and services (19th). The indicators with the most important gains in these sub-pillars include the quality of scientific publications (17th), National feature films (13th), Entertainment and media market (18th), and Creative goods exports (14th). The indicators of High- and medium-high-tech manufacturing (6th) and Trademarks (15th) also improve.

Korea remains 1st worldwide in a number of important indicators, including E-participation, Patents by origin—a top position that it shares with other five economies,[64] and Industrial designs. It reaches the 1st position in patent families (up from 4th), and ranks in the top three worldwide in indicators such as Gross expenditure on R&D, GERD performed by business, PCT patents, Tertiary enrolment, Researchers, and GERD financed by business. Korea hosts three clusters in the top 100, with Seoul ranking 3rd worldwide, followed by Daejeon (22nd), and Busan (75th) (Special Section: Cluster Rankings).

Movement in the top 20

In the top 20, there are three economies climbing up the rankings: Hong Kong (China), France, and Austria.

Hong Kong (China) edges closer to the top 10—ranking 11th this year (up from 13th), its best rank since 2016. Hong Kong's (China) most notable advances are in the Innovation Input Sub-Index (7th, up by 1), and in the pillars Institutions (5th, up by 2), Human capital and research (23rd, up by 5), and Market sophistication, where it achieves the 1st rank worldwide. In the latter, it also ranks 1st in the Investment sub-pillar (up by 10), and makes notable improvements in indicators Ease of protecting minority investors (7th) and Venture capital deals (4th). In Human capital and research, the sub-pillars Tertiary education (9th) and R&D (30th) increase the most, thanks to improvements in indicators Tertiary enrolment (22nd), Tertiary inbound mobility (15th), Researchers (25th), and Gross expenditure in R&D (42nd).

Austria makes it back to the top 20 after leaving the group in 2018. It increases two ranks in the Innovation Output Sub-Index (23rd) and one rank in the Innovation Input Sub-Index (18th). It goes up the ranks in five of the GII pillars: Knowledge and technology outputs (19th, up by 6), Creative Outputs (22nd, up by 3), Institutions (15th, up by 2), Human capital and research (7th, up by 1, and a relative strength), and Business sophistication (17th, up by 1). Indicators Mobile app creation

(28th), Rule of law (6th, and a relative strength), Government funding per pupil (16th), the quality of its universities (26th), Knowledge intensive employment (24th), GERD financed by business (18th), and ICT services imports (17th) improve notably.

China keeps its 14th place in 2020, after breaking into the GII top 15 last year and establishing itself as an innovation leader. It increases its ranks in two pillars: Human capital and research (21st, up by 4), and Market sophistication (19th, up by 2). It maintains its world leadership in several key output indicators, including Patents by origin, Utility models, Trademarks, Industrial designs, and Creative goods exports. China sustains its 12th rank in the Creative outputs pillar. It also maintains the 1st global place in sub-pillar Intangible assets. With 408 brands in the top 5,000, led by banks ICBC and China Construction Bank, and technology giant Huawei, it ranks 17th in the new GII indicator Global brand value. China also improves in sub-pillar Creative goods and services (12th, up by 2), moving up notably in indicators Cultural and creative services exports (46th), Entertainment & Media market (37th) and Printing and other media (72nd). It also maintains its top position worldwide in Creative goods exports (1st). China also keeps its 1st place in quality of innovation among middle-income economies for the eighth consecutive year (Figure 1.7).

Canada (17th) and **Luxembourg** (18th) each retain their position this year.

Finally, **Israel** (13th), **Ireland** (15th), **Japan** (16th), and **Norway** (20th) move down between one and three ranks each.

BOX 2

Is there a recipe to move up the GII rankings?

Over the years, the GII has been used by governments around the world to improve their innovation performance and to shape their evidence-based innovation policies.[65] While there is no recipe to move up the GII rankings, this box shares insights and sheds light on the process of using the GII to improve country innovation performance.

A core benefit of the GII is that it positions data-based evidence and metrics at the core of evaluating, crafting, and deploying innovation policies. As a first step, countries begin by bringing together statisticians and decision-makers to understand the country's innovation performance based on the GII metrics. In a second step, the policy discussion turns to leveraging domestic innovation opportunities while overcoming country-specific weaknesses. Both steps are an exercise in careful coordination among different public and private innovation actors, as well as between government entities at local, regional, and national levels. Ideally, the GII becomes a tool for such coordination.

Some do's:

- Ensure that innovation is embedded as a key priority in the country's path of national development and progress, possibly formulated in a clear innovation policy.
- Set up a cross-ministerial task force to pursue innovation policy and GII matters with a "whole of government approach", ideally reporting to top government leadership, such as the Prime Minister's office.
- Ensure that any innovation policy task force interacts and consults innovation actors from the private and public sector, including start-ups, deans of research universities, and the relevant innovation clusters.
- Ensure that any national intellectual property (IP) policy is aligned with or even integrated in the above innovation policy.
- Ensure that innovation policy targets or actions are quantifiable, and that they are regularly revisited and evaluated.

Some don'ts:

- Do not set overambitious and thus unrealistic GII rank targets—e.g., enter the top 20 by 2020 when the economy's rank is still far from that goal. GII rank increases are rarely large from year to year, in particular in the top echelons.
- Do not expect policy changes to result in improved GII indicator performance instantaneously. There are important lags between innovation policy formulation, execution, and impact. The latest available innovation data is also rarely current; it often lags by a few years.
- Do not treat the GII as a mathematical exercise—i.e. attempting to collect or focus on specific indicators to go up the rankings. At the end of the day, national development and progress are only partially captured by the GII rank alone.
- Do not overfocus on the GII year-on-year changes alone. These are influenced by the relative performance vis-à-vis other countries and other methodological considerations (Appendix IV)—of which many are outside the control of the economy in question. Setting objectives over a multiyear period—for example 3 to 5 years—and looking at the combined progress over a few years is a more fitting use of the GII.

Innovation leaders have balanced innovation systems; others should strive for them

Innovation leaders have complementarity and balance across the different areas of their innovation system. A successful innovation system balances the forces that push knowledge creation, exploration, and investments—the innovation inputs—with the forces that pull ideas and technologies towards application, exploitation, and impact—the innovation outputs.

Table 1.1 presents the overall GII rankings and the rankings in each of the GII pillars, colored according to where in the rankings each economy belongs. Pillars with strong performance are colored in dark blue, medium-high performance in green, medium-low performance in yellow, and low performance in orange.[66] In an ideal scenario, all pillars of a given country would be in dark blue. In reality, only a few economies achieve this. A majority of economies have pillars with high performance, while others have medium or low performance (i.e., a mix of colors). At the bottom of the rankings, most economies have low and medium-low performance across all pillars.

A balanced and strong performance across all seven pillars are most evident among the innovation leaders (top 25). Evidently, these leaders have strong and balanced innovation systems. Switzerland, the U.S., and Germany, for example, have strong performance across all GII pillars.

All in all, however, only 12 economies (9%) have all pillars in dark blue. Even among the top 25 or top 35, many economies have pillars that are outliers. For instance, in the top 10, Finland ranks lower in Market sophistication (33rd). In the top 20, Hong Kong (China) and Norway rank lower in Knowledge and technology outputs (54th and 33rd, respectively), Israel and China in Institutions and Infrastructure, Ireland and Austria in Market sophistication (35th and 48th, respectively) and Luxembourg in Human capital and research (41st). In the top 35, Iceland performs relatively lower in Market sophistication (54th) and Knowledge and technology outputs (34th), Belgium in Infrastructure (35th), Australia in Knowledge and technology outputs (40th), the Czech Republic and Cyprus in Human capital and research and Market sophistication, and New Zealand in both innovation output pillars—ranking 39th in Knowledge and technology outputs and 33rd in Creative outputs.

Similarly, the economies placed at the end of the rankings perform weakly across pillars—balanced, but at medium-low and low levels and without peaks. In fact, only Yemen, ranked the lowest this year at 131st, performs low in all GII pillars. Uganda, Malawi, and Tajikistan, for example, rank relatively higher in Market sophistication (63rd, 58th, and 60th, respectively), and the Plurinational State of Bolivia ranks relatively higher in Human capital and research (56th).

In contrast, economies ranked between the 33rd and the 98th place in the overall GII ranks show heterogeneous results, ranking high in some of the pillars—peak innovation performance—but low on others, hinting at more unbalanced innovation systems, but also at innovation systems that are on the move and positively in development.

Several economies outside the top ranks are among the top performers in specific pillars without bringing similar high performance in other pillars. For instance, the United Arab Emirates, ranked 34th overall, ranks within the top 30 in all innovation input pillars, but considerably lower in Knowledge and technology outputs (78th). India's high ranks in Knowledge and technology outputs (27th) and Market sophistication (31st) contrast with its relatively lower rank in Infrastructure (75th). Similarly, Thailand's high rank in Market sophistication (22nd) contrasts with its lower ranks in Human capital and research and Infrastructure (both ranked 67th). Market sophistication is also the best pillar for South Africa (15th), compared to its lower ranks in Human capital and research and Creative outputs (both at 70th), and Infrastructure (79th). Turkey also ranks high in Market sophistication (28th) compared to its lowest ranked pillar, Institutions (94th). Hungary—ranked 35th overall, ranks 22nd in Knowledge and technology outputs, in contrast to its lowest pillar, Market sophistication (89th).

Other interesting examples include Thailand (44th) ranking 22nd in Market sophistication. Qatar placed 70th overall and ranks 28th in Infrastructure; while Brunei Darussalam, ranked 71st in the GII, achieves the 25th place in the Institutions pillar. The Philippines ranks 50th overall, but has considerably higher ranks in the pillars Business sophistication (29th) and Knowledge and Technology outputs (26th) (see South East Asia, East Asia and Oceania); and the Islamic Republic of Iran, ranked 67th overall, is high ranked in pillars Human capital and research (46th) and Creative outputs (48th). Relative to its overall place, Kazakhstan ranks well in Institutions (49th), and so does Oman in Human capital and research (43rd). Despite ranking in the top 95, Rwanda, Uzbekistan, and Nepal rank well in Market sophistication.

TABLE 1.1

Heatmap: GII 2020 rankings overall and by pillar

Country/Economy	Overall GII rank	Institutions	Human capital & research	Infrastructure	Market sophistication	Business sophistication	Knowledge & technology outputs	Creative outputs
Switzerland	1	13	6	3	6	2	1	2
Sweden	2	11	3	2	12	1	2	7
United States of America	3	9	12	24	2	5	3	11
United Kingdom	4	16	10	6	5	19	9	5
Netherlands	5	7	14	18	23	4	8	6
Denmark	6	12	2	4	8	11	12	10
Finland	7	2	4	9	33	8	6	16
Singapore	8	1	8	13	4	6	14	18
Germany	9	18	5	12	24	12	10	9
Republic of Korea	10	29	1	14	11	7	11	14
Hong Kong, China	11	5	23	11	1	24	54	1
France	12	19	13	16	18	21	16	13
Israel	13	35	15	40	14	3	4	26
China	14	62	21	36	19	15	7	12
Ireland	15	17	22	10	35	14	5	21
Japan	16	8	24	8	9	10	13	24
Canada	17	6	19	29	3	20	21	17
Luxembourg	18	26	41	23	32	9	31	3
Austria	19	15	7	20	48	17	19	22
Norway	20	3	16	1	25	25	33	19
Iceland	21	14	28	31	54	18	34	8
Belgium	22	21	11	35	29	16	17	32
Australia	23	10	9	22	7	26	40	23
Czech Republic	24	32	33	21	47	23	15	20
Estonia	25	23	34	5	21	30	23	15
New Zealand	26	4	18	15	10	32	39	33
Malta	27	34	52	25	74	13	49	4
Italy	28	37	32	19	50	34	18	27
Cyprus	29	27	40	27	49	28	20	25
Spain	30	31	27	7	26	37	24	31
Portugal	31	24	25	26	65	45	32	29
Slovenia	32	20	26	32	77	27	35	41
Malaysia	33	40	29	48	20	31	38	35
United Arab Emirates	34	28	17	17	30	22	78	34
Hungary	35	43	36	34	89	33	22	46
Latvia	36	30	44	45	43	41	42	28
Bulgaria	37	48	64	30	97	40	29	37
Poland	38	39	35	42	69	38	36	47
Slovakia	39	41	62	33	82	46	30	39
Lithuania	40	33	45	38	46	47	48	40
Croatia	41	47	47	39	73	56	43	49
Viet Nam	42	83	79	73	34	39	37	38
Greece	43	52	20	41	75	62	47	59
Thailand	44	65	67	67	22	36	44	52
Ukraine	45	93	39	94	99	54	25	44
Romania	46	53	76	37	83	53	28	67
Russian Federation	47	71	30	60	55	42	50	60
India	48	61	60	75	31	55	27	64
Montenegro	49	44	54	53	61	78	66	36
Philippines	50	91	86	63	86	29	26	57
Turkey	51	94	42	54	28	57	57	50
Mauritius	52	22	69	64	16	117	79	43
Serbia	53	45	59	44	101	64	41	66
Chile	54	38	55	51	41	49	64	61
Mexico	55	74	58	59	59	59	55	54
Costa Rica	56	66	66	62	98	48	53	53
North Macedonia	57	50	72	49	17	66	58	76
Mongolia	58	76	80	87	13	81	84	30
Republic of Moldova	59	81	75	88	42	88	51	51
South Africa	60	55	70	79	15	50	62	70
Armenia	61	64	94	90	68	69	45	56
Brazil	62	82	49	61	91	35	56	77
Georgia	63	36	61	81	39	79	67	68
Belarus	64	84	37	58	107	67	46	97
Tunisia	65	75	38	74	112	110	52	63
Saudi Arabia	66	102	31	57	44	51	88	69

TABLE 1.1

Heatmap: GII 2020 rankings overall and by pillar, continued

Country/Economy	Overall GII rank	Institutions	Human capital & research	Infrastructure	Market sophistication	Business sophistication	Knowledge & technology outputs	Creative outputs
Iran (Islamic Republic of)	67	120	46	69	108	112	59	48
Colombia	68	57	82	50	45	52	72	80
Uruguay	69	46	71	52	114	85	63	62
Qatar	70	58	83	28	94	77	85	58
Brunei Darussalam	71	25	51	46	76	44	129	89
Jamaica	72	42	88	110	110	60	107	42
Panama	73	67	101	47	67	123	91	55
Bosnia and Herzegovina	74	80	50	84	51	102	61	96
Morocco	75	77	81	71	88	107	60	75
Peru	76	72	57	68	38	43	112	87
Kazakhstan	77	49	68	66	53	71	80	105
Kuwait	78	88	63	55	81	98	73	88
Bahrain	79	51	84	43	80	86	86	98
Argentina	80	97	48	70	120	61	75	71
Jordan	81	63	78	95	52	94	82	84
Azerbaijan	82	59	89	85	36	96	118	65
Albania	83	56	95	65	70	73	119	72
Oman	84	70	43	56	104	95	124	94
Indonesia	85	111	92	80	62	114	71	83
Kenya	86	78	110	114	57	68	70	91
Lebanon	87	103	85	98	90	80	76	85
United Republic of Tanzania	88	101	126	105	87	118	106	45
Botswana	89	60	53	103	96	99	89	111
Dominican Republic	90	98	100	77	105	83	99	82
Rwanda	91	54	112	93	37	63	103	114
El Salvador	92	100	105	101	71	76	110	74
Uzbekistan	93	95	77	72	27	127	90	127
Kyrgyzstan	94	92	73	97	66	105	81	117
Nepal	95	114	114	76	40	58	102	106
Egypt	96	115	90	99	106	103	65	101
Paraguay	97	109	98	89	93	84	115	78
Trinidad and Tobago	98	68	65	91	109	109	121	99
Ecuador	99	126	91	82	64	97	105	92
Cabo Verde	100	87	96	86	128	65	117	73
Sri Lanka	101	119	119	78	118	70	68	100
Senegal	102	73	106	106	95	130	74	103
Honduras	103	125	99	109	56	74	97	104
Namibia	104	69	115	112	103	111	127	79
Bolivia (Plurinational State of)	105	129	56	104	78	90	114	109
Guatemala	106	117	123	113	79	82	116	81
Pakistan	107	99	118	119	116	87	69	108
Ghana	108	121	104	96	111	113	104	90
Tajikistan	109	118	87	123	60	128	77	113
Cambodia	110	112	122	120	72	119	96	102
Malawi	111	106	124	128	58	92	92	107
Côte d'Ivoire	112	79	117	121	92	101	98	116
Lao People's Democratic Republic	113	130	113	118	117	72	108	86
Uganda	114	89	130	102	63	115	113	125
Madagascar	115	108	116	127	115	121	109	93
Bangladesh	116	124	129	92	100	122	95	115
Nigeria	117	110	121	124	102	75	120	110
Burkina Faso	118	86	102	111	113	116	111	129
Cameroon	119	113	103	117	123	100	94	123
Zimbabwe	120	128	93	131	84	108	101	112
Algeria	121	104	74	100	130	126	125	118
Zambia	122	122	111	107	85	91	123	126
Mali	123	107	120	125	119	106	93	120
Mozambique	124	127	108	83	125	124	122	122
Togo	125	90	109	116	121	129	126	121
Benin	126	85	97	122	122	125	130	128
Ethiopia	127	116	128	108	131	120	87	119
Niger	128	96	127	126	124	89	100	131
Myanmar	129	123	107	115	127	131	83	130
Guinea	130	105	131	130	126	93	131	95
Yemen	131	131	125	129	129	104	128	124

Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2020.
Note: Dark blue means the economy belongs to the 4th quartile (best performers) corresponding to ranks 1st to 32nd in the GII rank and its pillars; green = 3rd quartile (ranks 33rd to 65th); yellow = 2nd quartile (ranks 66th to 98th); and orange = 1st quartile (ranks 99th to 131st).

The top performers by income group

Table 1.2 shows the 10 best-ranked economies by income group in the GII 2020.

The top 10 economies in the GII are all high-income economies.

In the upper-middle income group, **China** (14th), **Malaysia** (33rd), and **Bulgaria** (37th) had held the top three positions since 2016 (GII 2020 Results: Highlights in this chapter and Box 3). **Thailand** (44th) remains the 4th economy in this group, while **Romania** (46th) ranks 5th (up from 8th last year). **The Russian Federation** (47th) keeps its 6th position among upper-middle income economies since 2017.

Among the lower middle-income group, **Viet Nam** (42nd) is at the top, followed by **Ukraine** (45th, up by 2) and **India** (48th, up by 4) (see Central and Southern Asia). The **Philippines** (50th, up by 4) moves up into the 4th position (see South East Asia, East Asia, and Oceania). **Indonesia** (85th) joins the top 10, ranked 9th.

The United Republic of Tanzania tops the low-income group (88th), gaining nine positions since last year and two positions within its income group. **Rwanda** (91st) goes down to 2nd place, which it held in 2017 and 2018. **Nepal** (95th) ranks 3rd (up from 6th last year). Two economies enter the low-income group top 10: **Madagascar** (115th) and **Mozambique** (124th), while Senegal[67] (102nd) and Ethiopia (127th) leave.

TABLE 1.2

10 best-ranked economies by income group (rank)

Rank	Global Innovation Index 2020
High-income economies (49 in total)	
1	Switzerland (1)
2	Sweden (2)
3	United States of America (3)
4	United Kingdom (4)
5	Netherlands (5)
6	Denmark (6)
7	Finland (7)
8	Singapore (8)
9	Germany (9)
10	Republic of Korea (10)

Rank	Global Innovation Index 2020
Upper middle-income economies (37 in total)	
1	China (14)
2	Malaysia (33)
3	Bulgaria (37)
4	Thailand (44)
5	Romania (46)
6	Russian Federation (47)
7	Montenegro (49)
8	Turkey (51)
9	Mauritius (52)
10	Serbia (53)

Rank	Global Innovation Index 2020
Lower middle-income economies (29 in total)	
1	Viet Nam (42)
2	Ukraine (45)
3	India (48)
4	Philippines (50)
5	Mongolia (58)
6	Republic of Moldova (59)
7	Tunisia (65)
8	Morocco (75)
9	Indonesia (85)
10	Kenya (86)

Rank	Global Innovation Index 2020
Low-income economies (16 in total)	
1	United Republic of Tanzania (88)
2	Rwanda (91)
3	Nepal (95)
4	Tajikistan (109)
5	Malawi (111)
6	Uganda (114)
7	Madagascar (115)
8	Burkina Faso (118)
9	Mali (123)
10	Mozambique (124)

Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2020.

BOX 3

The global and regional innovation divides—further deepening ahead?

China, Malaysia, and Bulgaria are still the only middle-income economies in the GII top 40; otherwise, the gap across income groups and regions largely perseveres

The top-performing economies in the GII are almost exclusively from the high-income group. The income group divides are large across all pillars and most innovation indicators—and growing as one moves from high income, to middle income, and finally to the low-income group.

Given the known relationship between innovation and development (Figure 1.6), this is generally not surprising. The innovation systems of low- and middle-income economies struggle with lower levels of education, science and technology investments, often weaker science and industry linkages, limited inward knowledge flows, lower absorptive and innovative capacity of domestic firms, challenging business environments with scarce access to financial resources, undersized venture capital markets (Theme Section), and limited use of intellectual property.[68]

China is the only exception, ranking 14th for the second time in a row and the only middle-income economy in the top 30. China edged into the top 25 in 2016, moved to 17th in 2018, and to 14th in 2019. Aside from China, Malaysia (33rd, up from 35th) and Bulgaria (37th, up from 40th) remain the only other middle-income economies that are close to the top 25. In addition to these three economies, there are only seven other middle-income economies in the top 50 of the GII 2020.

The divides are regional too; Northern America and Europe lead, while Asia is catching up

A regional innovation divide also persists. Northern America is the most innovative region–driven by the United States of America (3rd). Europe remains 2nd and South East Asia, East Asia, and Oceania comes in 3rd. Northern Africa and Western Asia remains 4th, Latin America and the Caribbean 5th, and Central and Southern Asia and Sub-Saharan Africa 6th and 7th, respectively ("Which countries lead their respective regions?" in this chapter).

Will the current economic crisis reverse the frail progress in innovation convergence?

The question regarding how the current pandemic will affect these innovation divides looms large. With a possible disintegration of global value chains, generally reduced trade, an economic slowdown, and increased debt, there is a real possibility that the little progress in terms of innovation convergence over the recent years might grind to a halt or even reverse ("What are the likely impacts of the pandemic recession on financing innovation and R&D?" in this chapter).

Which economies are outperforming on innovation relative to their peers?

The more developed an economy is, the more it innovates, and vice versa. The curve in the GII chart below illustrates this rather predictable relationship between innovation and development (Figure 1.6).

Yet, some economies break from this pattern. They perform above or below expectations, relative to their predicted performance—sometimes strongly so.

In this figure and analysis, the economies that rank in the GII top 25 are innovation leaders (in blue). The group of economies in this category is unchanged relative to last year with one exception: the Czech Republic joins this group. In return, New Zealand moves out.[69] With the exception of China, all innovation leaders are high-income economies.

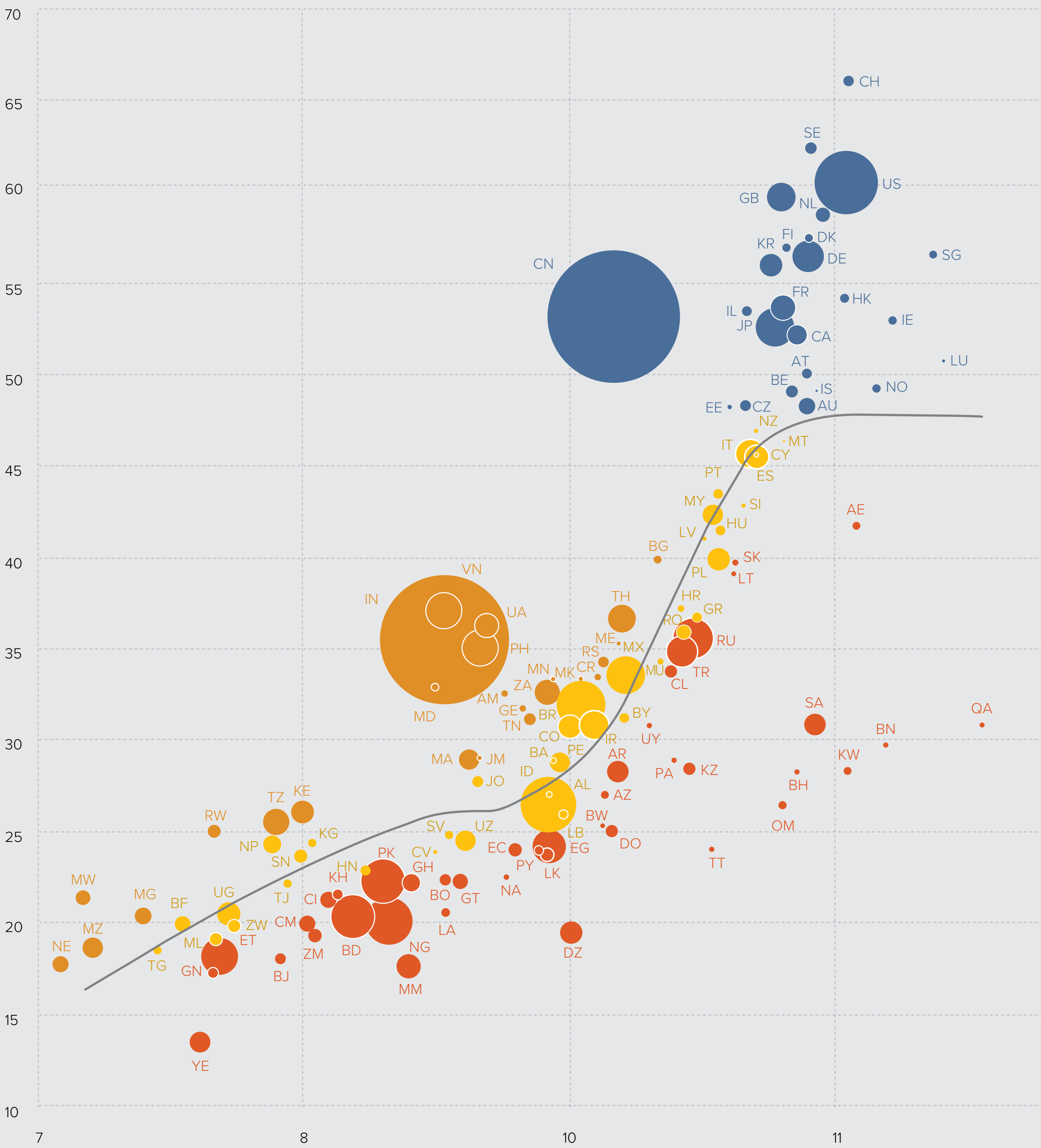
Innovation achievers are those economies that outperform their peers (in orange). There are 25 economies in this group this year, the largest number ever (Table 1.3). Jamaica and the Niger become innovation achievers for the first time.

Sub-Saharan Africa is the region with the largest number of economies performing above expectations for their level of development, thanks to three new (re)entries: the United Republic of Tanzania, Madagascar, and the Niger (8 economies in total). Europe is 2nd (with 6 economies), while Northern Africa and Western Asia (4) and South East Asia, East Asia, and Oceania (4) tie for 3rd. Latin America and the Caribbean (2) and Central and Southern Asia (1) are behind.[70]

India, Kenya, the Republic of Moldova, and Viet Nam hold the record of being innovation achievers for 10 consecutive years (Table 1.3). India ranks 3rd among the economies in the lower middle-income group and has an overall innovation performance that is above the average of the upper middle-

FIGURE 1.6

The positive relationship between innovation and development



▲ GII score
▶ GDP per capita in PPP$ logarithmic scale
● Bubbles sized by population

● Innovation leaders
● Performing above expectations for level of development

● Performing at expectations for level of development
● Performing below expectations for level of development

Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2020.
Notes: As in past editions, Figure 1.6 presents the GII scores plotted against GDP per capita in natural logs and in PPP US$. The main element of the figure is the trend line, which shows the expected levels of innovation performance for a given economy relative to its level of GDP per capita. The figure presents all economies covered in the GII 2020 against this trend line. The trend line is the cubic spline with five knots determined by Harrell's default percentiles ($R2 = 0.6827$). Economies that are close to the trend line are those whose innovation performance is in line with expectations given its level of development (yellow). The further above an economy is in relation to this trend line, the better its innovation performance is relative to its level of development and thus other peer economies at similar levels. In contrast, those economies located below the trend line are those whose innovation performance is below expectations (red).

ISO-2 codes

Country/Economy	Code
Albania	AL
Algeria	DZ
Argentina	AR
Armenia	AM
Australia	AU
Austria	AT
Azerbaijan	AZ
Bahrain	BH
Bangladesh	BD
Belarus	BY
Belgium	BE
Benin	BJ
Bolivia (Plurinational State of)	BO
Bosnia and Herzegovina	BA
Botswana	BW
Brazil	BR
Brunei Darussalam	BN
Bulgaria	BG
Burkina Faso	BF
Cabo Verde	CV
Cambodia	KH
Cameroon	CM
Canada	CA
Chile	CL
China	CN
Colombia	CO
Costa Rica	CR
Côte d'Ivoire	CI
Croatia	HR
Cyprus	CY
Czech Republic (the)	CZ
Denmark	DK
Dominican Republic (the)	DO
Ecuador	EC
Egypt	EG
El Salvador	SV
Estonia	EE
Ethiopia	ET
Finland	FI
France	FR
Georgia	GE
Germany	DE
Ghana	GH
Greece	GR

Country/Economy	Code
Guatemala	GT
Guinea	GN
Honduras	HN
Hong Kong, China	HK
Hungary	HU
Iceland	IS
India	IN
Indonesia	ID
Iran (Islamic Republic of)	IR
Ireland	IE
Israel	IL
Italy	IT
Jamaica	JM
Japan	JP
Jordan	JO
Kazakhstan	KZ
Kenya	KE
Kuwait	KW
Kyrgyzstan	KG
Lao People's Democratic Republic (the)	LA
Latvia	LV
Lebanon	LB
Lithuania	LT
Luxembourg	LU
Madagascar	MG
Malawi	MW
Malaysia	MY
Mali	ML
Malta	MT
Mauritius	MU
Mexico	MX
Mongolia	MN
Montenegro	ME
Morocco	MA
Mozambique	MZ
Myanmar	MM
Namibia	NA
Nepal	NP
Netherlands (the)	NL
New Zealand	NZ
Niger (the)	NE
Nigeria	NG
North Macedonia	MK
Norway	NO

Country/Economy	Code
Oman	OM
Pakistan	PK
Panama	PA
Paraguay	PY
Peru	PE
Philippines	PH
Poland	PL
Portugal	PT
Qatar	QA
Republic of Korea (the)	KR
Republic of Moldova (the)	MD
Romania	RO
Russian Federation (the)	RU
Rwanda	RW
Saudi Arabia	SA
Senegal	SN
Serbia	RS
Singapore	SG
Slovakia	SK
Slovenia	SI
South Africa	ZA
Spain	ES
Sri Lanka	LK
Sweden	SE
Switzerland	CH
Tajikistan	TJ
Thailand	TH
Togo	TG
Trinidad and Tobago	TT
Tunisia	TN
Turkey	TR
Uganda	UG
Ukraine	UA
United Arab Emirates (the)	AE
United Kingdom (the)	GB
United Republic of Tanzania (the)	TZ
United States of America (the)	US
Uruguay	UY
Uzbekistan	UZ
Viet Nam	VN
Yemen	YE
Zambia	ZM
Zimbabwe	ZW

income group in all innovation dimensions, with the exception of the pillars Infrastructure and Creative outputs. Kenya ranks 3rd in Sub-Saharan Africa and scores above its income and regional peers in Institutions, Market and Business sophistication, and Knowledge and technology outputs. Viet Nam continues to score above the lower middle-income group average in all pillars and has scores in Business and Market sophistication, as well as in both output pillars that are even above the average of the upper middle-income group.

Lastly, in red in Figure 1.6 are the economies whose innovation performance is below expectations for their level of development. This year, there are 42 economies in this group, also the largest-ever recorded number. Notably, six high-income economies are from Northern Africa and Western Asia (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates). All these economies have a large oil-related GDP, which sets the bar higher for them. Among the upper middle-income group, there are five economies that perform below expectations from Latin America and the Caribbean (Argentina, the Dominican Republic, Ecuador, Guatemala, and Paraguay).[71] In the lower middle-income group, twelve economies perform below expectations for their level of development, notably five from Sub-Saharan Africa (Cameroon, Côte d'Ivoire, Ghana, Nigeria, and Zambia) and three from South East Asia, East Asia, and Oceania (Cambodia, the Lao People's Democratic Republic, and Myanmar).

Relative to 2019, 24 economies change performance groups. The Czech Republic performed at expectations for its level of development in 2019, and it is an innovation leader this year. Eight economies—Bulgaria, Serbia, Tunisia, Jamaica, Morocco, the United Republic of Tanzania, Madagascar, and the Niger performed at expectations last year and are now innovation achievers (Figure 1.6, in orange). New Zealand moved out of the top 25 this year (ranked 26th) and is now part of the group of economies performing at expectations for their level of development. Mauritius, El Salvador, and Togo were performing

TABLE 1.3

Innovation achievers in 2020: income group, region, and years as an innovation achiever

Economy	Income group	Region	Years as an innovation achiever (total)
Viet Nam	Lower-middle income	South East Asia, East Asia, and Oceania	2020, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, 2011 (10)
India	Lower-middle income	Central and Southern Asia	2020, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, 2011 (10)
Republic of Moldova	Lower-middle income	Europe	2020, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, 2011 (10)
Kenya	Lower-middle income	Sub-Saharan Africa	2020, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, 2011 (10)
Armenia	Lower-middle income	Northern Africa and Western Asia	2020, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012 (9)
Ukraine	Lower-middle income	Europe	2020, 2019, 2018, 2017, 2016, 2015, 2014, 2012 (8)
Malawi	Low income	Sub-Saharan Africa	2020, 2019, 2018, 2017, 2016, 2015, 2014, 2012 (8)
Rwanda	Low income	Sub-Saharan Africa	2020, 2019, 2018, 2017, 2016, 2015, 2014, 2012 (8)
Mozambique	Low income	Sub-Saharan Africa	2020, 2019, 2018, 2017, 2016, 2015, 2014, 2012 (8)
Mongolia	Lower-middle income	South East Asia, East Asia, and Oceania	2020, 2019, 2018, 2015, 2014, 2013, 2012, 2011 (8)
Thailand	Upper-middle income	South East Asia, East Asia, and Oceania	2020, 2019, 2018, 2015, 2014, 2011 (6)
Montenegro	Upper-middle income	Europe	2020, 2019, 2018, 2015, 2013, 2012 (6)
Georgia	Upper-middle income	Northern Africa and Western Asia	2020, 2019, 2018, 2014, 2013, 2012 (6)
Costa Rica	Upper-middle income	Latin America and the Caribbean	2020, 2019, 2018, 2013 (4)
Madagascar	Low income	Sub-Saharan Africa	2020, 2018, 2017, 2016 (4)
Bulgaria	Upper-middle income	Europe	2020, 2018, 2017, 2015 (4)
South Africa	Upper-middle income	Sub-Saharan Africa	2020, 2019, 2018 (3)
Serbia	Upper-middle income	Europe	2020, 2018, 2012 (3)
Philippines	Lower-middle income	South East Asia, East Asia, and Oceania	2020, 2019 (2)
North Macedonia	Upper-middle income	Europe	2020, 2019 (2)
Tunisia	Lower-middle income	Northern Africa and Western Asia	2020, 2018 (2)
United Republic of Tanzania	Low income	Sub-Saharan Africa	2020, 2017 (2)
Morocco	Lower-middle income	Northern Africa and Western Asia	2020, 2015 (2)
Niger	Low income	Sub-Saharan Africa	2020 (1)
Jamaica	Upper-middle income	Latin America and the Caribbean	2020 (1)

Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2020.
Notes: Income group classification follows the World Bank Income Group Classification of June 2019. Geographic regions correspond to the United Nations publication on standard country or area codes for statistical use (M49).

below expectations last year, and now perform at expectations. Finally, eleven economies are now performing below expectations for their level of development (Figure 1.6, in red), while before they were performing at expectations: Sri Lanka, Uruguay, Cameroon, Egypt, Argentina, Azerbaijan, Ethiopia, Slovakia, Chile, Cote d'Ivoire, and Cambodia. In 2019, these eleven economies were already at the border of performing below expectations. With most of them decreasing their GII scores and ranks this year (with the exception of Azerbaijan, whose GII score decreases while its rank goes up), they swap out of the performing-at-expectations group.

Who is best in the quality of innovation?

Assessing the quality of innovation is a priority to the innovation policy community. As every year, three indicators are used to measure the quality of innovation. First, the quality of local universities is measured through the average score of the top 3 universities in each country in the QS university ranking (indicator 2.3.4). Second, patent families filed in at least two offices (indicator 5.2.5) are used as a proxy of the internationalization of local inventions. Third, the H-index (indicator 6.1.5), which is the number of citations that locally produced research documents receive abroad, is used to assess the quality of scientific publications.

As a complement to this section, Box 4 discusses different approaches to measure the quality of universities around the world.

Figure 1.7 shows the scores of these three indicators added together to capture the top 10 performing high- and middle-income economies in the quality of innovation.

Among the high-income group, the U.S. ranks 1st, followed by Switzerland, which moves up to 2nd position, and Japan, which ranks 3rd, as it did last year. Germany ranks 4th (down by 2), while the Netherlands moves up to 5th—its highest ranking in the quality of innovation to date. The U.K. ranks 6th, moving down one position, while Sweden is stable at 7th place.

China (16th), India (27th), and the Russian Federation (28th) take the top 3 positions among their middle-income peers (Figure 1.7). Brazil (29th), Malaysia (30th), and Mexico (32nd) are next in line, followed by Argentina (35th), South Africa (38th), Turkey (41st), and Thailand (44th). Argentina replaces Colombia in the group of top middle-income economies as the third economy from Latin America and the Caribbean to reach the top ranks.

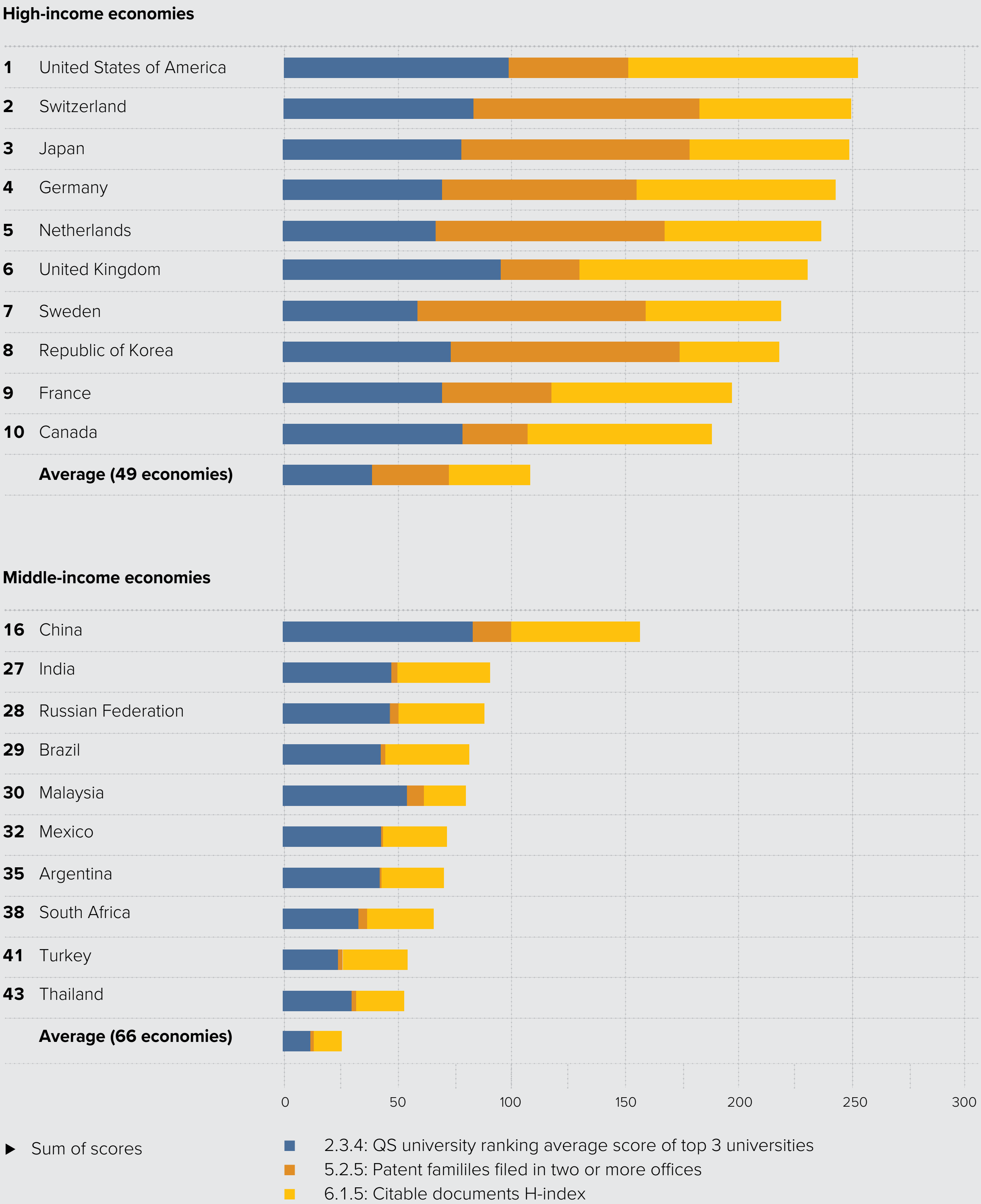
China remains the top middle-income economy in the quality of innovation for the eighth consecutive year. It ranks 3rd in the quality of its universities, with Tsinghua University, Peking University, and Fudan University ranking within the top 50 universities worldwide. **India** ranks 2nd for the fifth consecutive year, with top positions in the quality of scientific publications (21st globally) and the quality of its universities (22nd), thanks to its top three universities: the Indian Institute of Technology (Bombay and Delhi) and the Indian Institute of Science Bengaluru. The **Russian Federation** remains 3rd, a position it has held for four consecutive years. It ranks 22nd in the quality of its scientific publications and 21st in the quality of its universities, with three leading institutions: Lomonosov Moscow State University, Novosibirsk State University, and Saint-Petersburg State University.

The three indicators comprising innovation quality have different relative importance across economies and income groups. Among high-income economies, the three indicators have almost equal importance in the aggregate innovation quality score. Comparatively, high-income economies are more reliant on the internationalization of inventions and, on average, score higher in patent families than middle-income economies (Figure 1.7). Among high-income economies, patent families are critical to economies like Switzerland, Japan, the Netherlands, Sweden, the Republic of Korea, Austria, Finland, and Israel, accounting for more than 40% of their innovation quality score. The quality of universities is proportionately important for the U.K., Canada, Australia, Hong Kong (China), Singapore, Spain, New Zealand, and Ireland, representing nearly half of the innovation quality scores in these economies.

In contrast, the quality of universities and the quality of scientific publications weigh equally on innovation quality among middle-income economies—each comprising 48% of the average score. Patent families, on the other hand, define only 4% of the average innovation quality score among middle-income economies. China is an exception, investing heavily in the internationalization of its inventions; patent families account for 10% of China's innovation quality score. Malaysia is next in line with 8% of its score attributed to the internationalization of inventions, and South Africa is third with 5%. In comparison, patent families explain only 3% of innovation quality in India and the Russian Federation and 1% in Mexico and Argentina.

FIGURE 1.7

Quality of innovation: top 10 high- and middle-income economies, 2020



Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2020.
Notes: Numbers to the left of the economy name are the innovation quality rank. Economies are classified by income according to the World Bank Income Group Classification (June 2019). Upper- and lower middle-income categories are grouped together as middle-income economies.

BOX 4

The U.S. and U.K. remain uncontested leaders in university rankings; as a region Europe leads

Universities play a key role in modern innovation systems: as educators of the future work force, as a place of where research is conducted, and as an important vector for university-industry technology transfer.

To reflect their role in innovation, the GII uses data from the QS World University Ranking (QS) to assess the quality of universities in the economies covered (indicator 2.3.4). The U.S. (1st), U.K. (2nd), and China (3rd) are the leading three economies in the indicator of university quality.

A similar university ranking is the Academic Ranking of World Universities (ARWU)—the so-called Shanghai ranking.[72] It gives more weight to the quality of academic papers. Moreover, the Shanghai ranking attributes great importance to Nobel Prizes and Field Medals won by the respective university's alumni or staff.[73]

Nearly 80% of top universities identified by QS and 89% of top universities identified by Shanghai ranking are based in three world regions: Europe; South East Asia, East Asia and Oceania; and Northern America (by order of importance and thus top universities in the region). Around 9% of institutions ranked by QS index and 4% by ARWU are in Latin America and the Caribbean, and 5% (QS) to 3% (ARWU) are in Northern Africa and Western Asia or Central and Southern Asia. Slightly less than 1% of universities in the top-ranked institutions are located in Sub-Saharan Africa. Both QS and ARWU identify the same top 3 institutions in Sub-Saharan Africa: University of Cape Town (198th in QS, 301–400th in ARWU), University of Witwatersrand (400th in QS, 201–300th in ARWU), and Stellenbosch University (427th in QS, 401–500th in ARWU).

The U.S. and the U.K. harbor close to all universities occupying the top 10 ranks in the world. MIT (1st in QS, 3rd in ARWU), Harvard University (1st in ARWU, 3rd in QS), Stanford University (2nd in both QS and ARWU), University of Oxford (4th in QS, 7th in ARWU), and the University of Cambridge (3rd in ARWU, 7th in QS) are the top institutions in the world.

China is ranked 3rd in QS, while it ranks 8th in ARWU due to the weight that the Shanghai ranking gives to the quality of publications and Nobel prizes. China's top 5 institutions are Tsinghua University (1st in QS and ARWU), Peking University (2nd in QS and ARWU), Fudan University (3rd in QS), Zhejiang University (4th in QS, 3rd in ARWU), Shanghai Jiao Tong University (5th in QS, 4th in ARWU), and University of Science and Technology of China (5th in ARWU, 6th in QS).

Box 4, Table 1 shows the best-ranked universities in middle- or low-income economies outside China.

Ultimately, the above rankings are focused on the quality of science and research outputs and, to some extent, on their reputation with graduates and employers. Despite their richness, more statistical work is needed to properly assess the role of universities in innovation, in particular their role of fostering knowledge and technology transfer to the private sector—a key vector to foster growth and employment. Aside from countries, such as the U.S. or Israel, with solid data on knowledge transfer, currently available innovation indicators do not permit easily establishing which other countries and institutions do well on this innovation front. This is an important research agenda for the future.[74]

BOX 4, TABLE 1

Top 10 universities in middle- or low-income economies, excluding China

Rank	QS World University Rankings	ARWU—Academic Ranking of World Universities (Shanghai ranking)
1	University of Malaya, 70 (Malaysia)	Lomonosov Moscow State University, 87 (Russian Federation)
2	University of Buenos Aires, 74 (Argentina)	University of Sao Paulo, 101-150 (Brazil)
3	Lomonosov Moscow State University, 84 (Russian Federation)	University of Cape Town, 201-300 (South Africa)
4	National Autonomous University of Mexico, 103 (Mexico)	University of the Witwatersrand, 201-300 (South Africa)
5	University of Sao Paulo, 116 (Brazil)	National Autonomous University of Mexico, 201-300 (Mexico)
6	Indian Institute of Technology Bombay, 152 (India)	University of Buenos Aires, 201-300 (Argentina)
7	Monterrey Institute of Technology, 158 (Mexico)	University of Campinas, 301-400 (Brazil)
8	University Putra Malaysia, 159 (Malaysia)	University of Tehran, 301-400 (Iran)
9	The National University of Malaysia , 160 (Malaysia)	Saint Petersburg State University, 301-400 (Russia)
10	University of Science, Malaysia, 165 (Malaysia)	Sao Paulo State University, 301-400 (Brazil)

Source: QS World University Rankings 2019 (QS Quacquarelli Symonds Limited) and The 2019 Academic Ranking of World Universities (ARWU) (ShanghaiRanking Consultancy)
Note: The values after the university names refer to the rank of the institution in said ranking in 2019.

Which economies have the most valuable brands?

Brands are an important aspect of everyday life. They are also an important element of how a country scores on intangible assets.

On average, firms that invest more in innovation invest more in branding; it is an important way for firms to secure returns on their R&D investments.[75] To move up global value chains and to increase the possibility of capturing greater profit margins, companies in low- and middle-income economies increasingly seek to develop their own brands or to acquire them from abroad.[76]

As a result, global branding investments approached half a trillion dollars[77] and account for a growing share of GDP—equivalent to about one-third of global research and development (R&D).[78]

The GII already takes into account the importance of intangible assets to innovation in pillar 7.1, which captures trademarks (indicator 7.1.1)—another proxy for brands, designs (7.1.3), and organizational innovation (7.1.4).

In addition, the GII 2020 innovated this year to include a novel indicator showing which economies have the most valuable brands (7.1.2 Global brand value, top 5,000, % GDP). The Global brand value annual ranking of the top 5,000 most valuable brands in the world includes a distribution of brands and their values by economy and sector.[79] This novel GII indicator sums the values of all the top brands of each economy and then scales this brand value by GDP.

If one takes the value of all brands by economy without scaling, the U.S. is the clear leader. Out of the top 5,000 brands, it has US$4.3 trillion, followed by China with US$1.6 trillion, and Japan with US$0.7 trillion. The U.S. also leads by number of brands (1,359 out of 5,000), followed by China (408), and Japan (344). In both cases, the distance between the U.S., and now China, and the rest of the world is massive.

Figure 1.8 shows the top most valuable 25 brands and their origin. The U.S. scores highest with Amazon (1), Google (2), and Apple (3). China follows with Industrial and Commercial Bank of China (6), Ping An (9), and Huawei (10). The Republic of Korea has Samsung (5).[80]

North America is the uncontested region with the highest total brand value of top global brands. South East Asia, East Asia, and Oceania—which includes China—is second. Then follows Europe. Northern Africa and Western Asia come next—with Saudi Arabia oil and gas (Saudi Aramco) and telecommunications (Saudi Telecom Company); and both the United Arab Emirates and Turkey with airlines Emirates and Turkish Airlines, respectively. Central and Southern Asia follows—with India and its TATA Group (Engineering and Construction) leading. These are followed by Latin America and the Caribbean, with Mexico leading in beer (Corona and Victoria) and telecoms (Claro); and Brazil, with top brands in banking (Itaú, Bradesco, Caixa, and Banco do Brasil). Sub-Saharan Africa is last, led by South Africa, with brands in telecommunication (MTN and Vodacom); and Nigeria, with Dangote Industries in construction materials.

Indeed, with exceptions, the richer an economy is, the more top global brands it produces, and vice versa. In the GII, given a strong GDP to brand value correlation, we scale brand values by GDP. After scaling, Hong Kong (China) comes out on top, followed by Switzerland, Sweden, the U.S., France, the U.K., Malaysia, the Republic of Korea, the Netherlands, and Japan.

There is also another way to look at this brand data (Figure 1.9). When plotting the level of development of a country against its share of brand value in the top global brands, one can see economies which over- and underperform relative to their level of development. Most economies in the upper right quadrant are high income and, as expected, top-brand producers, while those in the lower right are also mostly high income but—somewhat less expected—weaker on producing top brands. Those in the upper left quadrant—the true outperformers in this graphical analysis—are a mix of large- and mid-sized middle-income economies. Nonetheless, they manage to have top brands. The outperformers are China, India, Mexico, Brazil, Indonesia, Thailand, South Africa, Vietnam, the Philippines, Colombia, and Argentina (by order of value of all brands in the top 5,000). The lower left quadrant are middle- and low-income economies which have brands that make it into the top 5,000 ranking, but their value is relatively weaker. That does not mean that these countries are underperformers. Economies with no top-valued brands do not make it into the figure. They are the economies which need to prioritize brand building most.

Thanks to this new dataset, brands—as intangible assets important to innovation—can be included in the GII. In the years to come, however, it will also be important to make more internationally comparable data available on other intangible assets as proposed in the currently existing measurement frameworks, such as firm-specific human capital and the strength of organizational structures.[81]

Which economies get the most bang for their buck on their innovation investments?

In 2018, the GII started plotting the input-output performance of economies against each other (Figure 1.10) following advice from the European Commission's Competence Centre on Composite Indicators and Scoreboards (COIN). Using this approach, some economies stand out in terms of their ability to translate more effectively innovation inputs into innovation outputs.

This analysis also groups high-income economies that show much higher outputs than other high-income economies with similar inputs and those with similar returns but using much less

FIGURE 1.8

Top 25 global brands, by value and origin, 2020

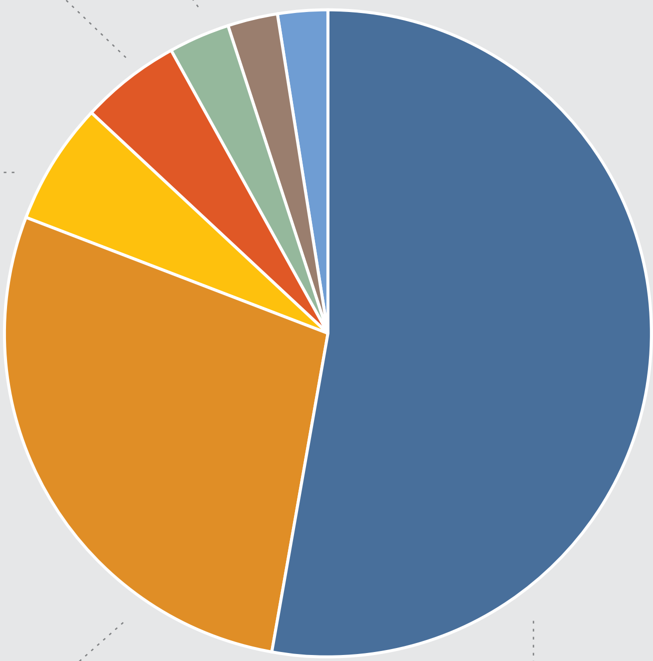
Japan
$58,076
15. Toyota

Netherlands
$47,529
23. Shell

Saudi Arabia
$46,768
24. Saudi Aramco

Republic of Korea
$94,494
5. Samsung Group

Germany
$109,938
11. Mercedes-Benz
25. Volkswagen



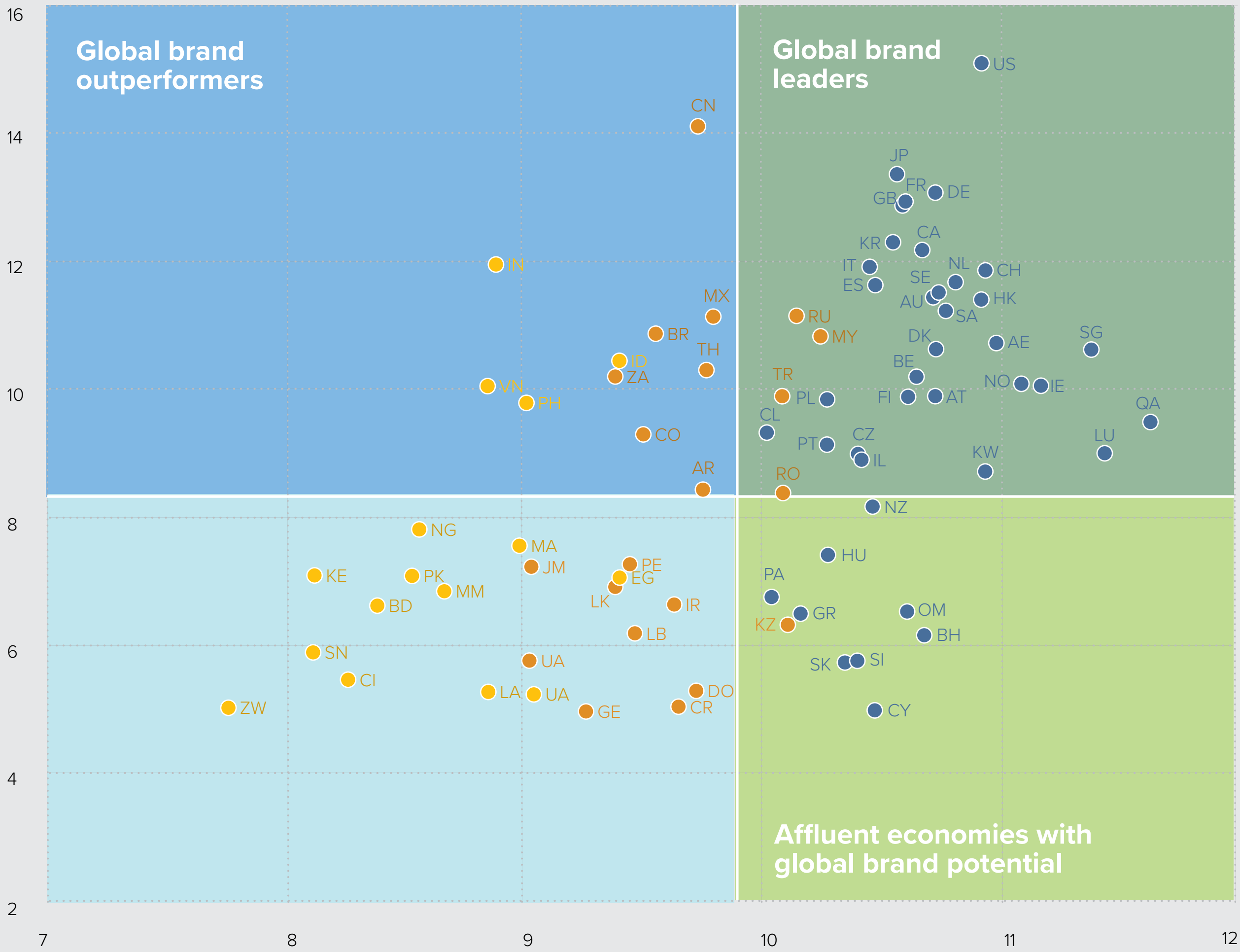
China
$542,940
6. ICBC
9. Ping An
10. Huawei
13. China Construction Bank
16. State Grid
18. Agricultural Bank of China
19. WeChat
20. Bank of China
22. China Mobile

United States of America
$1,024,859
1. Amazon
2. Google
3. Apple
4. Microsoft
7. Facebook
8. Walmart
12. Verizon
14. AT&T
17. Disney
21. The Home Depot

Source: Brand Finance, 2020.
Note: Figures in US$ millions.

FIGURE 1.9

Brand value by level of economic development, 2020



▲ Value of an economy's top brands, amongst the top 5,000 global brands (logarithmic scale)

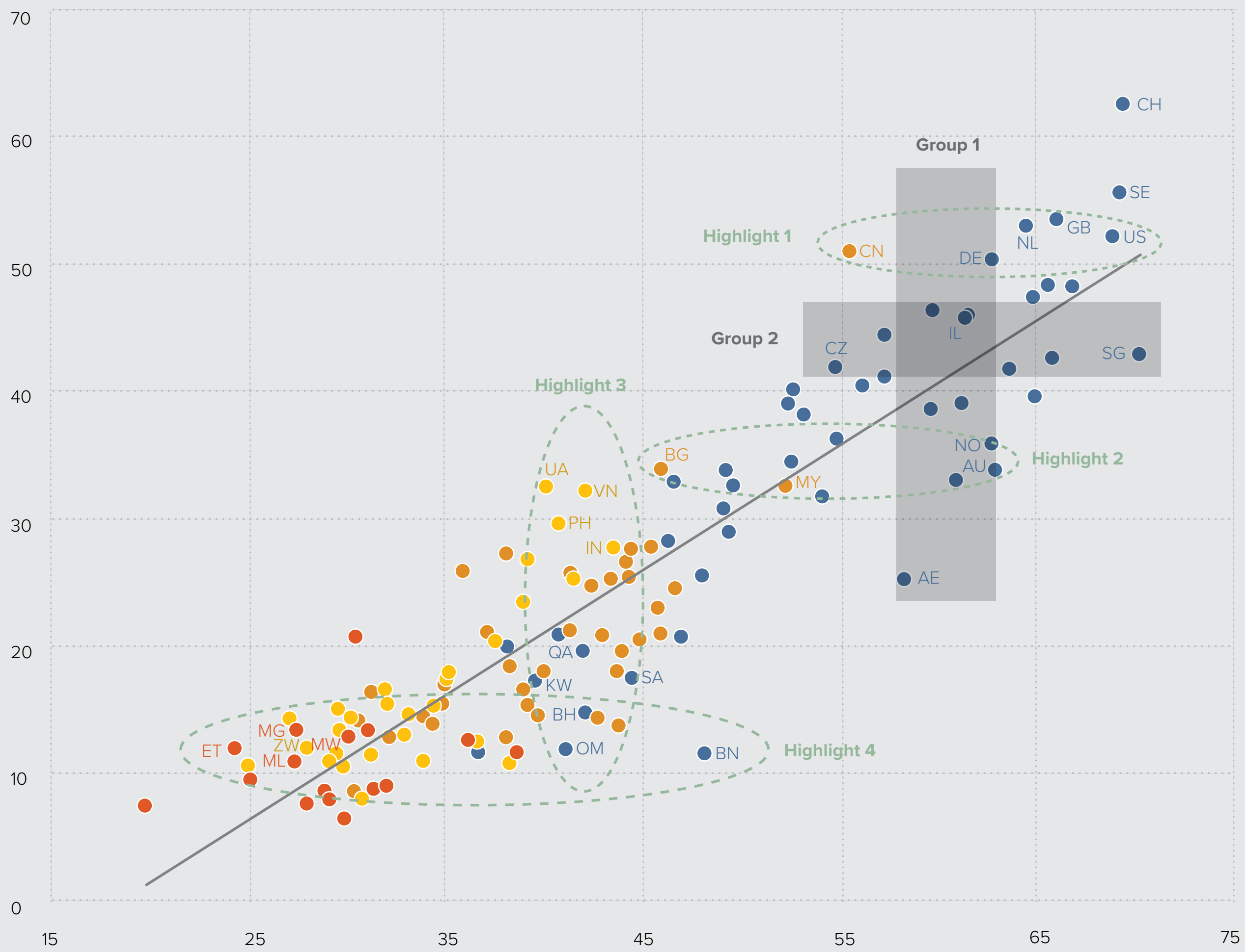
▶ GDP per capita (logarithmic scale)

● High income group
● Upper middle-income group
● Lower middle-income group
● Low income group

Source: GII calculations based on data from Brand Finance and International Monetary Fund (IMF), 2019.

FIGURE 1.10

Innovation input to output performance, 2020



▲ Output score
▶ Input score
● High-income group
● Upper middle-income group
● Lower middle-income group
● Low-income group
— Fitted values

AU	Australia
BH	Bahrain
BN	Brunei Darussalam
BG	Bulgaria
CN	China
CZ	Czech Republic
ET	Ethiopia
DE	Germany
IN	India
IL	Israel
KW	Kuwait
MG	Madagascar
MW	Malawi
ML	Mali
MY	Malaysia
NL	Netherlands
NO	Norway
OM	Oman
PH	Philippines
QA	Qatar
SA	Saudi Arabia
SG	Singapore
SE	Sweden
CH	Switzerland
UA	Ukraine
AE	United Arab Emirates
GB	United Kingdom
US	United States of America
VN	Viet Nam
ZW	Zimbabwe

Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2020.

inputs. Similarly, it highlights clusters that show lower-income economies that are getting comparable or higher returns on their innovation investments compared to other economies in higher-income groups.

Among the high-income group, the top ranked economies located more towards the right of Figure 1.8, such as Switzerland (CH), the U.K. (GB), Sweden (SE), and the U.S. (US), produce more outputs relative to their levels of innovation inputs. Group 1 in Figure 1.10 shows economies that at similar levels of inputs produce very different levels of outputs. Group 2 shows the mirroring situation: economies that at very different levels of inputs produce comparatively similar level of outputs. For instance, the Czech Republic (CZ) and Israel (IL) continue to achieve the same level of outputs as Singapore (SG) at much lower levels of inputs (Group 1), while Germany (DE) shows much higher outputs than the United Arab Emirates (AE) with similar level of inputs (Group 2).

Highlights 1 and 2 show the catching-up of some middle-income economies to the high-income group with respect to the levels of innovation outputs produced. China (CN) stands out for having innovation outputs that are comparable to those of the high-income group (Box 2), including to top 10 economies such as the Netherlands (NL), the U.K., and the U.S. (Figure 1.10, Highlight 1). Malaysia (MY) and Bulgaria (BG) are middle-income economies that have outputs comparable to high-income economies, like Norway (NO) and Australia (AU), with less inputs (Highlight 2).

Viet Nam (VN), Ukraine (UA), the Philippines (PH), and India (IN) stand out as lower middle-income economies that are getting much more outputs for their inputs. Their levels remain above those of high-income, oil-rich economies Kuwait (KW), Qatar (QA), Bahrain (BH), Saudi Arabia (SA), and Oman (OM) (Highlight 3). With significantly lower efforts on the input side, lower middle-income Zimbabwe (ZW), and low-income Ethiopia (ET), Madagascar (MG), Mali (ML), and Malawi (MW)–all economies from Sub-Saharan Africa–display the same level of outputs as Brunei Darussalam (BN), a high-income economy (Highlight 4).

This sort of efficiency analysis has proven useful in practical assessments with innovation practitioners and policymakers on the ground. The assumption, however, is that innovation inputs and output are perfectly measured, which is not the case. Besides, in real innovation systems, their relationship is not linear in any way. These facts need consideration in earnest. They are also a call for action to innovation statisticians and scholars.

Which countries lead their respective regions?

Regional innovation divides persist (Box 3). While Sub-Saharan Africa has historically occupied the last place in terms of innovation performance of all world regions, as shown in Figure 1.11, the Africa continent as a whole—comprising Sub-Saharan Africa and Northern Africa, has one of the most heterogeneous performances across continents. While some economies rank in the top 60, nine economies rank below the 120th place (Figure 1.11). Two Sub-Saharan African countries, Mauritius (52nd) and South Africa (60th) lead the continent, followed by Northern African Tunisia (65th) and Morocco (75th) in the top 80. All economies in the lowest ranks of the continent are Sub-Saharan African economies, with Ethiopia (127th), the Niger (128th) and Guinea (130th) trailing.

Innovation systems in Africa are broadly characterized for having low levels of science and technology activities, a high reliance on government or foreign donors as a source of R&D, limited science-industry linkages, low absorptive capacity of firms, limited use of IP, and a challenging business environment.

But this is a broad generalization; some economies stand out. In contrast, the typical innovation leader in Africa usually has higher expenditure on education (Botswana, Tunisia) and R&D (South Africa, Kenya, Egypt), strong financial market indicators such as Venture capital deals (South Africa), openness to technology adoption and inward knowledge flows, improving science and research base (Tunisia, Algeria, Morocco), active use of ICTs and organizational model creation (Kenya), as well as a stronger use of their IP systems (Kenya, Tunisia, South Africa, Namibia, Madagascar, Morocco). Thanks to innovation in the informal sector and the inability to measure innovation perfectly in these and similar developing country settings, innovation is also more pervasive in Africa than formal innovation metrics suggests.

Sub-Saharan Africa (26 economies)

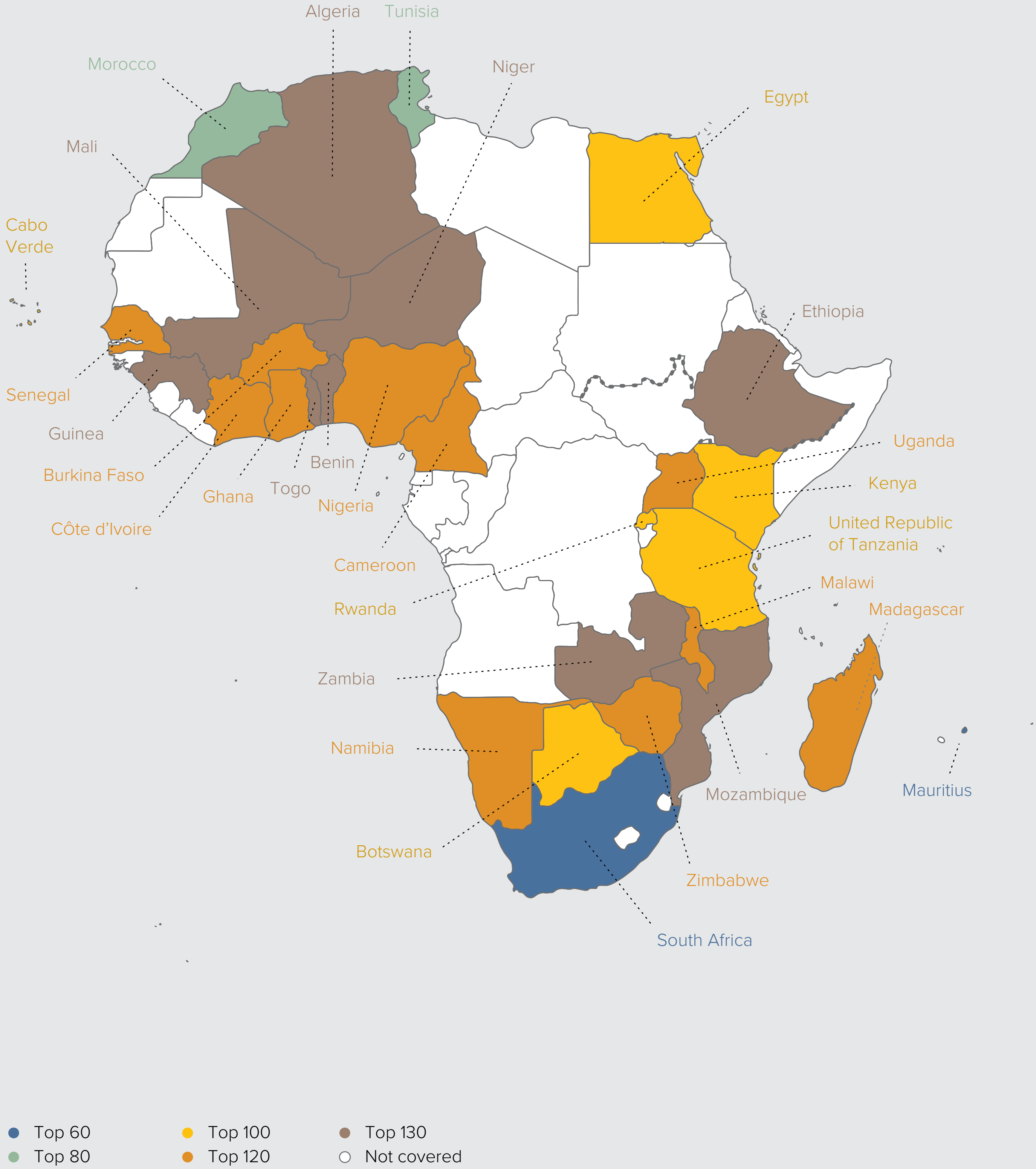
Figure 1.11 shows the regional performance differences in Sub-Saharan Africa: two economies rank in the top 60 (dark blue), while eight economies are in the top 130 (brown). The majority of all other economies covered in the region (11), rank in the top 120 (orange).

In 2020, the top 5 economies in the region are Mauritius (52nd), South Africa (60th), Kenya (86th), the United Republic of Tanzania (88th), and Botswana (89th) (Figure 1.11). With the exception of Kenya, all of these economies improve their GII ranking when compared to 2019. In particular, Mauritius displays the most notable rank change this year. More complete innovation data, data revisions at source, performance improvements, and model changes explain Mauritius's rise in the rankings. Rwanda (91st) and Cabo Verde (100th) round up the other economies in the region that are among the top 100. The other 19 economies in the region rank beyond the top 100, with only Malawi (111th), Madagascar (115th), Zimbabwe (120th), Zambia (122nd), and Togo (125th) improving their rankings this year. On average, the region performs the best in the pillars Institutions, and both Market and Business sophistication, while it trails the most in Creative outputs when compared to other regions.

Historically, Sub-Saharan Africa continues to host the largest number of economies that perform above expectations on innovation for their level of development (Figure 1.6 and Table 1.3).

FIGURE 1.11

GII 2020 rankings in Northern Africa and Sub-Saharan Africa



Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2020.

This year, Cabo Verde and the Niger improved their data coverage and are newcomers to the GII.

Rwanda ranks 91st (up by 3). It drops in the Innovation Input Sub-index (79th, down by 14) and moves up in the Innovation Output Sub-index (112th, up by 11). On innovation inputs, it improves modestly in the pillar Market sophistication (37th, up by 1, and a relative strength), where sub-pillar Credit (15th) as well as indicators Ease of getting credit (4th) and Microfinance gross loans (1st) are relative strengths for Rwanda. In the Market sophistication pillar, indicator Applied tariff rate (77th) increases the most. On the outputs-side, Rwanda improved the most in Knowledge and technology outputs (103rd, up by 22), where sub-pillar Knowledge impact (85th) increased mostly because the indicator productivity growth is available this year and Rwanda ranks in the top 15 worldwide (15th). This indicator is the only relative strength for Rwanda on innovation outputs. Rwanda continues to work closely with the GII to improve its data coverage, some of which will show in the GII 2021.

The United Republic of Tanzania ranks 88th this year (up by 9) and enters the top three in the region (Figure 1.4). It increases three positions in the Innovation Input sub-index (112th) and goes up six ranks in the Innovation Output Sub-Index (67th). It moves up the most in two pillars: Market sophistication (87th), and Creative outputs (45th). Overall, Tanzania's relative strengths are evenly split between innovation inputs and outputs. It ranks in the top 25 in indicators Cost of redundancy dismissal (25th) and Gross capital formation (13th). Conversely, Tertiary enrolment (123rd), Global R&D companies (42nd), the quality of local universities (77th), GERD financed by business (102nd), Patent families (101st), and Computer software spending (124th) remain relative weaknesses for the country. It is worth noting that although Tanzania's data coverage is satisfactory, it could benefit greatly from updating its innovation metrics more systematically.

Northern Africa and Western Asia (19 economies)

The top three of the most innovative economies in the Northern Africa and Western Asia region remains unchanged. Israel, ranking 13th worldwide (down by 3), continues to be the most innovative economy in the region ("What are the top 10 economies in innovation inputs?" in this chapter), followed by Cyprus (29th, down by 1), and the United Arab Emirates (34th, up by 2). These three economies are the only ones in the region that rank in the top 50 of the GII overall.

Seven economies in the region improve their GII ranks: the United Arab Emirates (34th), Armenia (61st), Tunisia (65th), Saudi Arabia (66th), Jordan (81st), Azerbaijan (82nd), and Lebanon (87th). Among the economies in Northern Africa, only Tunisia (65th) has a rank increase (Figure 1.11). Kuwait (78th) and Georgia (63rd) experience the largest drops in overall ranks in the region. For Kuwait, better data availability, notably on the innovation outputs side—and in particular in the Knowledge creation (109th) and the Intangible assets (76th) sub-pillars—explains a good part of the drop. In the case of Georgia, a mix of better data availability, changes to the GII model, and performance decreases both in innovation inputs and outputs explain the decrease.

Saudi Arabia (66th) increased its rank by two positions this year. It ramped up notably in the Innovation Output Sub-Index by eight ranks to reach the 77th place. The sub-pillar Intangible assets (51st) increased the most by a combination of performance improvements and model changes. It gained seven ranks in the indicator Trademarks by origin (111th). With 46 brands in the top 5,000, led by telecoms STC, Saudi Arabia ranks 18th in the novel GII indicator Global brands value. Other relative strengths include the Ease of protecting minority investors, where it ranks 3rd worldwide, Global R&D companies (22nd), ICT access (31st), ICT use (29th), and the quality of its universities (31st).

Jordan (81st) goes up by five positions–the largest move in the region, together with Tunisia (65th, up from 70th). Most of Jordan's improvements are on the Innovation Input Sub-Index (77th), where it goes up by 14 ranks. At the pillar level, Jordan improves in Institutions (63rd), Market sophistication (52nd), and Business sophistication (94th). In Market sophistication, the indicator Ease of getting credit (4th) is now a relative strength and remarkably improved. Jordan strengthened access to credit by introducing a new secured transactions law, amending their insolvency law, and improving access to credit information. Indicators Ease of resolving insolvency (98th), Ease of protecting minority investors (92nd), Domestic credit to private sector (35th), and Venture capital deals (17th) improved as well.

Central and Southern Asia (10 economies)

India (48th) retains the highest rank in the region. The Islamic Republic of Iran (67th) ranks 2nd, and Kazakhstan (77th) ranks 3rd. Uzbekistan (93rd) enters the GII rankings as the 4th economy in this region, thanks to better data availability, and Kyrgyzstan (94th) remains 5th, although losing three spots.

India (48th) moves up four positions since 2019 to retain the regional top rank and becomes 3rd in the rankings among the lower middle-income economies. For the 10th consecutive year, India is an innovation achiever (Table 1.2).

India increases the most in three pillars: Institutions (61st), Business sophistication (55th), and Creative outputs (64th). In Institutions, indicators Political and operational stability (83rd), Government effectiveness (55th), and most of all Ease of resolving insolvency (47th) improved remarkably. In Business sophistication, indicator GERD financed by business (48th) is available this year, while ranks also improved for both IP payments (27th) and Research talent (38th). In Creative outputs (64th), India increased by a combination of performance improvements and model changes. It gained several places in indicator Cultural and creative services exports (21st) and it ranks 31st in the new GII indicator on Global brands thanks to its164 brands in the top 5,000, led by TATA Group.

India shows relative strengths that are in the GII top 10 rankings in sub-pillar Knowledge diffusion (10th) and indicators ICT services exports (1st), Domestic market scale (3rd), and Government's online service (9th). Other relative strengths for India include sub-pillar Trade, competition, and market scale (15th) and indicators Graduates in science and engineering (12th), Global R&D companies (16th), E-participation (15th), Ease of protecting minority investors (13th), and the quality of both local universities (22nd) and scientific publications (21st).

India made great progress in its GII innovation statistics over the last years. A significant number of indicators were updated this year. Almost half of them are in the pillar Human capital and research–Pupil-teacher ratio, Researchers, and Gross expenditure on R&D—and others in the pillar Knowledge and technology outputs—Knowledge-intensive employment, GERD performed by business, Females employed with advanced degrees, and Research talent. Nevertheless, two indicators that relate to education and research, PISA scales and GERD financed by abroad, are not available and Expenditure on education and Government funding per pupil remain outdated.[82]

Uzbekistan ranks 93rd. With improved data availability above the 66% indicator coverage per sub-index threshold, it is the single Central Asia economy to enter the GII this year. Uzbekistan's highest ranks are in the Innovation Input Sub-Index (81st), in pillars Human capital and research (77th), Infrastructure (72th), and Market sophistication (27th). Indicators that are in the GII top 10 and are relative strengths for Uzbekistan include Graduates in science & engineering (7th), Ease of starting a business (8th), and Gross capital formation (8th). Other relative strengths in the GII top 50 for Uzbekistan include indicators Expenditure on education (31st), Pupil-teacher ratio (38th), Government's online service (48th), Ease of protecting minority investors (36th), Patents by origin (45th), productivity growth (12th), and Cultural & creative services exports (33rd).

Uzbekistan's continuous and systematic process to improve data coverage has resulted in the inclusion of the country in the GII this year.[83] Yet, additional progress in data collection, especially in the Innovation Input Sub-Index, are still required to further increase the reliability of the economy's overall rank.

Latin America and the Caribbean (18 economies)

Latin America and the Caribbean continues to be a region with great imbalances. The region is overall characterized for its low investments in R&D and innovation, its incipient use of IP systems, and the disconnection between the public and private sectors in the prioritization of R&D and innovation. Only Brazil, for instance, has an R&D intensity that is comparable to some European economies, such as Portugal and Spain. Brazil, Mexico, and Argentina are the only three economies in the region with global R&D companies. Moreover, most R&D investments are primarily public, with a low share of private sector financing. Overall, the economic sectors of the region are not technology-intensive and the labor productivity growth remains at low levels.

With low innovation inputs, the region also struggles to translate these efficiently into outputs. Only Chile, Uruguay, and Brazil produce high levels of Scientific and technical articles, and only Brazil does in Patents by origin. In contrast, Central America and the Caribbean economies have levels of Knowledge and technology outputs that are lower than the average of the Sub-Saharan Africa region.

Figure 1.12 shows the GII ranks of economies in the Latin America and the Caribbean region. The innovation performance of the region is divided into three broad groups. First, the regional leaders (in dark blue) ranking in the top 60: Chile (54th) is the most innovative economy in the region, followed by Mexico (55th, up by 1) and Costa Rica (56th, down by 1), which swap the 2nd and 3rd top ranks of the region this year. Second, a middle group of seven economies—mostly from South America and upper-middle income, with the exception of high-income Uruguay and Panama: Brazil (62nd, up by 4), Colombia (68th, down by 1), Uruguay (69th, down by 7), Jamaica (72nd, up by 9), Panama (73rd, up by 2), Peru (76th, down by 7), and Argentina (80th, down by 7). The third group, comprised of eight economies (in yellow and orange), ranks in the top 100 and top 110. These broad groups have remained largely unchanged, with two exceptions: Jamaica ranks in the top 80 this year (vs. in the top 100 in 2019), and El Salvador in the top 100 (92nd this year vs. 108th in 2019).

Eight economies in the region move up the GII ranks this year, while nine economies lose between one and seven positions in the ranking. Jamaica joins Costa Rica as the only two innovation achievers in the region–or those that perform on innovation above expectations relative to their level of development (Figure 1.6 and Table 1.3). Chile and Mexico are the only two economies that score above the regional average in all GII pillars. Colombia scores above the regional average in all innovation input pillars, while Costa Rica and Uruguay do so in all innovation output pillars, showing potential for take-off.

Mexico ranks 55th this year, up one place since last. It improves the most in Business sophistication (59th) and Creative outputs (54th). In the former, sub-pillar Knowledge absorption (41st) increases the most, thanks to performance improvements in indicators High-tech imports (9th, and a relative strength), FDI inflows (50th) and Research talent in business enterprise (35th). Mexico goes up in all Creative outputs sub-pillars, and especially in Creative goods and services (17th), which remains a relative strength for the country. In this sub-pillar, it continues leading in indicator Creative goods exports (1st), and it improves in indicators National feature films (65th) and Entertainment and media market (39th). Additionally, thanks to its leading brands, Corona and telecoms Claro and Telcel, Mexico ranks 30th worldwide in the new indicator Global brands value, with a total of 81 brands in the top 5,000. It also ranks in the top 10 worldwide in output indicators High- and medium-high-tech manufacturing (10th), and High-tech net exports (8th), as well as in input indicator Ease of getting credit (10th).

Brazil ranks 62nd this year, up four positions from 2019. It increases one rank in the Innovation Input Sub-Index (59th) and goes up three ranks in the Innovation Output Sub-Index

FIGURE 1.12

GII 2020 rankings in Latin America and the Caribbean

Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2020.

(64th). It ramps up in two of the input pillars: Infrastructure (61st, up by 3), and Business sophistication (35th, up by 5). In the latter, the Knowledge workers sub-pillar (32nd) increases the most by a combination of performance increases and lack of data: indicators Knowledge-intensive employment (64th), GERD financed by business (33rd) and Females employed with advanced degrees (50th) increase, while the indicator Firms offering formal training is not available this year. Brazil goes up in both innovation output pillars. Sub-pillars Knowledge impact (69th) and Knowledge diffusion (53rd) increase the most, notably because of improvements in indicators New businesses (76th), High- and medium-high-tech manufacturing (31st), IP receipts (30th) and ICT services exports (83rd).

South East Asia, East Asia, and Oceania (17 economies)

This year the two most innovative economies in the South East Asia, East Asia, and Oceania region—Singapore (8th) and the Republic of Korea (10th)—rank in the top 10. Hong Kong (China) (11th), stands just outside this group followed by China (14th), and Japan (16th). These economies continue to be the five most innovative in the region and, along with Australia (23rd), are those that rank in the top 25 of the GII.

Four economies in the region improve their GII ranks: The Republic of Korea, Hong Kong (China), Malaysia (33rd), and the Philippines (50th). The Lao People's Democratic Republic (113th) and Myanmar (129th), both economies from South East Asia, enter the GII this year.

Malaysia ranks 33rd, up by two positions. It increases its rank in the Innovation Output Sub-Index (36th, up by 3) and remains stable in the Innovation Input Sub-index (34th). It shows relative strengths at the sub-pillar level in both inputs and outputs. In the inputs-side, sub-pillar Tertiary education (8th) is a strength for Malaysia, where it ranks 4th in Graduates in science & engineering and 17th in the quality of top 3 universities. Conversely, in the outputs-side, it ranks 28th in sub-pillar Intangible assets and 7th in the new GII indicator Global brands value (and a relative strength), thanks to 60 brands in the top 5,000, led by Petronas. Other top 20 indicators are strengths for Malaysia including: Ease of protecting minority investors (2nd), Market capitalization (7th), University and industry research collaboration (14th), State of cluster development (7th), High-tech imports (3rd), High-tech net exports (1st), and Creative goods exports (1st).

The Philippines (50th) increases its ranking by four positions and enters the top 50 for the first time. It improved in both innovation sub-indices but does it more notably in the Innovation Input Sub-Index (70th, up by 6). The Philippines improves the most in Market sophistication (86th) with higher rankings in Investment (85th), derived mainly by an improved ranking in the indicator Ease of protecting minority investors (71st). At the sub-pillar level, strengths for the Philippines are in Trade, competition, and market scale (20th), Knowledge absorption (7th), and Knowledge diffusion (8th). Other relative strengths include indicators Utility models by origin (8th), productivity growth (6th), High-tech net exports (3rd), ICT services exports (8th), Firms offering formal training (7th), Creative goods exports (10th), E-participation (19th), and High-tech imports (1st). This year, data for PISA scores is available for the Philippines.

The Philippines is currently implementing a new innovation act in an effort to foster innovation in the country and to define it as a vital component of national development and sustainable economic growth. The act places innovation at the center of its development policies and it proposes the GII as a measurement rod.[84]

Europe (39 economies)

Europe continues to host a large number of innovative economies. Sixteen of the innovation leaders in the top 25 are European countries, with seven of them ranking in the top 10 (GII 2020 Results: Highlights in this chapter). The Czech Republic rejoins the top 25 this year (24th, up by 2). Seventeen economies rank in the top 50. Seven of them climb up the ranks: Italy (28th, up by 2), Portugal (31st, up by 1), Bulgaria (37th, up by 3), Poland (38th, up by 1), Croatia (41st, up by 3), Ukraine (45th, up by 2) and Romania (46th, up by 4). Six economies rank below the top 50, with four of them increasing their ranks this year: Serbia (53rd), North Macedonia (57th), Belarus (64th), and Bosnia and Herzegovina (74th).

France ranks 12th, up four spots from last year, thanks to a combination of performance improvements and changes to the GII model. It goes up by two ranks in the Innovation Output Sub-Index to achieve the 12th place, and sustains its 16th rank in the Innovation Input Sub-Index. The Creative Outputs pillar increases the most (13th), with sub-pillar Intangible assets (6th, up by 4) remaining a relative strength. The rank changes in this sub-pillar are a consequence of performance improvements and model changes. It improves in indicators Trademarks (9th, and a relative strength), and Industrial designs (21st). It also benefits from the use of the new GII indicator Global brands value: with 205 brands in the top 5,000, it ranks 5th worldwide with Total (Oil & gas), Orange (Telecoms) and Axa (Insurance) leading the country ranks. There are also improvements in input indicators Government effectiveness (16th), Ease of resolving insolvency (24th), Tertiary inbound mobility (19th), ICT access (10th, and a strength), GERD financed by business (17th), University/industry research collaboration (26th), and Research talent in business enterprise (10th). It also made remarkable improvements in output indicators New businesses (31st), High- and medium-high-tech manufacturing (12th), ICT services exports (48th) and FDI net outflows (20th). Additionally, it ranks in the top 10 in indicators such as Global R&D companies (7th), Environmental performance (5th), and the quality of its scientific publications (5th).

France sustains its ninth position overall in the quality of innovation, while it improves its score in the quality of its universities (11th, and a relative strength) (Figure 1.7). France hosts five S&T clusters in the top 100, with Paris ranked 10th worldwide (Special Section Cluster Rankings).

The Czech Republic ranks 24th this year (up by 2). It goes up in both the Innovation Input Sub-Index (28th, up by 1) and the Innovation Output Sub-Index (17th, up by 4). It goes up in three input pillars: Human capital and research (33rd, up by 1), Infrastructure (21st, up by 11), and Business sophistication (23rd, up by 2). In Infrastructure, sub-pillar Ecological sustainability (4th, and a relative strength) improved notably. It goes up in the two output pillars, ranking in the top 20 in both: 15th in Knowledge and technology outputs (up by 1), and 20th in Creative outputs (up by 1). In Knowledge and technology outputs, it moves up in sub-pillar Knowledge impact (4th, up by 6, and a relative strength). It remains in the top five in indicators ISO 9001 quality certificates (3rd) and High- and medium-high-tech manufacturing (5th). Other relative strengths in this pillar include Utility models (6th) and high-tech net exports (7th). In the Creative outputs pillar (20th), the Czech Republic improves in the sub-pillar Creative goods and services (4th, up by 2, and a relative strength), but goes down in sub-pillars Intangible assets (43rd, down by 7) and Online creativity (27th, down by 1). It upholds its global top position in Creative goods exports (1st).

Northern America (2 economies)

The Northern America region includes two economies—the U.S. and Canada—both in the top 20. The U.S. remains the 3rd most innovative economy in the world and ranks in the top 5 in both the Innovation Input (4th) and the Innovation Output (5th) Sub-Indices. Canada keeps its 17th rank overall, and ranks 9th in innovation inputs and 22nd in innovation outputs. Canada improves in indicators Tertiary enrollment, PCT patent applications, and ICT services exports.

Conclusions

Confronted with an unprecedented crisis, we need to fully leverage the power of innovation to collectively build a cohesive, dynamic, and sustainable recovery. In doing so, we need to emphasize the countercyclical role of policies to ensure the continuity of innovation financing.

This chapter presents the main GII 2020 results and analyzes how economies rank on innovation this year. It also provides an early assessment of the impact of the COVID-19 crisis on innovation. It is relatively clear from this analysis that R&D financing—particularly in some sectors, start-up financing, and related venture capital investments will take a severe hit in the months to come—making entrepreneurship funds even more limited in terms of geographical and sectoral access. Existing innovation finance divides will be harshly accentuated, if no action is taken.

Three important points deserve emphasis in this conclusion:

First, as noted in this chapter and in the preface to this report, one visible effect of the current crisis has been to stimulate interest in innovative solutions for health, naturally, but also for areas such as remote work, distance education, e-commerce, mobility, and others. Building on that experience may well support our collective pursuit of societal goals, including reducing or reversing long-term climate change.

Second, the short-term and longer-term impacts of the pandemic on the science and innovation systems have to be monitored and possibly acted on. Some aspects are mightily positive, for example, an unexpected level of international science collaboration and the reduction of red tape for scientists. Some aspects, however, are alarming, such as the standstill of major research projects, the possible (and uneven) reduction of R&D expenditures in some sectors, and the loss of employment prospects for junior researchers.

Finally, there are increased risks to international openness and knowledge flows. We already raised these concerns as of the 2018 edition of the GII. But with a significant fall in trade to come, the downturn of the global economy, and increasing protectionist pressures, this perspective is now seriously alarming and needs to be counteracted. If anything, the reaction of the economies and researchers to the COVID-19 crisis, and the joint search for medical solutions, has demonstrated how powerful openness and collaboration can be. As noted in this chapter, the speed and efficacy of this collaboration might well inspire internationally coordinated R&D missions on important societal topics—such as the development of new energy technologies—in the future.

Notes:

1 Ms. Bayona and Ms. Garanasvili are Consultants to WIPO.

2 MSTI in OECD (2020a).

3 See Dutta et al., 2017 for a longer discussion; OECD, 2020a.

4 Hernández et al., 2019. See also "Worldwide R&D spending among the world's 1000 largest corporate R&D spenders increased 11.4 percent in 2018 to $782 billion", at https://www.strategyand.pwc.com/gx/en/insights/innovation1000.html#GlobalKeyFindingsTabs4. Forward-looking projections done before the pandemic predicted that this positive innovation expenditure trend was going to continue over the following five years. R&D Magazine, 2019; R&D World Online, 2020.

5 WIPO, 2019b.

6 WIPO, 2020.

7 IMF, 2020.

8 Jackson et al., 2020.

9 Oxford Economics, 2020. If previous pandemics such as the Spanish 1918 flu or SARS are any guide, the fact that governments implemented lockdowns quickly has helped contain the growth impact to the short term. See Correla et al., 2020 on this latter point and Garret, 2007 for more background.

10 The WTO projects that global trade will fall steeply this year. See WTO Press Release 855, "Trade set to plunge as COVID-19 pandemic upends global economy" at https://www.wto.org/english/news_e/pres20_e/pres20_e.htm.

11 Jordà, 2020.

12 UNCTAD, 2019; UNCTAD, 2020. Global foreign direct investment (FDI) flows slid by 13% in 2018 to US$1.3 trillion from $1.5 trillion the previous year—the third consecutive annual decline, according to UNCTAD's World Investment Report 2019. The recent Global

Investment Trends Monitor of UNCTAD predicts a drastic drop in global foreign direct investment flows—up to 40%—during 2020-2021, reaching the lowest level in the past two decades.

13 Guellec et al., 2009; WIPO, 2010; Dutta et al., 2017; Hingley et al., 2017; Fatas et al., 2018, Dachs et al., 2020; Foray et al., 2020.

14 For a detailed analysis of a similar impact after the 2009 crisis, see WIPO, 2011. R&D and IP drops reflect the move of firms to cut costs at an organization-wide level and uniformly through all business departments. In the case of IP, during the last crisis and reflecting business uncertainty, firms also applied a more conservative stance towards filings abroad and towards a geographic reorientation of patent filings to a narrower set of countries.

15 Dutta et al., 2019.

16 Austria, Chile, Estonia, Germany, Greece, Israel, Italy, Slovak Republic, Sweden, U.K., U.S., Brazil, Singapore, and South Africa.

17 WIPO, 2011.

18 Archibugi et al., 2013.

19 Hernández et al., 2019.

20 Alphabet First Quarter 2020 Results, https://abc.xyz/investor/static/pdf/2020Q1_alphabet_earnings_release.pdf?cache=4690b9f; Microsoft Earnings Release FY20 Q3, https://www.microsoft.com/en-us/Investor/earnings/FY-2020-Q3/press-release-webcast.

21 Hernandez et al., 2019.

22 Samsung Electronics First Quarter 2020 Results at https://news.samsung.com/global/samsung-electronics-announces-first-quarter-2020-results; Huawei First Quarter Results at https://www.huawei.com/en/press-events/news/2020/4/huawei-announces-q1-2020-business-results and https://www.reuters.com/article/us-huawei-tech-results/huawei-first-quarter-revenue-growth-slows-sharply-amid-u-s-ban-virus-headwinds-idUSKBN2230WV; and Apple First Quarter Results at https://www.apple.com/newsroom/pdfs/FY20_Q2_Consolidated_Financial_Statements.pdf.

23 Roche First Quarter Results at https://s21.q4cdn.com/317678438/files/doc_financials/2020/q1/updated/Q1-2020-PFE-Earnings-Release-(1).pdf and https://www.roche.com/dam/jcr:f19ebc50-969f-4d22-b414-0a51ea25b41a/en/200422_IR_Roche_Q1_en.pdf.

24 IHS Markit, 2020.

25 Volkswagen First Quarter Results at https://www.volkswagenag.com/presence/investorrelation/publications/interim-reports/2020/Q1_2020_e.pdf.

26 WIPO, 2019b.

27 Howell et al., 2020. The authors provide the following reasons: downward shifts in investment opportunities, in entrepreneurs seeking capital, and frictions or constraints in the supply of venture capital financing. See also Townsend, 2015.

28 PwC and CB Insights' Q1 2020 MoneyTree report at https://www.cbinsights.com/research/report/venture-capital-q1-2020/.

29 Howell et al., 2020.

30 PwC and CB Insights' Q1 2020 MoneyTree report; Herbert Smith Freehills, 2020.

31 Howell et al., 2020.

32 "China's startups hit by 50% drop in Series A deals due to coronavirus" at https://thenextweb.com/growth-quarters/2020/03/24/chinas-startups-hit-by-50-drop-in-series-a-deals-due-to-coronavirus-COVID-19/; "This is what COVID-19 did to start-ups in China" at https://www.weforum.org/agenda/2020/05/COVID-19-s-coronavirus-startups-china-funding/; "China's VC industry bounces back after coronavirus-induced winter" at https://pitchbook.com/news/articles/chinas-vc-industry-bounces-back-after-coronavirus-induced-winter; "In March, China's VC deals come back, raising more than $2.5bn during the month", Financial Times, April 14, 2020; and data by the China VC & Private Equity Association at http://js-vc.org/article-34710-71390.html.

33 Online education, which attracts US$1 bn financing from start-up Yuanfudao, "China's venture capital funding rallies after coronavirus lockdown", Financial Times, April 14, 2020; "The venture capital market in China: Could the Coronavirus eventually revive startup investments?", Daxue Consulting, May 1, 2020 at https://daxueconsulting.com/venture-capital-market-in-china/.

34 "Big Tech goes on pandemic M&A spree despite political backlash", Financial Times, May 28, 2020.

35 Transcript of IMF Press Briefing, May 21, 2020 at https://www.imf.org/en/News/Articles/2020/05/21/tr052120-transcript-of-imf-press-briefing.

36 Bruegel, 2020 for a compilation of stimulus measures and related analyses; Tran, 2020 and IMF COVID Policy Tracker at https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19; OECD, 2020b; OECD, 2020c.

37 "UK start-ups call for emergency support to help them survive coronavirus crisis", CNBC, March 30, 2020.

38 In the U.S. Care Act, for example, the referenceable baseline average monthly payroll expense for employees is the eligibility criteria. As outlined in "Coronavirus Information and Resources for VCs and Startups" by the U.S. National VC Association at https://nvca.org/nvca-response-to-COVID-19/, venture-backed start-ups face trouble accessing available lending facilities. See also "CARES Act: What the Paycheck Protection Program Means for Startups", Fenwick, March 27, 2020, https://www.fenwick.com/publications/pages/cares-act-what-the-paycheck-protection-program-means-for-startups-.aspx.

39 Herbert Smith Freehills, 2020.

40 The People's Bank of China at http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/3989149/index.htm, http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/3989112/index.html and http://js.people.com.cn/n2/2020/0314/c359574-33875508.html.

41 This scheme is piloted by the Banque Publique d'Investissement.

42 "Start-up: Mesures de soutien économique", French Government Announcement, March 23, 2020, https://www.economie.gouv.fr/coronavirus-startup-mesures-de-soutien-economique.

43 "UK Support package for Innovative firms", U.K. Government Announcement, April 20, 2020, https://www.gov.uk/government/news/billion-pound-support-package-for-innovative-firms-hit-by-coronavirus.

44 COVID19: liquidity support for startups up and running", Swiss Government Announcement, May 4, 2020, https://www.seco.admin.ch/seco/en/home/seco/nsb-news.msg-id-79006.html.

45 Guellec et al., 2009.

46 Dutta et al., 2017.

47 "Coronavirus: Macron annonce 5 milliards d'euros en plus sur 10 ans pour la recherche", France Info, March 19, 2020.

48 "Pressekonferenz zu Konjunktur-/Krisenbewältigungspaket und Zukunftspaket", Germany Government Announcement, June 3, 2020, https://www.bundesregierung.de/breg-de/suche/pressekonferenz-zu-konjunktur-krisenbewaeltigungspaket-und-zukunftspaket-1757642

49 "Senate GOP crafting wish list for next coronavirus package", The Hill, May 13, 2020 at https://thehill.com/homenews/senate/497467-senate-gop-crafting-wishlist-for-next-coronavirus-package.

50 In addition, the problem—both in the short-term liquidity programs as well as longer-term stimulus packages on innovation and infrastructure—remains that coordinating the effective disbursements will be challenging. If the years after the 2009 crisis are any guide, announcing large spending bills and signing them into law is less complicated than actually spending the funds in a sound manner.

51 UNGA A/RES/70/1 Transforming our world: the 2030 Agenda for Sustainable Development.

52 United Nations General Assembly A/74/L.56, 8 April 2020.

53 Economic and Social Council forum on financing for development follow-up E/FFDF/2020/L.1/Rev.1, 23 April 2020.

54 WIPO, 2015 on future breakthrough technologies; WIPO, 2019a on artificial intelligence.

55 “Covid-19 Changed How the World Does Science, Together”, New York Times, April 1, 2020 at https://www.nytimes.com/2020/04/01/world/europe/coronavirus-science-research-cooperation.html; “US research labs closing down for everything but coronavirus”, World University Rankings, March 23, 2020 at https://www.timeshighereducation.com/news/us-research-labs-closing-down-everything-coronavirus; “Research on ice across Europe, as all resources are focused on COVID-19”, Science Business, March 26, 2020 at https://sciencebusiness.net/covid-19/news/research-ice-across-europe-all-resources-are-focussed-covid-19; “Universities, research institutes, clinical trials and big science machines are shut down, as scientists are redeployed into critical research areas and medically-trained academic staff freed up to care for patients”, Science Business, April 23, 2020 at https://sciencebusiness.net/news/researchers-debate-long-term-effects-COVID-19-induced-recession-rd-budgets.

56 Myers et al., 2020.

57 See related calls in EFI, 2020.

58 WIPO, 2017.

59 WIPO, 2019c; Dutta et al., 2019; Roubini, 2020a; Roubini, 2020b.

60 In current U.S. dollars.

61 Appendix I includes further details on the GII framework and the indicators used. A review and update of the GII measurement framework is conducted each year in order to provide the best and most current assessment of innovation. Methodological issues—such as missing data, the revision of scaling factors, and the number of economies covered—also affect the year-on-year comparability of the rankings. Appendix IV contains details on the changes done this year to the methodological framework and an analysis of the factors influencing year-on-year comparability. Since 2016, the Joint Research Centre (JRC) recommended a more stringent criterion for the inclusion of countries in the GII (Appendix IV). Economies were included in the GII 2020 only if 66% of data were available within each of the two sub-indices and if computations were possible for at least two sub-pillars in each pillar.

62 See also Chaminde et al., 2018; Lee, 2019.

63 To recall, the referendum took place in June 2016, but the U.K. has only effectively left the EU in January 2020. The withdrawal of January 2020 also only kicked off a transition period lasting to the end of the year, during which the U.K. remains part of the single market and the customs union. The GII 2020 data naturally cannot capture these effects. First, the impacts will only develop over time, and mostly after this transition period ends. Second, available GII data by far predate the actual exit of early 2020 or the said transition period. Specifically, 30% of the U.K.’s indicators are from 2019 (three years after the referendum but one year before actual withdrawal); 48% are from 2018, the remaining 22% reflect 2017 and earlier years. Even when full data will become available, the U.K.’s withdrawal from the EU will only be one parameter among many to consider in the mix of possible triggers of upward and downward movements of the U.K.’s GII rank.

64 Due to outlier treatment, the Republic of Korea shares first place in the indicator patents by origin with five other economies: Switzerland, the U.S., Germany, China, and Japan.

65 Between 2018 and early 2020, numerous GII workshops and missions took place in collaboration with different economies—including Algeria, Belarus, Brazil, Belgium, China, Colombia, the Czech Republic, Egypt, the European and African Union, Germany, Georgia, Hong Kong (China), India, Mexico, Morocco, Oman, Peru, the Philippines, Rwanda, Serbia, Thailand, Turkey, the U.S., Viet Nam, among others—often in the presence of key ministers.

66 Dark blue means the economy belongs to the 4th quartile (best performers) corresponding to ranks 1st to 32nd in the GII rank and its pillars; light blue = 3rd quartile (ranks 33rd to 65th); yellow = 2nd quartile (ranks 66th to 98th); and orange = 1st quartile (ranks 99th to 131st).

67 Senegal is since this year part of the lower middle-income group.

68 See Chapter 1, GII 2019. Most developing economies also have high shares of their innovative and other forms of economic activity in the informal sector, making innovation more difficult to measure but also to scale up, see Kraemer-Mbula and Wunsch-Vincent, 2016.

69 The Czech Republic scores above the high-income group average in Infrastructure, Business sophistication, Knowledge and technology outputs, and Creative outputs.

70 From Sub-Saharan Africa, Burundi is not anymore an innovation achiever/over-performer. It is not included in the GII rankings this year because of decreased data availability. The innovation achievers from Central and Southern Asia; and South East Asia, East Asia, and Oceania remain unchanged relative to 2019.

71 Argentina changes income group classification from high income to upper-middle income according to the 2020 World Bank Country and Lending Groups classification. See: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

72 Both indexes are released annually since 2003-2004. QS Quacquarelli Symonds publishes the QS—the world’s largest international higher education network, connecting universities, business schools & students. QS, in addition to quantitative data, relies on a survey to assess teaching and research quality and an employer survey. ARWU is conducted by Shanghai Ranking Consultancy—a fully independent organization dedicating to research on higher education intelligence and consultation. Both—QS and ARWU—comprise universities located in world’s six continents and rank nearly 1000 Universities worldwide. The geographical allocation of universities is more diverse in the QS ranking system spanning 82 economies.

73 QS World University ranking index is constructed based on six measures: Academic reputation (40%), Employer reputation (10%), Faculty student ratio (20%), International faculty ratio (5%), International student ratio (5%), and Citations per faculty (20%). Academic Ranking of World Universities (ARWU) index is constructed based on the following six measures: Score on Alumni winning Nobel and Field Medals (10%), Score on Award - Staff winning Nobel and Field Medals (20%), Score on HiCi (highly cited researchers) (20%), Score on N&S (papers published in Nature and Science) (20%), Score on PUB (papers indexed in Science / Social Science Citation Index) (20%), and Score on PCP (per capita academic performance of an institution) (10%).

74 The OECD and WIPO have run multiple work streams on this front in the last years. See the WIPO project “Leveraging Public Research for Innovation and Growth—An international Comparison of Knowledge Transfer Policies and Practices”, at https://www.wipo.int/edocs/mdocs/mdocs/en/wipo_ip_bei_16/wipo_ip_bei_16_ref_project.pdf. See also Arundel et al., 2020 (forthcoming).

75 WIPO, 2013.

76 WIPO, 2017a; WIPO, 2017b.

77 According to estimates for 2011, now outdated.

78 WIPO, 2013.

79 See Appendix III on Sources and Definitions, https://brandirectory.com/, https://brandfinance.com/ and Box 1.6, in WIPO, 2013 for methodologies.

80 Global 5,000, 2020. The annual report on the world’s most valuable and strongest brands. January 2020.

81 Corrado et al., 2004; WIPO, 2017a.

82 India’s expressed will to participate in OECD’s Programme for International Students Assessment (PISA) in 2021.

83 More than half of the available data are in the pillar Knowledge and technology outputs—High- and medium-high-tech manufactures, Intellectual property receipts, High-tech net exports, ICT services exports, and FDI net outflows; and in pillar Creative outputs—ICTs and business model creation, Cultural and creative services exports, Printing and other media, and Creative goods exports. Additionally, three input-side indicators—Intellectual property payments, High-tech imports, and ICT services imports—are also now available for Uzbekistan.

84 The Philippines Innovation Act was enacted on 17 April 2019. See: http://www.neda.gov.ph/wp-content/uploads/2019/12/RA-11293-or-the-Philippine-Innovation-Act.pdf

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THE TOP 100 SCIENCE AND TECHNOLOGY CLUSTERS

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Measuring innovation performance across the world needs to go beyond national economies as the unit of analysis. For several years, the Global Innovation Index has provided a perspective on the spatial distribution of innovative activity. In particular, it has identified the world's most vibrant clusters of science and technology (S&T) activity and has ranked the top 100.

The approach towards identifying the most vibrant S&T clusters is "bottom up", meaning it ignores any existing administrative or political borders and instead pinpoints geographical areas showing a high density of inventors and scientific authors. While mostly associated with large urban agglomerations, the resulting S&T clusters often encompass several municipal districts, sub-federal states, and sometimes even two or more countries. The microdata underlying this measurement approach, in turn, enables a rich characterization of S&T clusters.

The compilation of this year's top 100 list relies on the same methodology as the one used last year. It thus allows for an assessment of how the performance of different clusters has evolved over time. In a nutshell, our methodology relies on:

- Inventors listed in patent applications under WIPO's Patent Cooperation Treaty (PCT), spanning the years 2014 to 2018.
- Authors listed in scientific publications in the Web of Science's Science Citation Index Expanded (SCIE) and covering the same period.
- The geocoding of inventor and author addresses and the use of density-based spatial clustering of applications with noise (DBSCAN) algorithm to the geocoded inventor and author points.[1]

Readers interested in a more detailed description of the cluster identification and performance measurement methodology are referred to last year's Special Section.[2]

This year's top 100 list

Table S-1.1 presents this year's top 100 S&T clusters. As in previous years, Tokyo-Yokohama comes out as the top-performing cluster. Its lead mainly reflects the cluster's strong patenting performance. Its overall total score—reflecting combined patenting and scientific publication performance—is still considerably higher than that of 2nd-ranked Shenzhen-Hong Kong-Guangzhou. However, Tokyo-Yokohama's lead has narrowed. This mainly reflects that the inclusion of the 2018 data led to a merger of the previously distinct Shenzhen-Hong Kong and Guangzhou clusters.[3] This enlarged cluster has, in turn, cemented its 2nd position, and it continues to be followed by Seoul, Beijing, and San Jose-San Francisco.

There is considerable stability among the top 100 clusters. This is partly due to the 5-year time window on which our ranking is based. It arguably also reflects the stability of local innovation ecosystems that often take a long time to form, but, once established, show remarkable persistence.

While the ranks of the first eight clusters have remained the same, Shanghai moved up from 11th to the 9th position. As a result, Paris and San Diego each moved down one position to rank 10th and 11th, respectively. More generally, all Chinese clusters—other than the already highly ranked Shenzhen-Hong Kong-Guangzhou and Beijing—saw rank improvements.

TABLE S-1.1

Top 100 cluster rankings

Rank	Cluster name	Economy	PCT applications	Scientific publications	Share of total PCT filings, %	Share of total pubs, %	Total	Rank 2013-17	Rank change
1	Tokyo-Yokohama	JP	113,244	143,822	10.81	1.66	12.47	1	0
2	Shenzhen-Hong Kong-Guangzhou	CN/HK	72,259	118,600	6.90	1.37	8.27	2	0
3	Seoul	KR	40,817	140,806	3.90	1.63	5.52	3	0
4	Beijing	CN	25,080	241,637	2.40	2.79	5.18	4	0
5	San Jose-San Francisco, CA	US	39,748	89,974	3.8	1.04	4.83	5	0
6	Osaka-Kobe-Kyoto	JP	29,464	67,514	2.81	0.78	3.59	6	0
7	Boston-Cambridge, MA	US	15,458	128,964	1.48	1.49	2.96	7	0
8	New York City, NY	US	12,302	137,263	1.17	1.58	2.76	8	0
9	Shanghai	CN	13,347	122,367	1.27	1.41	2.69	11	2
10	Paris	FR	13,561	93,003	1.30	1.07	2.37	9	-1
11	San Diego, CA	US	19,665	34,635	1.88	0.40	2.28	10	-1
12	Nagoya	JP	19,327	24,582	1.85	0.28	2.13	12	0
13	Washington, DC-Baltimore, MD	US	4,592	119,647	0.44	1.38	1.82	13	0
14	Los Angeles, CA	US	9,764	69,161	0.93	0.80	1.73	14	0
15	London	GB	4,281	107,680	0.41	1.24	1.65	15	0
16	Houston, TX	US	10,852	51,163	1.04	0.59	1.63	16	0
17	Seattle, WA	US	11,558	34,143	1.10	0.39	1.50	17	0
18	Amsterdam-Rotterdam	NL	4,409	78,602	0.42	0.91	1.33	18	0
19	Cologne	DE	7,827	47,161	0.75	0.54	1.29	20	1
20	Chicago, IL	US	6,167	57,976	0.59	0.67	1.26	19	-1
21	Nanjing	CN	1,662	84,789	0.16	0.98	1.14	25	4
22	Daejeon	KR	8,306	26,037	0.79	0.30	1.09	22	0
23	Munich	DE	7,532	31,259	0.72	0.36	1.08	24	1
24	Tel Aviv-Jerusalem	IL	7,076	31,086	0.68	0.36	1.03	23	-1
25	Hangzhou	CN	4,832	48,627	0.46	0.56	1.02	30	5
26	Stuttgart	DE	8,336	18,241	0.80	0.21	1.01	26	0
27	Taipei-Hsinchu	TW	2,721	62,420	0.26	0.72	0.98	43	16
28	Singapore	SG	4,019	46,037	0.38	0.53	0.92	28	0
29	Wuhan	CN	1,796	63,837	0.17	0.74	0.91	38	9
30	Minneapolis, MN	US	6,444	25,157	0.62	0.29	0.91	27	-3
31	Philadelphia, PA	US	3,173	50,847	0.30	0.59	0.89	29	-2
32	Moscow	RU	2,060	58,153	0.20	0.67	0.87	33	1
33	Stockholm	SE	5,736	27,409	0.55	0.32	0.86	32	-1
34	Eindhoven	BE/NL	8,226	6,067	0.79	0.07	0.86	31	-3
35	Melbourne	AU	1,975	56,632	0.19	0.65	0.84	35	0
36	Raleigh, NC	US	2,949	47,499	0.28	0.55	0.83	34	-2
37	Sydney	AU	2,498	49,298	0.24	0.57	0.81	37	0
38	Frankfurt Am Main	DE	5,167	24,848	0.49	0.29	0.78	36	-2
39	Toronto, ON	CA	2,336	48,017	0.22	0.55	0.78	39	0
40	Xi’an	CN	775	60,017	0.07	0.69	0.77	47	7
41	Brussels	BE	3,171	39,066	0.30	0.45	0.75	40	-1
42	Portland, OR	US	6,270	12,349	0.60	0.14	0.74	45	3
43	Tehran	IR	149	62,530	0.01	0.72	0.74	46	3
44	Berlin	DE	3,333	35,640	0.32	0.41	0.73	41	-3
45	Madrid	ES	1,521	50,547	0.15	0.58	0.73	42	-3
46	Barcelona	ES	2,326	43,209	0.22	0.50	0.72	44	-2
47	Chengdu	CN	1,449	48,095	0.14	0.56	0.69	52	5
48	Milan	IT	2,205	38,821	0.21	0.45	0.66	48	0
49	Zürich	CH/DE	3,117	29,945	0.30	0.35	0.64	50	1
50	Denver, CO	US	2,789	32,387	0.27	0.37	0.64	49	-1

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TABLE S-1.1

Top 100 cluster rankings, continued

Rank	Cluster name	Economy	PCT applications	Scientific publications	Share of total PCT filings, %	Share of total pubs, %	Total	Rank 2013-17	Rank change
51	Istanbul	TR	2,677	31,709	0.26	0.37	0.62	54	3
52	Montréal, QC	CA	2,027	36,816	0.19	0.42	0.62	51	-1
53	Heidelberg-Mannheim	DE	3,913	20,814	0.37	0.24	0.61	53	0
54	Copenhagen	DK	2,958	27,267	0.28	0.31	0.60	55	1
55	Atlanta, GA	US	1,646	36,533	0.16	0.42	0.58	56	1
56	Tianjin	CN	812	41,989	0.08	0.48	0.56	60	4
57	Cambridge	GB	2,623	26,033	0.25	0.30	0.55	58	1
58	Rome	IT	791	40,233	0.08	0.46	0.54	57	-1
59	Cincinnati, OH	US	3,900	14,133	0.37	0.16	0.54	61	2
60	Bengaluru	IN	3,289	17,021	0.31	0.20	0.51	65	5
61	São Paulo	BR	751	37,675	0.07	0.43	0.51	59	-2
62	Dallas, TX	US	3,157	17,340	0.3	0.20	0.50	64	2
63	Nuremberg-Erlangen	DE	3,729	12,515	0.36	0.14	0.50	62	-1
64	Pittsburgh, PA	US	1,617	29,864	0.15	0.34	0.50	63	-1
65	Ann Arbor, MI	US	1,355	30,856	0.13	0.36	0.49	66	1
66	Changsha	CN	502	37,115	0.05	0.43	0.48	67	1
67	Delhi	IN	855	33,570	0.08	0.39	0.47	70	3
68	Helsinki	FI	2,789	17,047	0.27	0.20	0.46	68	0
69	Qingdao	CN	2,074	22,957	0.20	0.26	0.46	80	11
70	Vienna	AT	1,551	27,119	0.15	0.31	0.46	69	-1
71	Oxford	GB	1,430	27,016	0.14	0.31	0.45	71	0
72	Suzhou	CN	2,627	15,129	0.25	0.17	0.43	81	9
73	Cleveland, OH	US	1,456	24,679	0.14	0.28	0.42	73	0
74	Vancouver, BC	CA	1,460	24,514	0.14	0.28	0.42	72	-2
75	Busan	KR	2,190	17,982	0.21	0.21	0.42	75	0
76	Lyon	FR	2,328	16,665	0.22	0.19	0.41	74	-2
77	Chongqing	CN	689	30,023	0.07	0.35	0.41	88	11
78	Phoenix, AZ	US	2,469	13,701	0.24	0.16	0.39	76	-2
79	Hefei	CN	536	29,536	0.05	0.34	0.39	90	11
80	Harbin	CN	168	31,980	0.02	0.37	0.39	87	7
81	Ottawa, ON	CA	1,964	16,842	0.19	0.19	0.38	78	-3
82	Jinan	CN	511	27,956	0.05	0.32	0.37	89	7
83	Brisbane	AU	1,174	22,184	0.11	0.26	0.37	83	0
84	Bridgeport-New Haven, CT	US	1,298	20,993	0.12	0.24	0.37	82	-2
85	Hamamatsu	JP	3,407	3,433	0.33	0.04	0.36	102	17
86	Austin, TX	US	2,184	13,501	0.21	0.16	0.36	79	-7
87	Changchun	CN	209	29,720	0.02	0.34	0.36	93	6
88	Ankara	TR	430	27,758	0.04	0.32	0.36	77	-11
89	Lausanne	CH/FR	1,921	14,682	0.18	0.17	0.35	86	-3
90	Hamburg	DE	1,806	15,146	0.17	0.17	0.35	84	-6
91	Kanazawa	JP	2,987	4,537	0.29	0.05	0.34	106	15
92	Grenoble	FR	1,950	12,854	0.19	0.15	0.33	85	-7
93	Manchester	GB	938	21,115	0.09	0.24	0.33	92	-1
94	St. Louis, MO	US	948	21,012	0.09	0.24	0.33	94	0
95	Basel	CH/DE/FR	2,020	12,133	0.19	0.14	0.33	91	-4
96	Lund-Malmö	SE	2,037	11,980	0.19	0.14	0.33	95	-1
97	Columbus, OH	US	961	20,411	0.09	0.24	0.33	96	-1
98	Mumbai	IN	1,196	18,213	0.11	0.21	0.32	97	-1
99	Warsaw	PL	436	23,981	0.04	0.28	0.32	100	1
100	Göteborg	SE	1,806	12,613	0.17	0.15	0.32	101	1

Source: WIPO Statistics Database, March 2020.

This reflects the relatively fast growth in patents and scientific publications attributable to these clusters.

Figure S-1.1 compares the net change in clusters' S&T output to their change in rank from last year to this year. The net change in cluster output reflects the S&T output for 2018 less the S&T output for 2013. As can be seen, rank changes correlate closely with output performance changes. In other words, movements up and down the ranks mostly reflect differences in S&T output growth rates. However, there are some notable exceptions. Taipei-Hsinchu, Hamamatsu, and Kanazawa see rank improvements that are disproportionately greater than their net change in S&T output. This is due to a substantial expansion in these three clusters' geography.[4] By contrast, the enlarged Shenzhen-Hong Kong-Guangzhou cluster did not see any rank improvement, which reflects the cluster's already high 2nd position. There are also a considerable number of clusters—such as Phoenix and Ottawa—that have registered increases in net S&T output but have nonetheless fallen in the ranking. This reflects the relative nature of the ranking, as those clusters were overtaken by others that registered even higher increases in net S&T output.

The composition of countries hosting S&T clusters is similar to that of last year—which, again, is a result of the overall stability of the top 100 clusters. The United States of America (U.S.) accounts for 25 clusters—one less compared to last year.[5] With 17 clusters, China's count remains the same, if one takes into account the Shenzhen-Hong Kong-Guangzhou merger. Germany follows with 10 clusters. Japan increased its count from 3 to 5, as 2 smaller clusters—Hamamatsu and Kanazawa—entered the ranking. The top 100 clusters are located in 26 countries, of which 6—Brazil, China, India, Iran, Turkey, and Russia—represent middle-income economies.[6]

S&T intensity of the top 100 clusters

Our top 100 clusters pinpoint the geographical areas accounting for most S&T activity in the world. However, they differ vastly in size and population density. For example, Istanbul (51st) and Montréal (52nd) show similar S&T performance, but the Istanbul metropolitan area has a population of 15.5 million, whereas the Montréal metropolitan area has a population of 4.1 million.[7] In other words, S&T activity is comparatively more intense in Montréal than in Istanbul.

To capture the S&T intensity of our top 100 clusters, we measure per capita S&T output. Given that we identify clusters using a bottom up method, this is not a straightforward exercise. The boundaries of our clusters do not coincide with municipal districts for which population data are readily available. We, therefore, need to draw on geospatial imagery that estimates population levels at a more granular level. In particular, we draw on the Global Human Settlement Population Grid dataset of the European Commission's Joint Research Centre that provides such imagery at a resolution of 250–300 square meters. The Appendix describes in detail how we match our clusters to the population imagery.

Table S-1.2 presents our top 100 clusters ranked by their S&T intensity. Our measure of S&T intensity is the sum of patent and scientific publication shares associated with a cluster, divided by its population. As can be seen, Cambridge and Oxford in the United Kingdom (U.K.) emerge as the most S&T-intensive clusters. Both clusters host highly productive scientific organizations in relatively small urban agglomerations. Cambridge additionally has a relatively large presence of tech companies—for example, ARM and Nokia—which results in a patent output normally seen in agglomerations with twice the population.[8] In the case of 3rd-ranked Eindhoven, the high S&T intensity principally stems from high patenting output. Interestingly, 4th-ranked San Jose-San Francisco illustrates that high S&T intensity does not have to be associated with small size. This cluster hosts a population of more than six million, and it is the fifth-largest S&T cluster in absolute terms (Table S-1.1).

Figure S-1.2 compares the absolute and per capita ranks of the 100 S&T clusters in a scatterplot. It confirms, first of all, that there is no obvious correlation between the rankings. There is wide variation in the S&T intensity of both small and large clusters. For example, Shanghai—ranked 9th in absolute size—holds only the 82nd position in the intensity ranking. By contrast, Lund-Malmö is only the 96th largest cluster but occupies the 10th position in the intensity ranking.

Another interesting pattern emerging from Figure S-1.2 is that many of the U.S. clusters appear in the upper right corner of the scatterplot—they are large in absolute and relative terms. Important exceptions are New York City and Los Angeles, which rank in the top 20 clusters mainly because of their large size and not their S&T intensity. Many Chinese clusters, in turn, do not exhibit high S&T intensity, which reflects the large populations covered by them.[9] One exception is the 4th ranked Beijing cluster, which still shows considerable S&T intensity and has a performance similar to that of Seoul. Interestingly, Tokyo-Yokohama—the top S&T and second most populous cluster—still shows high S&T intensity notwithstanding its large size.

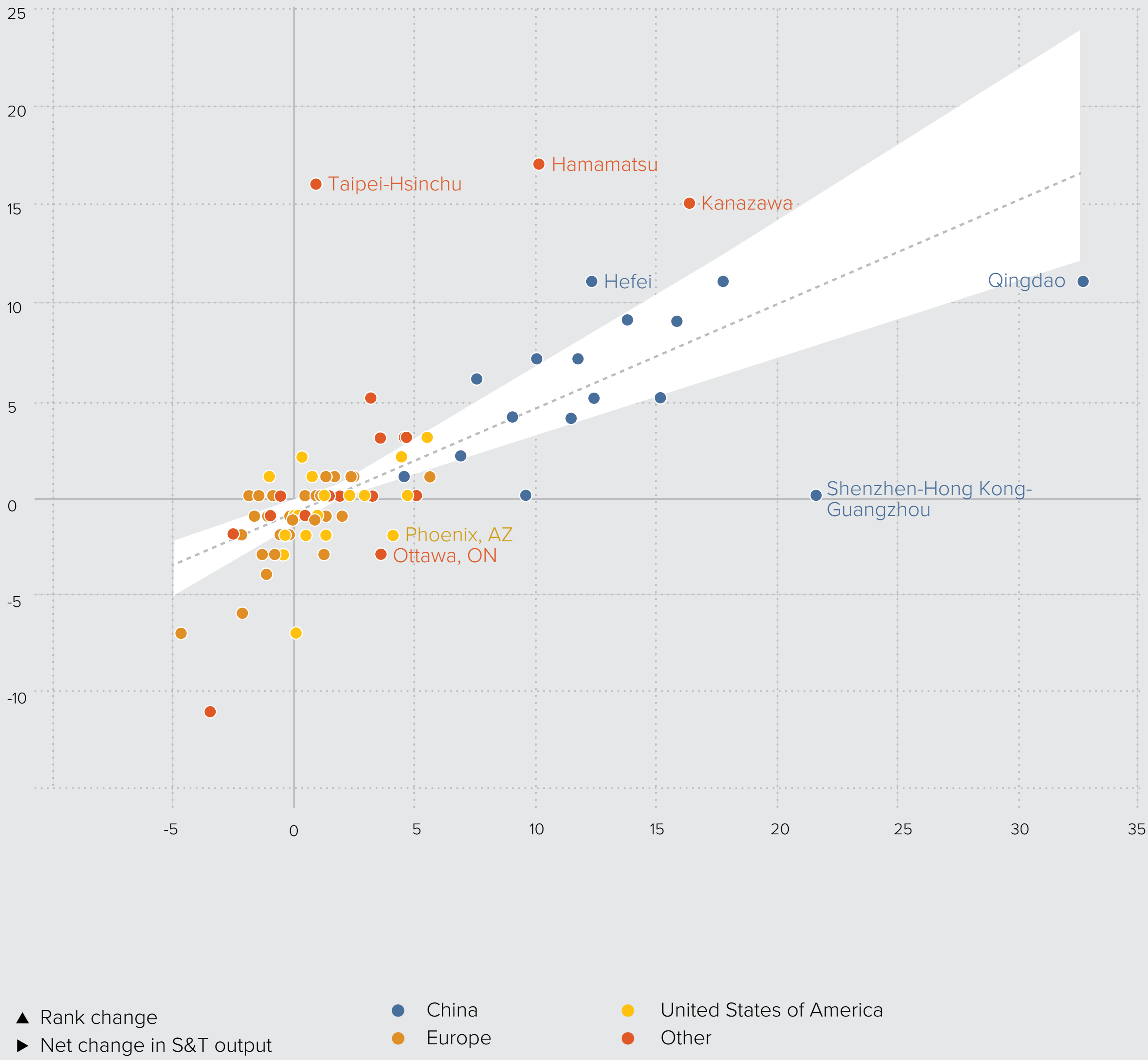
Many of the European clusters show above-average S&T intensity, but do not necessarily feature among the top-ranked clusters. This reflects the different agglomeration patterns in Europe, which have resulted in smaller cities compared to North America and East Asia.

Finally, Figure S-1.3 plots the S&T intensity of clusters against their population levels. It also indicates whether a cluster's S&T output is mainly driven by patenting, mainly driven by scientific publication, or equally driven by both types of S&T output. Two insights emerge.

First, there is a negative correlation between S&T intensity and population, especially for populations below 3.3 million. This reflects the presence of select small and midsize cities specializing in S&T activities. In larger cities, this specialization effect seems less pronounced, and the S&T intensity of clusters becomes more similar. Again, San Jose-San Francisco emerges as the most significant outlier in this respect, suggesting a disproportionately high degree of S&T specialization notwithstanding the cluster's large size.

FIGURE S-1.1

Rank change versus net change in S&T output for the top 100 clusters



Source: WIPO Statistics Database, March 2020.
Notes: "Rank change" is the change in a cluster's rank compared to last year. "Net change in S&T output" is defined as the (new) S&T output for 2018 minus the (removed) S&T output for 2013, holding clusters' geographies constant using this year's geographies

TABLE S-1.2

Ranking of S&T intensity

Intensity rank	Cluster name	Economy	Estimated cluster population	PCT applications per capita (a)	Scientific publications per capita (a)	Total S&T share per capita (b)
1	Cambridge	GB	449,129	584	5,796	1.23
2	Oxford	GB	508,033	282	5,318	0.88
3	Eindhoven	BE/NL	1,008,639	816	602	0.85
4	San Jose-San Francisco, CA	US	6,056,626	656	1,486	0.80
5	Ann Arbor, MI	US	620,199	218	4,975	0.78
6	Boston-Cambridge, MA	US	4,029,151	384	3,201	0.74
7	Daejeon	KR	1,683,639	493	1,546	0.65
8	Seattle, WA	US	2,315,154	499	1,475	0.65
9	San Diego, CA	US	3,552,659	554	975	0.64
10	Lund-Malmö	SE	595,436	342	2,012	0.56
11	Raleigh, NC	US	1,554,250	190	3,056	0.53
12	Grenoble	FR	642,565	303	2,000	0.52
13	Lausanne	CH/FR	691,003	278	2,125	0.51
14	Stockholm	SE	1,905,106	301	1,439	0.45
15	Munich	DE	2,480,475	304	1,260	0.44
16	Göteborg	SE	781,819	231	1,613	0.41
17	Kanazawa	JP	859,213	348	528	0.39
18	Helsinki	FI	1,197,375	233	1,424	0.39
19	Nuremberg-Erlangen	DE	1,304,244	286	960	0.38
20	Copenhagen	DK	1,561,237	189	1,746	0.38
21	Portland, OR	US	2,073,296	302	596	0.36
22	Pittsburgh, PA	US	1,399,419	116	2,134	0.36
23	Minneapolis, MN	US	2,545,762	253	988	0.36
24	Zürich	CH/DE	1,831,070	170	1,635	0.35
25	Basel	CH/DE/FR	960,928	210	1,263	0.35
26	Tokyo-Yokohama	JP	36,229,685	313	397	0.34
27	Stuttgart	DE	3,015,276	276	605	0.33
28	Bridgeport-New Haven, CT	US	1,110,364	117	1,891	0.33
29	Ottawa, ON	CA	1,216,805	161	1,384	0.31
30	Heidelberg-Mannheim	DE	1,964,398	199	1,060	0.31
31	Houston, TX	US	5,227,899	208	979	0.31
32	Hamamatsu	JP	1,188,729	287	289	0.31
33	Cleveland, OH	US	1,385,879	105	1,781	0.31
34	Cincinnati, OH	US	1,776,679	220	795	0.30
35	Washington, DC-Baltimore, MD	US	6,231,144	74	1,920	0.29
36	Beijing	CN	19,661,686	128	1,229	0.26
37	Seoul	KR	21,845,038	187	645	0.25
38	Austin, TX	US	1,492,160	146	905	0.24
39	Nagoya	JP	8,785,429	220	280	0.24
40	St. Louis, MO	US	1,422,096	67	1,478	0.23
41	Sydney	AU	3,450,163	72	1,429	0.23
42	Atlanta, GA	US	2,529,174	65	1,444	0.23
43	Denver, CO	US	2,806,543	99	1,154	0.23
44	Vancouver, BC	CA	1,862,596	78	1,316	0.23
45	Columbus, OH	US	1,444,747	67	1,413	0.23
46	Lyon	FR	1,831,493	127	910	0.23
47	Osaka-Kobe-Kyoto	JP	16,182,399	182	417	0.22
48	Philadelphia, PA	US	4,023,359	79	1,264	0.22
49	Frankfurt Am Main	DE	3,562,097	145	698	0.22
50	Chicago, IL	US	5,777,498	107	1,003	0.22

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TABLE S-1.2

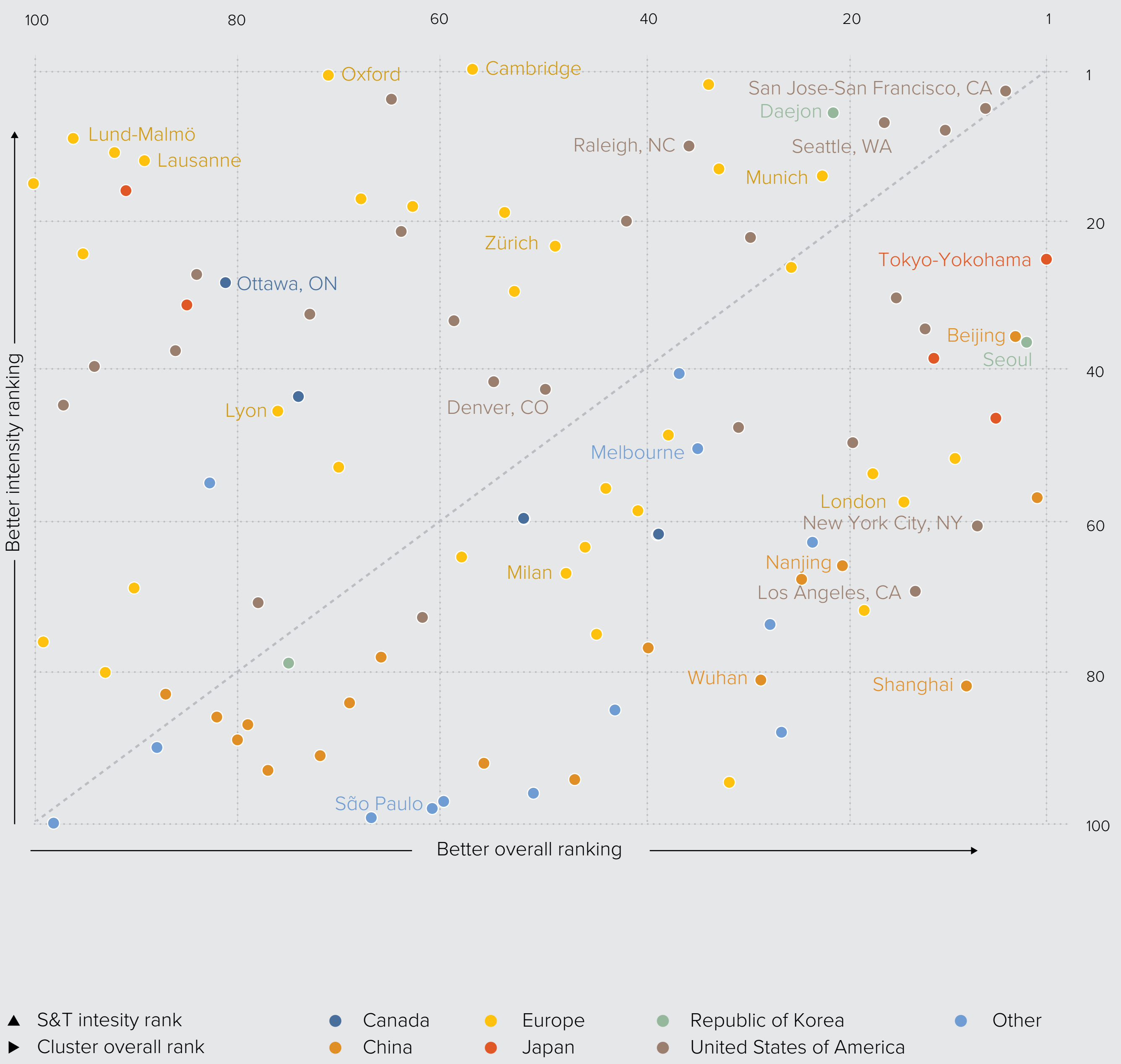
Ranking of S&T intensity, continued

Intensity rank	Cluster name	Economy	Estimated cluster population	PCT applications per capita (a)	Scientific publications per capita (a)	Total S&T share per capita (b)
51	Melbourne	AU	3,875,256	51	1,461	0.22
52	Paris	FR	10,986,036	123	847	0.22
53	Vienna	AT	2,220,257	70	1,221	0.21
54	Amsterdam-Rotterdam	NL	6,725,574	66	1,169	0.20
55	Brisbane	AU	1,907,143	62	1,163	0.19
56	Berlin	DE	3,874,431	86	920	0.19
57	Shenzhen-Hong Kong-Guangzhou	CN/HK	44,965,775	161	264	0.18
58	London	GB	9,015,343	47	1,194	0.18
59	Brussels	BE	4,159,224	76	939	0.18
60	Montréal, QC	CA	3,415,241	59	1,078	0.18
61	New York City, NY	US	15,539,937	79	883	0.18
62	Toronto, ON	CA	4,408,712	53	1,089	0.18
63	Tel Aviv-Jerusalem	IL	6,207,321	114	501	0.17
64	Barcelona	ES	4,349,072	53	994	0.17
65	Rome	IT	3,319,490	24	1,212	0.16
66	Nanjing	CN	7,029,606	24	1,206	0.16
67	Milan	IT	4,234,696	52	917	0.16
68	Hangzhou	CN	6,849,815	71	710	0.15
69	Hamburg	DE	2,364,204	76	641	0.15
70	Los Angeles, CA	US	11,851,722	82	584	0.15
71	Phoenix, AZ	US	2,707,525	91	506	0.15
72	Cologne	DE	9,057,074	86	521	0.14
73	Dallas, TX	US	3,763,640	84	461	0.13
74	Singapore	SG	6,993,405	57	658	0.13
75	Madrid	ES	5,570,432	27	907	0.13
76	Warsaw	PL	2,435,166	18	985	0.13
77	Xi'an	CN	6,203,467	12	967	0.12
78	Changsha	CN	3,912,227	13	949	0.12
79	Busan	KR	3,529,905	62	509	0.12
80	Manchester	GB	2,835,900	33	745	0.12
81	Wuhan	CN	8,107,626	22	787	0.11
82	Shanghai	CN	24,341,974	55	503	0.11
83	Changchun	CN	3,397,721	6	875	0.11
84	Qingdao	CN	4,346,522	48	528	0.11
85	Tehran	IR	7,000,893	2	893	0.11
86	Jinan	CN	3,668,439	14	762	0.10
87	Hefei	CN	4,232,996	13	698	0.09
88	Taipei-Hsinchu	TW	10,638,072	26	587	0.09
89	Harbin	CN	4,190,433	4	763	0.09
90	Ankara	TR	4,444,779	10	625	0.08
91	Suzhou	CN	5,238,169	50	289	0.08
92	Tianjin	CN	7,663,741	11	548	0.07
93	Chongqing	CN	5,630,242	12	533	0.07
94	Chengdu	CN	9,476,676	15	508	0.07
95	Moscow	RU	13,290,360	15	438	0.07
96	Istanbul	TR	14,429,857	19	220	0.04
97	Bengaluru	IN	11,892,944	28	143	0.04
98	São Paulo	BR	18,446,522	4	204	0.03
99	Delhi	IN	24,285,666	4	138	0.02
100	Mumbai	IN	19,808,326	6	92	0.02

Source: WIPO Statistics Database, March 2020.
Notes: (a) Per capita figures refer to 100,000 of population. (b) Per capita figures refer to 1,000,000 of population.

FIGURE S-1.2

Comparing cluster ranks to S&T intensity ranks



Source: WIPO Statistics Database, March 2020.
Notes: See Table S-1.1 for cluster ranks and Table S-1.2 for S&T intensity ranks.

FIGURE S-1.3

S&T intensity by population

Source: WIPO Statistics Database, March 2020.
Note: Cluster focus defined as any cluster where 60% or more of S&T output is from either academic publications or PCT patents.

Second, S&T intensity is, on average, higher if S&T output is mainly driven by patenting activity. This suggests that agglomeration effects associated with patenting activity may be stronger than those associated with scientific publishing. Again, however, a few outliers challenge this relationship—notably Cambridge in the U.K. and Boston-Cambridge in the U.S.—though, even in these cases, patenting is at least as important as scientific publication.

Conclusion

This chapter presented the latest ranking of the world's top 100 S&T clusters. Year-over-year changes in cluster ranks remain modest, though they are in line with the longer-term trend—namely, faster growth of S&T activity in East Asia and especially in China. Analyzing the S&T intensity of clusters provides a more nuanced perspective of the world's S&T cluster landscape. In particular, it suggests that many European and U.S. clusters show more intense S&T activity than their Asian counterparts, even though they show lower S&T activity in absolute terms.

As in previous years, it is important to point out that the shape of the clusters identified in this chapter and their measured performance depend on certain parameter choices. We have carefully rationalized the parameter values we have adopted and tested the sensitivity of our results to a plausible range of values.[10] While we are confident that the global patterns and trends discussed here would remain the same, it is nonetheless the case that different values may change the shape and output of certain clusters—especially those located in population-dense regions.

Notes:

1 Table SA-1.1 provides an overview of the geocoding results using the latest available data.

2 Bergquist et al., 2018.

3 Technically, the DBSCAN algorithm underlying the identification of clusters still identified Shenzhen-Hong Kong and Guangzhou as separate clusters. However, applying the same criteria for when to merge adjacent clusters as the ones used in the past (see Bergquist et al., 2018) leads—for the first time—to a merging of these two clusters. While this outcome is sensitive to the values of the DBSCAN parameters and merger criteria, the underlying phenomenon is real, in the sense that we observe many new inventor/author points at the periphery of the two previous separate clusters.

4 Note that the calculation of the net change in S&T output keeps the cluster geography constant using this year's geographies. This understates the true net change in S&T output for those clusters that have seen an expanding geography. In the case of Hamamatsu and Kanazawa, the larger cluster size emerged directly from the application of the DBSCAN algorithm to the updated data. The expansion of the Taipei-Hsinshu cluster, in turn, is due to a first-time merger of two previously separate clusters, similar to the Shenzhen-Hong Kong-Guangzhou cluster

5 Indianapolis dropped out of the top 100.

6 Ireland (Dublin) dropped out of the top 100.

7 These figures were taken from the Wikipedia pages of these two metropolitan areas.

8 See table S-1.3 for the full breakdown of the top scientific organizations and patent applicants per cluster.

9 We likely underestimate the current S&T output and intensity of Chinese clusters, because the data underlying our analysis go back to 2014, and the Chinese clusters have seen particularly fast growth since then.

10 Bergquist et al., 2018; Global Innovation Index 2020 (Appendix I).

References:

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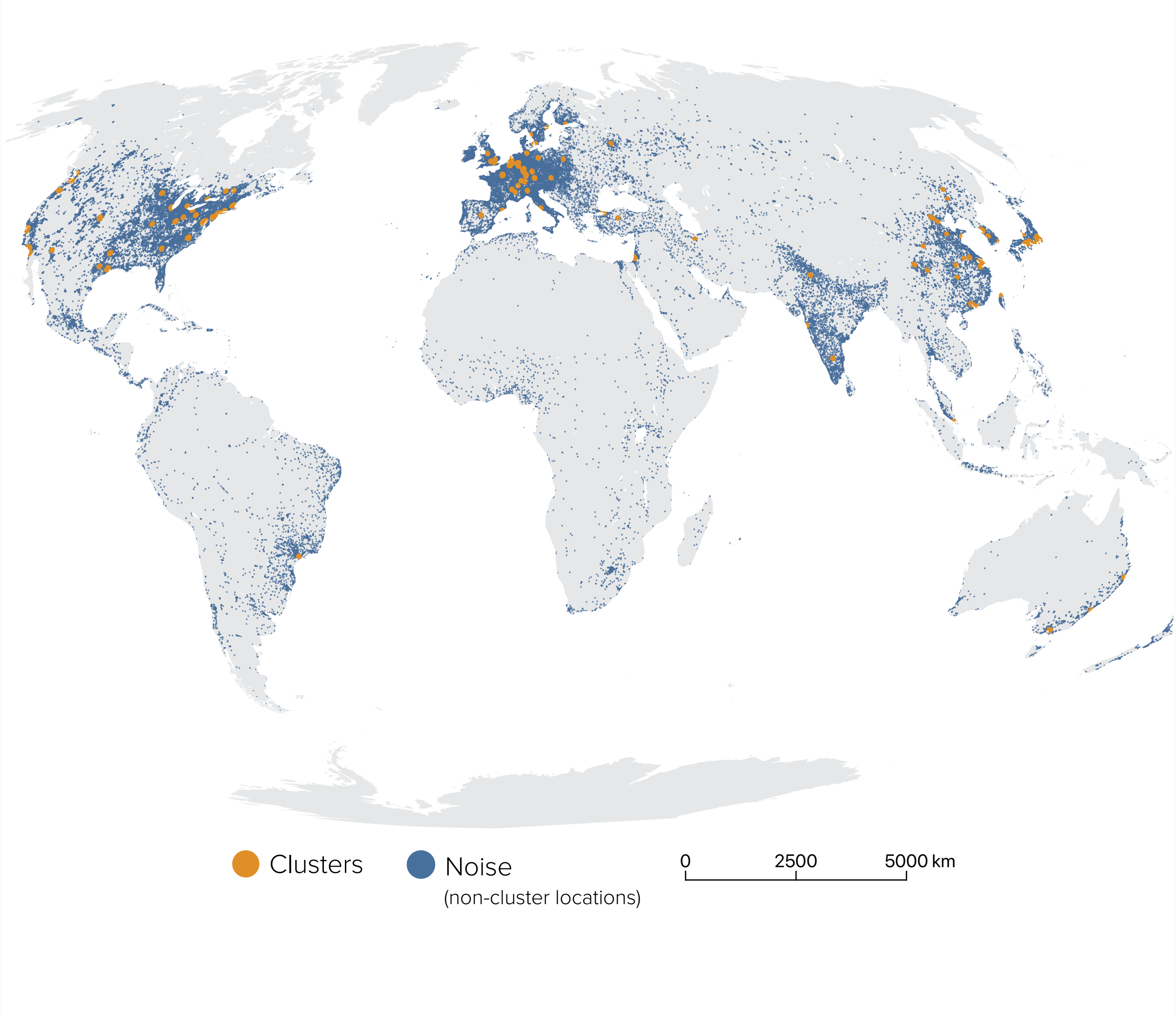
Schiavina, M., Freire, S., MacManus, K. (2019). GHS-POP R2019A - GHS population grid multitemporal (1975-1990-2000-2015) [Data set]. European Commission, Joint Research Centre (JRC). Retrieved from http://doi.org/10.2905/0C6B9751-A71F-4062-830B-43C9F432370F

FIGURE S-1.4

Top 100 clusters worldwide



Source: WIPO Statistics Database, March 2020
Note: Noise refers to all inventor/author locations not classified in a cluster.

TABLE S-1.3

Top 100 cluster rankings by publishing and patent performance

Rank	Cluster name	Economy	Scientific publishing performance		
			Top science field	Share, %	Top scientific organization
1	Tokyo-Yokohama	JP	Physics	8.73	University of Tokyo
2	Shenzhen-Hong Kong-Guangzhou	CN/HK	Chemistry	9.42	Sun Yat Sen University
3	Seoul	KR	Engineering	7.56	Seoul National University
4	Beijing	CN	Chemistry	10.09	Chinese Academy of Sciences
5	San Jose-San Francisco, CA	US	Chemistry	6.11	University of California
6	Osaka-Kobe-Kyoto	JP	Chemistry	10.08	Kyoto University
7	Boston-Cambridge, MA	US	Neurosciences & Neurology	5.79	Harvard University
8	New York City, NY	US	Neurosciences & Neurology	6.19	Columbia University
9	Shanghai	CN	Chemistry	12.61	Shanghai Jiao Tong University
10	Paris	FR	Physics	7.26	CNRS
11	San Diego, CA	US	Science & Technology-Other Topics	6.07	University of California
12	Nagoya	JP	Physics	9.38	Nagoya University
13	Washington, DC-Baltimore, MD	US	Neurosciences & Neurology	5.45	Johns Hopkins University
14	Los Angeles, CA	US	Neurosciences & Neurology	5.50	University of California
15	London	GB	General & Internal Medicine	6.58	University of London
16	Houston, TX	US	Oncology	11.29	UTMD Anderson Cancer Center
17	Seattle, WA	US	General & Internal Medicine	4.62	University of Washington
18	Amsterdam-Rotterdam	NL	Cardiovascular System & Cardiology	5.67	University of Utrecht
19	Cologne	DE	Chemistry	7.16	University of Bonn
20	Chicago, IL	US	Chemistry	5.49	Northwestern University
21	Nanjing	CN	Chemistry	11.84	Nanjing University
22	Daejeon	KR	Engineering	13.37	KAIST
23	Munich	DE	Physics	7.59	University of Munich
24	Tel Aviv-Jerusalem	IL	Physics	5.89	Tel Aviv University
25	Hangzhou	CN	Chemistry	12.06	Zhejiang University
26	Stuttgart	DE	Chemistry	7.19	Eberhard Karls University of Tubingen
27	Taipei-Hsinchu	TW	Engineering	9.26	National Taiwan University
28	Singapore	SG	Engineering	10.42	National University of Singapore
29	Wuhan	CN	Chemistry	10.35	Huazhong University of Science & Tech.
30	Minneapolis, MN	US	Chemistry	6.03	University of Minnesota
31	Philadelphia, PA	US	Neurosciences & Neurology	6.31	University of Pennsylvania
32	Moscow	RU	Physics	17.18	Russian Academy of Sciences
33	Stockholm	SE	Science & Technology-Other Topics	5.78	Karolinska Institutet
34	Eindhoven	BE/NL	Engineering	14.64	Eindhoven University of Tech.
35	Melbourne	AU	General & Internal Medicine	5.19	University of Melbourne
36	Raleigh, NC	US	Science & Technology-Other Topics	4.54	University of North Carolina
37	Sydney	AU	General & Internal Medicine	5.17	University of Sydney
38	Frankfurt Am Main	DE	Physics	8.68	Goethe University Frankfurt
39	Toronto, ON	CA	Neurosciences & Neurology	7.20	University of Toronto
40	Xi'an	CN	Engineering	14.64	Xi'an Jiaotong University
41	Brussels	BE	Neurosciences & Neurology	4.73	KU Leuven
42	Portland, OR	US	Neurosciences & Neurology	6.67	Oregon University System
43	Tehran	IR	Engineering	16.01	University of Tehran
44	Berlin	DE	Chemistry	7.23	Free University Of Berlin
45	Madrid	ES	Chemistry	5.61	CSIC
46	Barcelona	ES	Chemistry	5.22	University of Barcelona
47	Chengdu	CN	Engineering	11.69	Sichuan University
48	Milan	IT	Neurosciences & Neurology	8.20	University of Milan
49	Zürich	CH/DE	Chemistry	7.61	ETH Zurich
50	Denver, CO	US	Meteorology & Atmospheric Sciences	4.85	University of Colorado

	Patent performance			
Share, %	Top patenting field	Share, %	Top applicant	Share, %
10.4	Electrical machinery, apparatus, energy	9.69	Mitsubishi Electric	8.79
11.09	Digital communication	31.37	Huawei	23.46
11.67	Digital communication	17.27	LG Electronics	19.31
16.25	Digital communication	21.64	BOE Technology Group	28.24
28.83	Computer technology	23.28	Google	8.61
16.51	Electrical machinery, apparatus, energy	12.87	Murata Manufacturing	11.13
38.37	Pharmaceuticals	16.57	M.I.T	6.30
9.79	Pharmaceuticals	14.17	Honeywell	5.98
16.58	Digital communication	21.45	ZTE Corp.	22.66
17.03	Transport	11.19	L'Oréal	7.12
38.51	Digital communication	31.94	Qualcomm	59.31
26.37	Electrical machinery, apparatus, energy	18.26	DENSO Corp.	21.78
18.4	Pharmaceuticals	17.79	Johns Hopkins University	12.86
33.36	Medical technology	19.09	University of California	6.29
36.89	Computer technology	12.90	British Telecom	9.21
18.58	Civil engineering	34.54	Halliburton	19.44
48.84	Computer technology	41.04	Microsoft	45.44
11.97	Civil engineering	6.65	Shell	8.43
11.22	Basic materials chemistry	9.77	Henkel	9.54
20.24	Digital communication	7.80	Illinois Tool Works	15.65
12.54	Electrical machinery, apparatus, energy	11.09	Southeast University	9.93
17.84	Electrical machinery, apparatus, energy	21.46	LG Chem	44.06
40.19	Transport	12.18	BMW	16.43
25.13	Computer technology	17.16	Intel	5.54
42.15	Computer technology	29.88	Alibaba Group	42.94
32.84	Electrical machinery, apparatus, energy	12.45	Robert Bosch	45.67
16.35	Computer technology	11.02	MediaTek	14.24
27.5	Computer technology	8.12	A*Star	17.93
21.05	Optics	15.25	Wuhan China Star Optoelectronics Tech.	27.15
52.37	Medical technology	31.29	3M Innovative Properties	36.04
37.54	Pharmaceuticals	21.35	University of Pennsylvania	10.42
27.41	Computer technology	12.28	Yandex Europe	4.06
36.17	Digital communication	40.83	LM Ericsson	46.18
45.62	Medical technology	27.12	Philips Electronics	72.08
17.92	Pharmaceuticals	9.08	Monash University	5.07
37.04	Pharmaceuticals	14.09	Duke University	9.86
29.53	Medical technology	12.24	Cochlear	4.84
17.57	Medical technology	12.91	Merck Patent	9.89
60.06	Medical technology	13.96	Synaptive Medical	5.88
20.43	Digital communication	15.80	Xi'an Zhongxing New Software	11.35
26.02	Basic materials chemistry	8.01	Procter & Gamble Company	5.92
47.25	Computer technology	20.64	Intel	54.34
7.86	Medical technology	14.93	Fanavaran Nano-Meghyas	2.69
27.65	Electrical machinery, apparatus, energy	11.10	Siemens	13.76
11.17	Digital communication	10.59	CSIC	9.24
22.19	Pharmaceuticals	9.83	Hewlett-Packard	24.53
30.2	Pharmaceuticals	11.66	Sichuan University	4.91
18.24	Pharmaceuticals	7.02	Pirelli Tyre	7.63
29.23	Medical technology	8.18	Sika Technology	5.14
41.79	Medical technology	12.84	University of Colorado	7.09

CONTINUED

TABLE S-1.3

Top 100 cluster rankings by publishing and patent performance, continued

Rank	Cluster name	Economy	Scientific publishing performance		
			Top science field	Share, %	Top scientific organization
51	Istanbul	TR	Engineering	7.22	Istanbul University
52	Montréal, QC	CA	Engineering	7.29	McGill University
53	Heidelberg-Mannheim	DE	Oncology	9.86	Ruprecht Karl University Heidelberg
54	Copenhagen	DK	Neurosciences & Neurology	5.61	University of Copenhagen
55	Atlanta, GA	US	Public, Environmental & Occupational Health	6.92	Emory University
56	Tianjin	CN	Chemistry	17.49	Tianjin University
57	Cambridge	GB	Science & Technology-Other Topics	7.69	University of Cambridge
58	Rome	IT	Neurosciences & Neurology	6.75	Sapienza University Rome
59	Cincinnati, OH	US	Pediatrics	6.24	University of Cincinnati
60	Bengaluru	IN	Chemistry	12.62	IISC-Bangalore
61	São Paulo	BR	Neurosciences & Neurology	4.21	Universidade de Sao Paulo
62	Dallas, TX	US	Cardiovascular System & Cardiology	6.34	Univ. of Texas Southwestern Med. Center
63	Nuremberg-Erlangen	DE	Chemistry	7.75	University of Erlangen Nuremberg
64	Pittsburgh, PA	US	Neurosciences & Neurology	6.00	PCSHE
65	Ann Arbor, MI	US	Chemistry	4.47	University of Michigan
66	Changsha	CN	Engineering	11.43	Central South University
67	Delhi	IN	Chemistry	7.93	All India Institute of Medical Sciences
68	Helsinki	FI	Science & Technology-Other Topics	5.10	University of Helsinki
69	Qingdao	CN	Chemistry	13.08	Ocean University of China
70	Vienna	AT	Science & Technology-Other Topics	5.14	Medical University of Vienna
71	Oxford	GB	Physics	6.92	University of Oxford
72	Suzhou	CN	Chemistry	16.99	Suzhou University
73	Cleveland, OH	US	Cardiovascular System & Cardiology	7.32	Cleveland Clinic
74	Vancouver, BC	CA	Neurosciences & Neurology	5.18	University of British Columbia
75	Busan	KR	Engineering	9.82	Pusan National University
76	Lyon	FR	Chemistry	6.86	CNRS
77	Chongqing	CN	Chemistry	10.06	Chongqing University
78	Phoenix, AZ	US	Neurosciences & Neurology	7.51	Arizona State University
79	Hefei	CN	Chemistry	14.05	University of Science & Tech. of China
80	Harbin	CN	Engineering	13.04	Harbin Institute of Technology
81	Ottawa, ON	CA	Engineering	5.73	University of Ottawa
82	Jinan	CN	Chemistry	13.85	Shandong University
83	Brisbane	AU	Engineering	5.38	University of Queensland
84	Bridgeport-New Haven, CT	US	Neurosciences & Neurology	6.78	Yale University
85	Hamamatsu	JP	Physics	8.20	Hamamatsu University School of Medicine
86	Austin, TX	US	Chemistry	10.12	University Of Texas Austin
87	Changchun	CN	Chemistry	22.06	Jilin University
88	Ankara	TR	Engineering	5.81	Hacettepe University
89	Lausanne	CH/FR	Chemistry	7.91	EPFL
90	Hamburg	DE	Physics	7.64	University of Hamburg
91	Kanazawa	JP	Chemistry	7.75	Kanazawa University
92	Grenoble	FR	Physics	16.45	CNRS
93	Manchester	GB	Chemistry	6.71	University of Manchester
94	St. Louis, MO	US	Neurosciences & Neurology	6.70	Washington University (WUSTL)
95	Basel	CH/DE/FR	Neurosciences & Neurology	7.53	University of Basel
96	Lund-Malmö	SE	Science & Technology-Other Topics	5.55	Lund University
97	Columbus, OH	US	Oncology	5.23	Ohio State University
98	Mumbai	IN	Chemistry	16.43	Bhabha Atomic Research Center
99	Warsaw	PL	Chemistry	9.35	Polish Academy of Sciences
100	Göteborg	SE	Engineering	7.32	University of Gothenburg

Source: WIPO Statistics Database, March 2020.
Notes: Patent filing and scientific publication shares refer to the 2014–18 period and are based on fractional counts, as explained in the text. We use the location of inventors to associate patent applicants to clusters; note that addresses of applicants may be outside the cluster(s) to which they are associated. The identification of technology fields relies on the WIPO technology concordance table linking International Patent Classification (IPC) symbols with 35 fields of technology (available at http://www.wipo.int/ipstats/en/). The

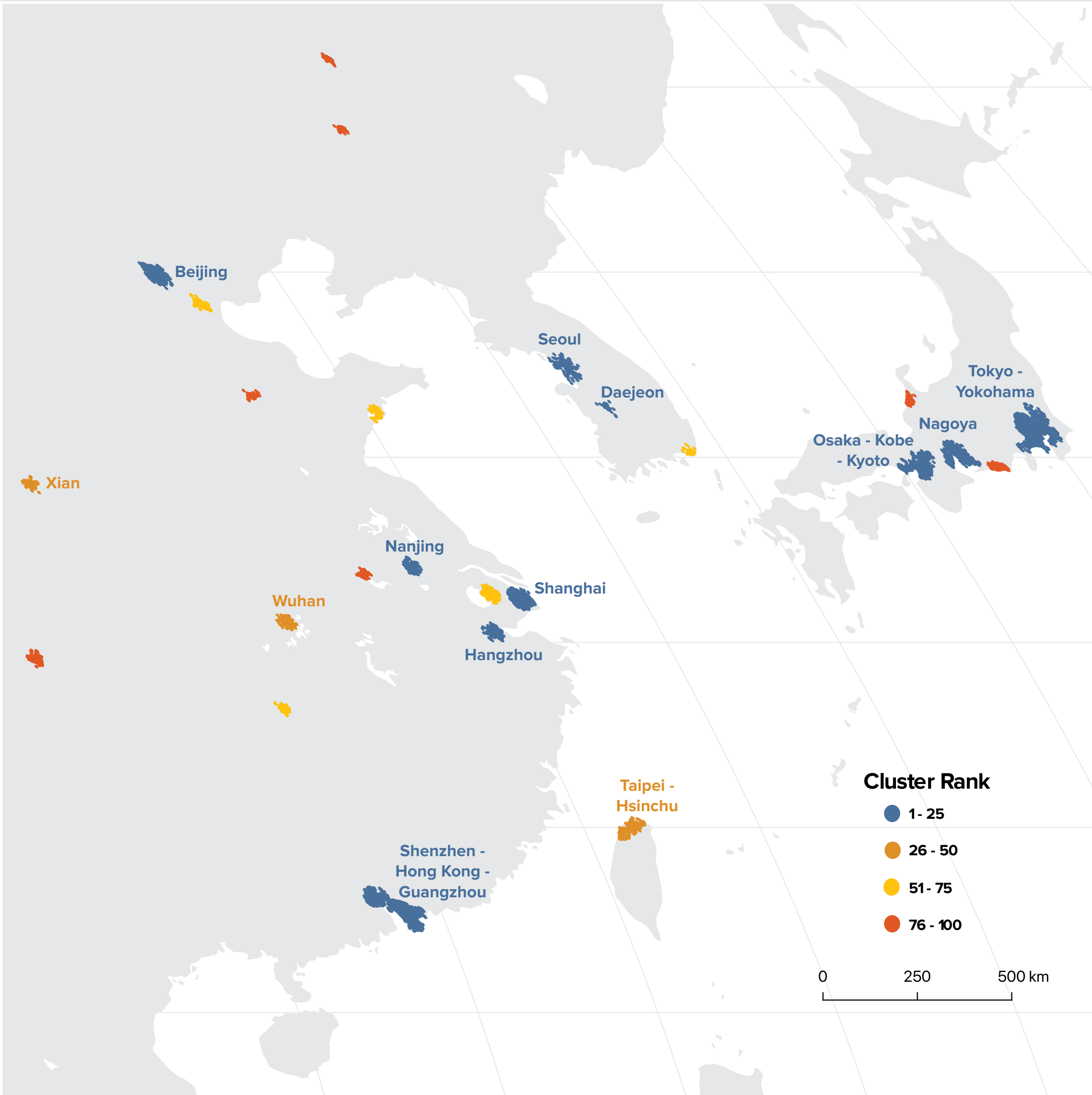
Patent performance

Share, %	Top patenting field	Share, %	Top applicant	Share, %
14.63	Other consumer goods	18.69	Arcelik	47.68
31.61	Digital communication	16.41	LM Ericsson	8.77
44.55	Basic materials chemistry	13.42	BASF	42.23
53.92	Biotechnology	14.95	Novozymes	10.76
27.34	Medical technology	13.58	Georgia Tech	7.70
20.57	Computer technology	10.47	Tianjin University	12.48
54.77	Computer technology	16.20	ARM	11.54
23.85	Pharmaceuticals	10.31	Bridgestone	7.58
32.76	Medical technology	33.82	Procter & Gamble Company	41.62
21.75	Computer technology	20.99	Hewlett-Packard	10.10
35.24	Medical technology	8.77	Natura Cosmeticos	4.01
36.11	Civil engineering	16.52	Halliburton	15.92
49.35	Electrical machinery, apparatus, energy	17.10	Siemens	35.26
50.15	Medical technology	12.69	University of Pittsburgh	14.15
65.63	Pharmaceuticals	10.22	University of Michigan	29.52
30.20	Electrical machinery, apparatus, energy	9.48	Zoomlion	7.97
10.26	Pharmaceuticals	12.02	Sun Pharmaceutical Industries	4.36
41.98	Digital communication	30.04	Nokia	11.79
15.45	Other consumer goods	43.01	Qingdao Haier Washing Machine	27.04
21.09	Electrical machinery, apparatus, energy	8.63	Technische Universitat Wien	4.28
57.83	Biotechnology	13.74	Oxford University	12.90
48.73	Digital communication	10.37	Fujitsu	11.76
35.07	Medical technology	17.22	Case Western Reserve University	10.71
52.55	Medical technology	9.44	University of British Columbia	5.99
27.37	Medical technology	7.68	Pusan National University	5.59
22.91	Basic materials chemistry	10.26	IFP Energies Nouvelles	11.29
18.59	Optics	16.58	HKC Corp.	36.69
37.63	Semiconductors	16.25	Intel	24.71
29.14	Other consumer goods	14.76	Hefei Hualing	15.29
30.20	Measurement	14.32	Harbin Institute of Technology	36.35
43.04	Digital communication	48.28	Huawei	42.98
42.47	Computer technology	17.85	Shandong University	18.35
36.87	Civil engineering	12.37	University of Queensland	8.18
63.11	Pharmaceuticals	15.69	Yale University	11.15
21.75	Mechanical elements	14.92	NTN Corp.	26.17
62.24	Computer technology	20.83	University Of Texas	13.94
41.61	Measurement	15.58	Changchun Institute Of Applied Chemistry	14.38
13.18	Medical technology	15.12	Aselsan	18.01
34.89	Food chemistry	8.86	NESTEC	25.83
42.84	Organic fine chemistry	14.60	Beiersdorf	8.75
52.62	Computer technology	8.89	Fujifilm Corp.	31.04
31.57	Electrical machinery, apparatus, energy	13.77	CEA	39.44
49.75	Electrical machinery, apparatus, energy	15.46	Micromass	13.54
51.25	Biotechnology	16.00	Monsanto Technology	17.65
45.41	Pharmaceuticals	18.98	F. Hoffmann-La Roche	13.56
64.26	Digital communication	25.61	LM Ericsson	24.18
66.73	Pharmaceuticals	12.87	Ohio State Innovation Foundation	18.96
17.00	Organic fine chemistry	17.71	Reliance Industries	4.90
14.59	Medical technology	8.43	General Electric	4.49
33.00	Digital communication	13.89	LM Ericsson	22.63

top scientific field is based on SCIE's Extended Ascatype subject field. An article can be assigned to more than one subject field. Fractional counting was used when more than one subject was assigned to an article. Codes refer to the ISO-2 codes. See chapter 1 for a full list, with the following addition: TW = Taiwan, Province of China. CNRS = Centre National De La Recherche Scientifique, KAIST = Korea Advanced Institute Of Science & Technology, CSIC = Consejo Superior De Investigaciones Cientificas, IISC - Bangalore = Indian Institute Of Science - Bangalore, PCSHE = Pennsylvania Commonwealth System Of Higher Education, EPFL = Ecole Polytechnique Federale De Lausanne, and CEA = Commissariat A L'Energie Atomique Et Aux Energies Alternatives.

FIGURE S-1.5

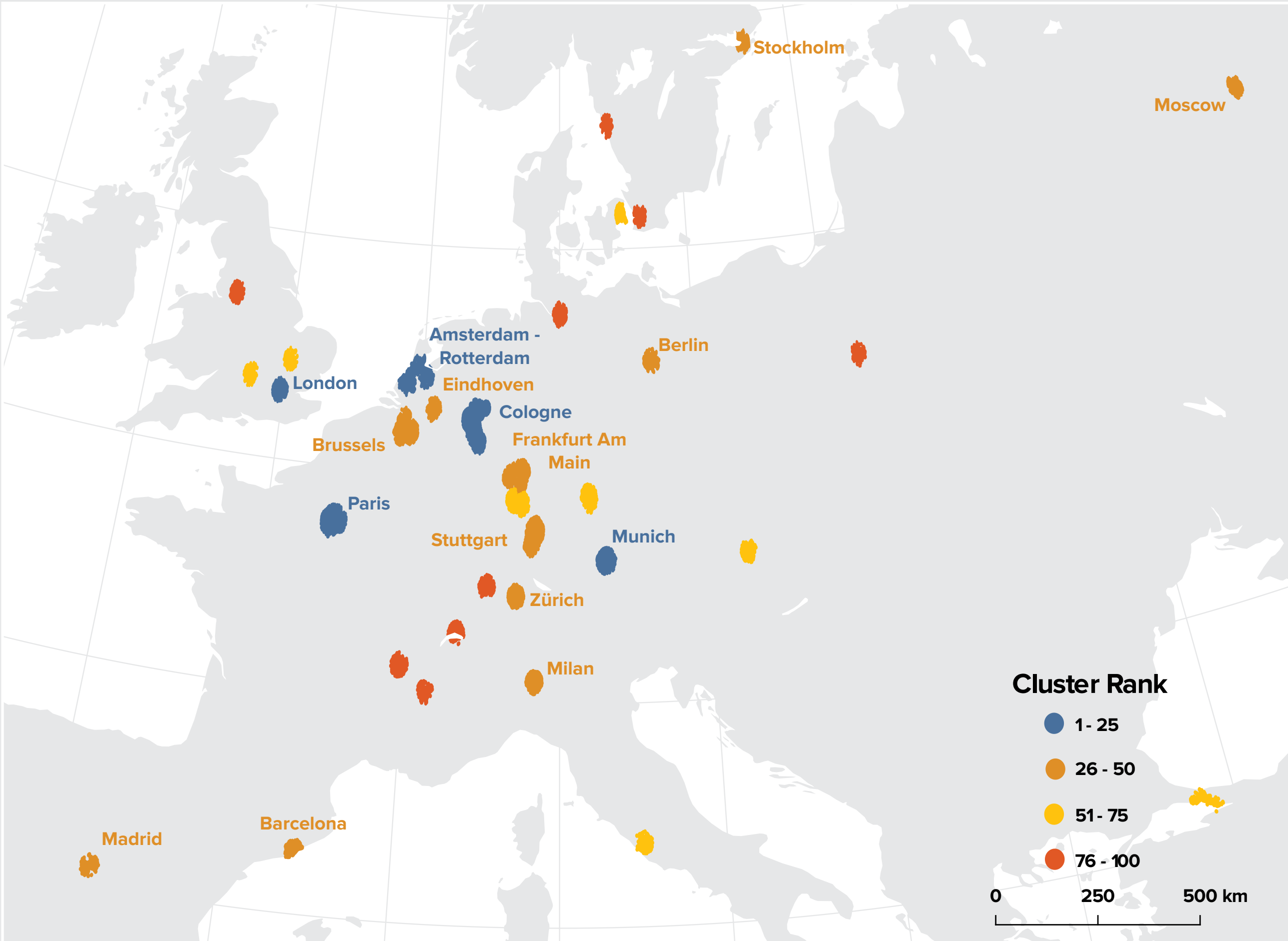
Regional clusters: Asia



Source: WIPO Statistics Database, March 2020.
Note: Cluster rank is based on total share in patent filing and scientific publication using fractional counting and the publication period of 2014-2018, as explained in the text.

FIGURE S-1.6

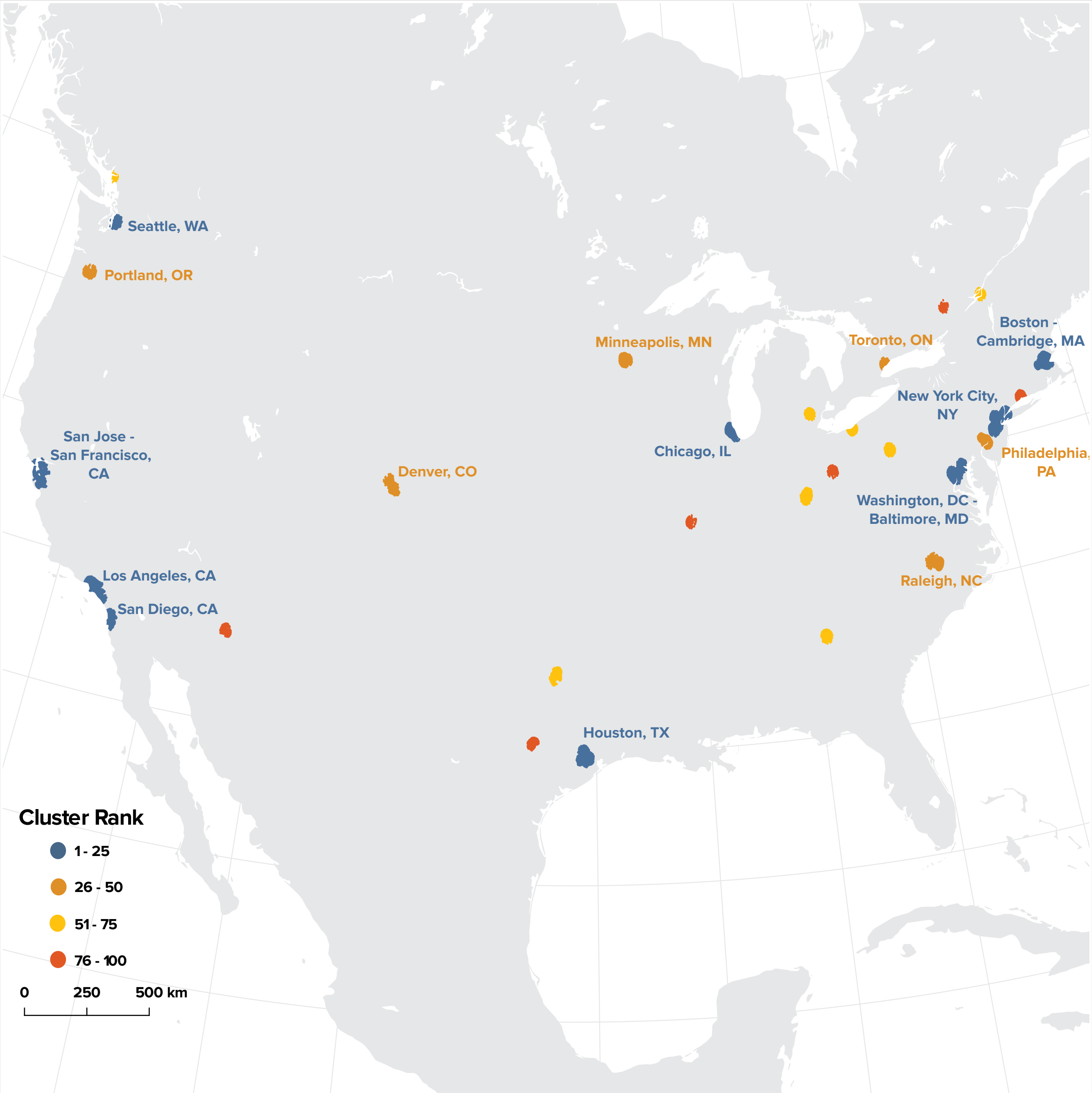
Regional clusters: Europe



Source: WIPO Statistics Database, March 2020.
Note: Cluster rank is based on total share in patent filing and scientific publication using fractional counting and the publication period of 2014-2018, as explained in the text.

FIGURE S-1.7

Regional clusters: Northern America



Source: WIPO Statistics Database, March 2020.
Note: Cluster rank is based on total share in patent filing and scientific publication using fractional counting and the publication period of 2014-2018, as explained in the text.

MATCHING S&T CLUSTERS TO POPULATION

Utilizing population data to enhance our cluster comparisons provides substantial improvement to our analysis. Unfortunately, aligning our “bottom up” clusters with typical population statistics is less than ideal. Our identified clusters almost never conform to standard administration boundaries with which we could find population statistics (for example, census blocks in the U.S. or NUTS—2/3 regions in the European Union). In addition, finding consistent administrative population data across multiple countries proved difficult.

To address these issues, we turned to the European Commission’s Global Human Settlement population distribution data. This data provides an estimation of population for every 250–300 square meters. By disaggregating census population data based on satellite imagery, we are able to plot population based on where people actually live, rather than just on arbitrary political boundaries. Having the population distribution at such a high level of detail allows us to reaggregate population into custom geographies (i.e., our clusters). Thus, just like our inventor/author geocoded locations, this population data allows us to define total population from the bottom up.

Matching the population data with our clusters is done geographically by capturing all pixels that are contained within a cluster’s area. For the purposes of aggregating population, we defined a cluster’s area as all space within 0.05 degrees of each inventor’s location.[1] Once the buffer radius was applied, we combined all areas of a cluster into one final polygon. We achieved the final total population by summing the values of all the population pixels that are contained in the final cluster polygon.[2]

The use of a buffer was preferred to possible alternative methods, due to its ability to capture nearby population pockets. For example, if we had limited our cluster area to edges defined only by our cluster points, we may have missed dense population areas that were just next to one of our points. This would have caused an underestimation of the population. As can be seen in Figure SA-1.1, if we had used only our cluster points to define the edges of San Jose-San Francisco, we would have missed the dense urban area of Concord, California. The use of buffers also minimizes errors that could occur from overreliance on imprecise geolocation. For example, our scientific publication data is only geocoded at the city level (see Table SA-1.1 for a full breakdown of our geocoding results). Thus, the use of a buffer for these points more appropriately reflects the lack of precision that some of our geolocated points have.

Buffers require a choice of radius size or how much area around the point should be included. Similar to choosing the radius and density parameters used for DBSCAN, we chose a buffer radius that minimizes the potential for false negatives (not capturing population areas that should be included in the cluster) and false positives (capturing areas that should not be included). Increasing the buffer radius decreases the risk of underestimating the population but increases the risk of overestimating it. This can be seen in Figure SA-1.1. If we had used 0.01 degrees as the radius, we would not have captured Concord, causing an underestimation. However, if we had chosen 0.10 degrees, we would have captured the city of Antioch, California, which is in the next valley over from Concord. This would have caused an overestimation of the

TABLE SA-1.1

Summary of geocoding results

Country	Scientific publications			PCT applications				
	Number of addresses	City-level address accuracy (%)	Publications covered (%)	Number of addresses	Block-level address accuracy (%)	Sub-City-level address accuracy (%)	City-level address accuracy (%)	Applications covered (%)
United States of America	5,925,624	97.55	98.64	861,743	94.25	5.40	0.15	99.86
China	3,454,935	99.04	99.47	451,848	92.35	0.05	4.90	97.38
Japan	1,117,078	94.96	97.02	548,970	32.50	28.20	37.73	98.76
Germany	1,262,920	97.36	98.18	258,816	97.47	0.41	1.68	99.74
United Kingdom	1,276,213	96.61	97.70	79,335	74.06	13.89	10.03	98.22
France	1,040,275	92.91	95.08	106,503	86.34	1.50	6.72	95.79
Italy	990,376	95.54	96.98	40,780	87.60	5.08	6.26	99.09
Republic of Korea	734,697	94.12	96.75	215,692	0.12	0.69	79.91	87.77
Canada	813,125	98.36	98.94	41,886	96.84	2.32	0.59	99.69
Australia	761,695	81.77	87.84	20,505	92.17	4.77	2.18	99.31
Spain	747,705	96.75	97.98	26,508	73.21	10.03	15.67	99.21
India	632,809	94.77	96.71	38,193	33.14	44.63	19.06	97.24
Brazil	572,348	98.65	99.54	9,304	80.48	12.25	6.30	99.45
Netherlands	471,728	97.38	98.48	50,790	87.47	0.38	11.79	99.66
Turkey	365,592	96.66	97.11	12,579	32.12	51.74	12.98	97.11
Iran (Islamic Republic of)	356,585	97.09	98.34	529	0.57	2.84	89.22	91.13
Russian Federation	341,968	99.00	99.26	14,542	85.57	5.35	7.35	99.26
Switzerland	300,307	90.67	92.37	35,888	89.74	3.71	4.34	98.55
Sweden	274,192	97.63	98.22	41,828	94.52	0.86	4.15	99.60
Israel	145,890	90.55	94.78	28,497	54.09	3.91	32.16	94.85

Source: WIPO Statistics Database, March 2020.
Note: This list includes the top 20 countries that account for the highest combined shares of patents and scientific articles. PCT inventor addresses were geocoded to the highest level of detail. Due to the much larger volume, scientific author addresses were geocoded to the city level only.

population. Therefore, we calculated population using a number of different radiuses for the buffer and looked at the changes in the population estimations, preferring the one that minimized large shifts. When compared to other distances, a radius of 0.05 degrees minimized large shifts in the total population calculated across all clusters as well as minimized the maximum population shift of any one cluster.

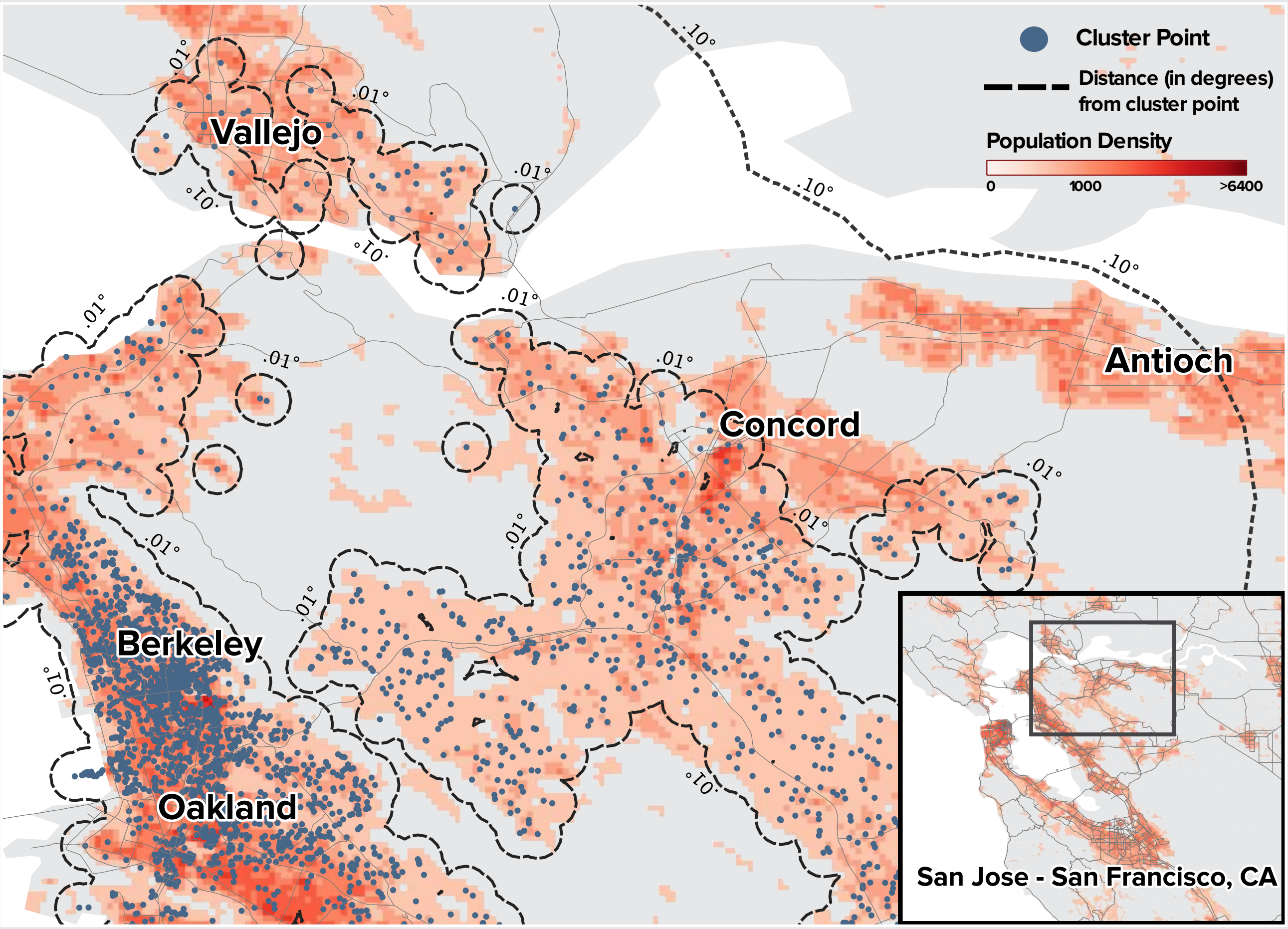
Notes:

1 When using degrees to define the radius, the actual distance will vary depending on the latitude of the center point. In this case, 0.05 degrees translates to between 4–5 kilometers for the vast majority of our points.

2 We utilized QGIS's Raster Analysis Zonal Statistics tool to perform the aggregation. A pixel was included in a polygon if at least its center point was included. Given the size of our clusters and the large number of population pixels typically contained, this binary in or out selection is acceptable.

FIGURE SA-1.1

Comparing buffer radius



Source: WIPO Statistics Database, March 2020; Schiavina et. al., 2019.

WHO WILL FINANCE INNOVATION?

INTRODUCTION TO THE GII 2020 THEME WHO WILL FINANCE INNOVATION?

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To boost entrepreneurship and economic growth, how best to finance innovation is a top business and policy concern in the 21st century—and these innovation finance ambitions are only more pressing amidst the personal and economic toll of the coronavirus disease (COVID-19) pandemic.

The GII 2020 and the following 15 chapters by leading policymakers, academic experts, and business leaders shed light on the state of innovation finance by investigating the evolution of existing financing mechanisms and by pointing to progress and remaining challenges.

Recent developments in innovation financing

The lack of financing sources—due to imperfections in the capital market, and other causes—can lead to a worrying underinvestment in innovation. This is particularly true when the technological risk associated with an innovation is too high for investors, when entrepreneurs have only intangible assets as collateral, or in emerging and developing economies where financial markets are still to be strengthened.

Today, innovators enjoy an increasingly broad spectrum of funding mechanisms, including from a range of new actors, such as not-for-profit organizations, sovereign wealth funds (SWFs), wealthy individuals, and celebrities.

- Traditional innovation financing mechanisms include public support schemes, firm-specific innovation investments, and market-based mechanisms targeting innovation specifically, such as loans, private equity, and venture capital (VC).
- New mechanisms include corporate venturing, intellectual property (IP) marketplaces, microfinance, crowdfunding, and technology solutions.

Despite the recent fall in VC deals caused by the COVID-19 pandemic, VC investments had surged in the past two decades (Chapter 1 and Chapter 5–Nanda). While VCs have usually been successful in selecting entrepreneurs, few winners usually take all (Chapters 1, 2–Cornelius, and 4–Lerner). Even in the United States of America (U.S.), VC funding is a rather uncommon event: only around a sixth of 1% of new businesses obtain VC financing (Chapter 2). In recent years, these “winners” are increasingly found among scale-ups, later-stage firms, and “unicorns”—young and generally tech-focused companies valued at US$1 billion or more.

Sovereign wealth funds have partly contributed to this trend with conspicuous rounds of financing to companies, such as Uber and WeWork. SWFs differ from many other investors in their character, risk tolerance, and time horizons—investing in disruptive technologies and early-stages companies while balancing technological investments with investments for economic competitiveness and well-being (Chapter 3–Engel et al.). While their financial resources have helped many start-ups flourish, their investments have raised national concerns in certain countries, related to the recent revival in economic nationalism (Chapter 3).

The following additional findings emerge on the topic of “Who Will Finance Innovation?”.

Access to innovation finance is skewed across countries and sectors

While the U.S. has traditionally been the largest VC market globally, other countries have also embraced the VC model. New VC hotbeds have emerged, first in Israel (Chapter 12–Daniely) and Europe, more recently in China and India, and, to a lesser extent, in some countries in South East Asia, Latin America, and Africa.

Despite this welcome sign, VC penetration rates remain uneven across countries at different stages of development—and even across countries at similar income levels (Figure T-1.1 and Chapter 2). Within these countries, VC investments are concentrated in a few cities. For example, 11 cities—6 in the U.S., 3 in China, London, and Bengaluru—account for over 60% of total venture disbursements worldwide (Chapter 4). This divide is likely to become even more pronounced in the years following the current economic crisis (Chapter 1).

Other forms of financing, such as investments by SWFs, are also concentrated—mainly in the U.S. and Asia, and much less in Europe and elsewhere (Chapter 3). For this reason, some SWFs have been specifically created to invest in their domestic economies to foster economic development, diversification, and improved living standards. Examples include initiatives in France, Ireland, Turkey, Kazakhstan, Morocco, Oman, and Singapore (Chapter 3).

A subset of innovations—in particular, those that can generate returns in the short term—attract most VC investments (Chapter 5). By contrast, more complex nascent technologies that build on new science have received less capital, despite great societal need (Chapter 5 and Chapter 6–Dassault Systèmes). Indeed, VC investments are highly concentrated in IT software and services as well as consumer products and services, business products and services, and financial services. These sectors not only absorb the bulk of the financial resources available through VCs, but their growth has been quite fast in the last 10 years. Healthcare, IT hardware, and energy, materials, and resources have not kept up with the overall growth of VC investments (Figure T-1.2 and Chapter 5). The current crisis is likely to further deepen this tendency, with sectors and firms that have longer research horizon facing the most severe financial constraints (Chapter 1).

Interestingly, with much more patient capital at hand, SWFs are better suited to invest in firms with longer incubation times, including healthcare (Chapter 3). Beyond healthcare, SWFs have shown interest in business software, consumer services with high-tech elements (such as e-commerce), and consumer technology, while preferring practical technologies that solve daily problems and create new opportunities for customers (Chapter 3).

Currently, however, the need to finance disruptive innovations—“the unknown” referred to in Chapter 6—is stronger than ever. Significant societal changes call for large investments in science-intensive technological fields with long research horizons that can help shape the unknown (Chapter 6). Funding innovations that can contribute to societal challenges is a cornerstone of European innovation policies, as described in the case of, for example, the Czech Republic (Chapter 9–Havlíček et al.).

Sound innovation ecosystems must balance start-ups, scale-ups, and mature firms

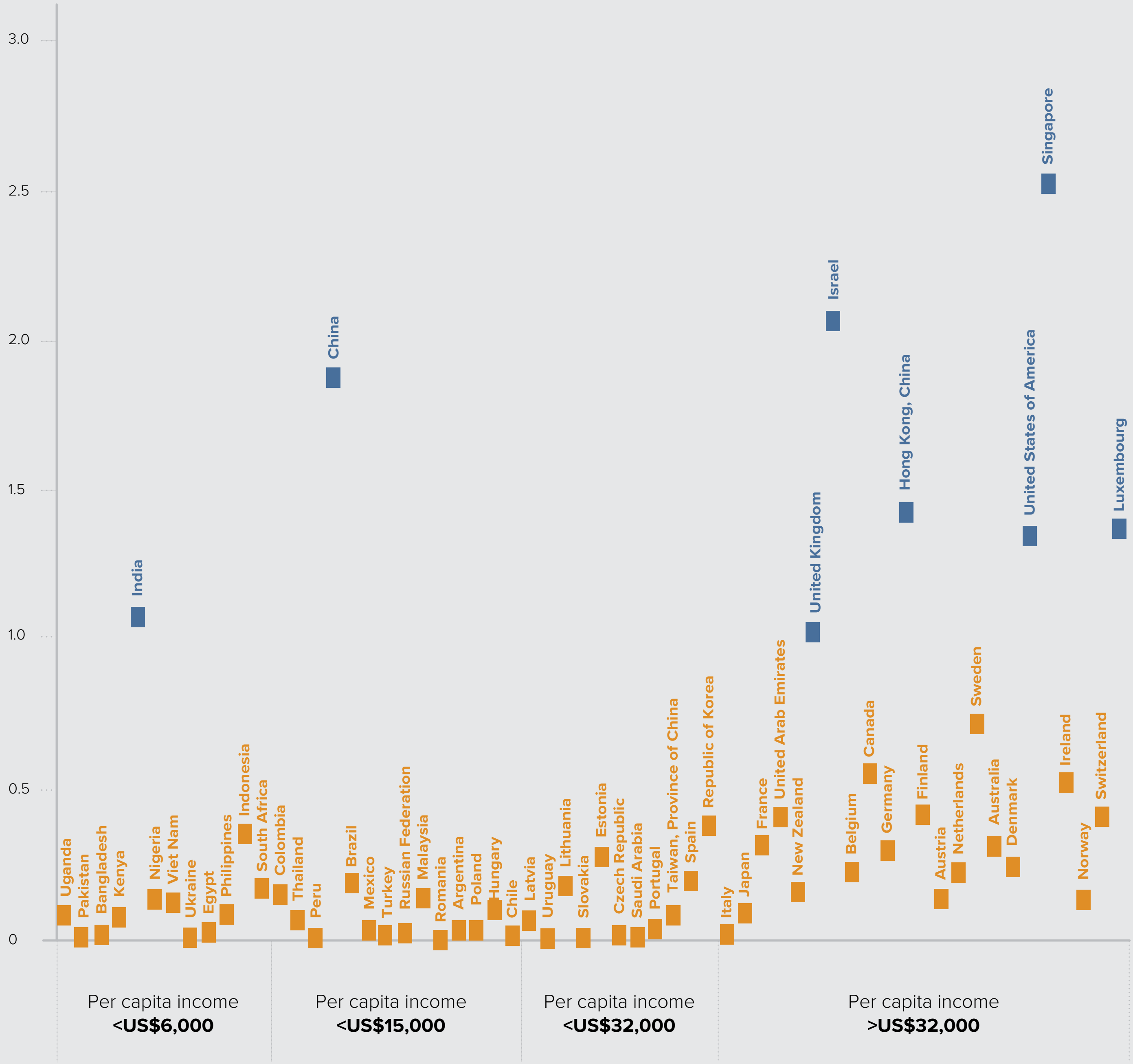
Since the emergence of the private equity industry, investing in innovation has been conflated with investing in start-ups (Chapter 7–Parpaleix et al.). Finding the right balance between financing start-ups, scale-ups, and mature firms, however, is crucial for innovation ecosystems (Chapters 2, 7, 11–Chattopadhyay, 12, and 13–Mwangi).

In many parts of the world, start-ups still attract most of the resources of innovation financiers, even though “scale-up” is the real litmus test for innovation (Chapter 7). In Israel, for example, the tendency of investors to push for early exits through acquisitions by foreign multinational companies contributes to a myopic situation where a brilliant entrepreneur is more interested in becoming a “start-upist” than in building a global multibillion-dollar company (Chapter 12). India also boasts a vibrant start-up ecosystem, hosting 6 of the top 100 most entrepreneurial cities in the world, with Bengaluru occupying the 11th position (Chapter 11). Even in other middle- and low-income economies, including Kenya, investing in start-ups has become a cornerstone of innovation policy, despite the fact that the “missing middle” phenomenon—i.e., the shortage of mid-sized firms—threatens innovation ecosystems (Chapters 7 and 13).

In recent years, a shift from seed funding to later-stage and expansion rounds has occurred, reflecting the interests of non-traditional investors, including SWFs and mutual funds (Chapters 2, 3, and 11, in the case of India). Thanks to easier access to expansion and growth capital, firms remain private longer than was previously the case (Chapters 2 and 3). Exits, which were already compromised in 2019, have become even more rare during the pandemic crisis (Chapter 1). While the void created by this shift has been partially bridged by angel investors, accelerators, and crowdfunding platforms, overall innovation financing has become disproportionally available to less risky and already successful later-stage companies. This tendency is further reinforced by the current crisis, as risk aversion grows and investors specialized in early-stage deals are more responsive to business cycles (Chapter 1).

FIGURE T-1.1

Venture capital penetration in selected economies, 2016-2018

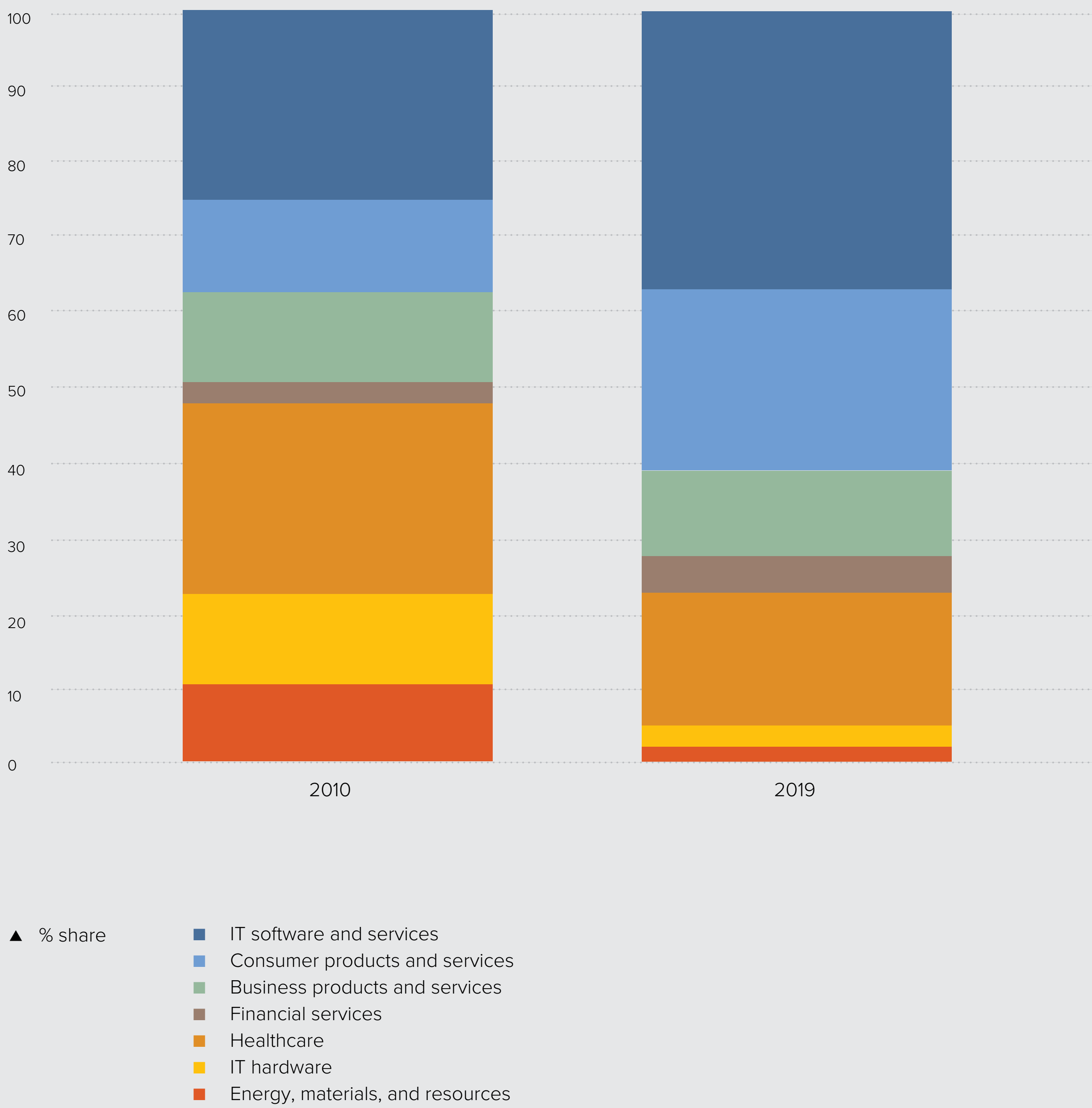


▲ %, Venture capital investments/GDP

Source: Figure 2.3 in Chapter 2.

FIGURE T-1.2

Share of global venture capital investment, by sector



Source: Figure 5.2 in Chapter 5.

Mature, established firms also need access to finance to be able to introduce new innovations—including radical innovations—and to avoid growing obsolete. As Chapter 7 shows, these firms lack sources of finance who can support their regenerative strategies in the long run. Such strategies entail investments in new concepts, knowledge and shared imaginaries that are difficult to appraise on a financial market, leading to a risk of undervaluation and liquidity gaps (Chapter 7).

This need for mature and existing firms to be able to access innovation capital is a vital and often overseen point. Generally, policymakers and the financiers of innovation are obsessed with funding start-ups, and thus new ventures only. Recently that attention has shifted to unicorns as the sacred source of innovation. Existing, mature firms are in, in turn, regularly forgotten. That is a mistake. Many countries would first and foremost benefit from the innovation rate of firms on the market, be they in the technology sector or in more traditional sectors or linked to natural resource. Unfortunately, often that is not how support schemes are currently conceived. Often, and understandably, new ventures instead attract all the excitement and attention.

Finding the right balance between under and overinvestment in the search for unicorns

In recent years more and more VC has been available, specifically for later-stage ventures—with SWFs particularly focused on targeting the next unicorn (Chapters 2, 3, and 5). In 2018, megadeals accounted for 47% of total capital invested in the U.S. and unicorns for 35%.[1]

There are compelling reasons for the growth in unicorns: 1) greater ability of firms to raise capital as private entities, 2) technological changes that facilitate “winner takes all” markets (rise of technology platforms), 3) the poor experience of the late 1990s when too many very small companies went public and underperformed, 4) securities regulation, and 5) other reasons which are amply documented in the literature.[2] The winner-takes-all notion is backed by the idea that, due to network effects and economies of scale, only one or a few players are able to survive in some markets; hence, it is worth pouring large sums of money into those potential winners.

The fact that so much money is being invested in late-stage and growth capital transactions—including unicorns—is also, to a large extent, a reflection of a huge increase in private capital. With benchmark yields having been extremely low for more than a decade, private equity and VC funds have attracted substantially more capital. Even mutual funds have invested in VC transactions.

This development of vast amounts of money chasing a few winners comes with a number of risks:

First, overfunding of firms during booms might stimulate creativity, but it might also generate wasteful duplication of efforts as multiple companies pursue the same opportunity—with few followers adding concrete value and most, in fact, doomed to go out of business rapidly (Chapter 4). This is a problem of too much VC being spread indiscriminately to many similarly promising—and most likely failing—ventures. Before a slowdown in 2019 and, finally, in 2020 due to COVID-19, the Chinese VC market was said to have been significantly overheated with capital-backed business ventures that had no promising or original business plan or technology.

Second, and related to the first point, we have witnessed large investment funds and SWFs focusing on a limited number of unicorns or prominent venture-backed firms. Often this is fueled by the incentives of the winner-takes-all notion—a rationale for aggressive investment strategies aimed at gaining market share while running substantial losses at the expense of revenue or profits. Recently, however, that approach has led to investment bubbles which eventually burst, in particular when paired with significant governance failure.

While this heavy focus on one company enables that company to build market share while “burning cash”, it also drives out competitors who cannot sustain this rate of loss, possibly inducing anti-competitive effects in the market place at the expense of smaller, more innovative ventures.

As with financial investments generally, it is important to maintain balanced investment strategies that encourage a healthy level of VC and unicorn investments, while avoiding combining enormous sums with bad governance to create bubbles. The recent months have provided an important wake-up call, which may help investors and regulators alike to find this critical balance.

New instruments—that have raised expectations—are helping, but have not fully eased financial constraints in developing economies

Microcredit has been hailed as a major financial innovation, helping to alleviate credit constraints faced by underserved communities. Microlending has made credit easily accessible to poor entrepreneurs, women, and rural areas. To this day, however, microcredit has not been used to foster transformational entrepreneurship and innovation. Many borrowers of microcredit lines are subsistence or “reluctant” entrepreneurs with limited interest in innovation (Chapter 2). Yet, as evidenced in the GII 2020, advances in digital finance could help microlenders become more efficient, thereby allowing them to achieve scale.

Indeed, advances in financial technology (fintech) are transforming the way capital is intermediated. Financial technologies have enormous potential, including the possibility of relaxing financial constraints on firms—especially small firms in developing countries. New technologies enable businesses and individuals to become connected to a digital payment infrastructure via mobile phones, computers, and point-of-sale devices. Employing new technologies in artificial intelligence (AI) and machine learning, fintech lenders provide loans through Internet-based platforms for individuals, called peer-to-peer (P2P) lending, or through institutional funders, referred to as marketplace lending.

Fintech is spreading across the board, affecting advanced economies as well as emerging and developing countries. Kenya, for example, is among the earliest and most prominent African innovators in mobile money, with ambitions to replicate its success in financial inclusion and small firms' financing in other sub-Saharan African countries (Chapter 13). Another example is India Stack, a set of technologies that allows governments and businesses to utilize a digital infrastructure to make cashless payments for service deliveries, helping to solve the challenges of digital and financial inclusion (Chapter 11).

Since the financial crisis of 2008-2009, crowdfunding has emerged as an alternative financial mechanism to fund innovation, especially for small and medium-sized enterprises (SMEs). Crowdfunding today is taking various forms—donations, rewards, loans, and equity—and is spreading geographically, from the U.S. to Europe, Asia, Australia, Latin America, and Africa. While some hoped that crowdfunding could "democratize" innovation, only a few projects account for the bulk of the financial resources raised in crowdfunding platforms (Chapter 2).[3] At the same time, crowdfunding is particularly suited to the pre-seed phase of an innovation project—which is also the phase where financing is drying up the most (Chapters 1 and 5). Crowdfunded projects often attract other investors too, including venture capitalists and angel investors.

Despite these encouraging prospects, the real impact of fintech and other instruments remains difficult to assess at this early stage. Data on new fintech adoptions across the world are of critical importance to understand if, where, and how these technologies are changing the global innovation finance landscape. Regulatory frameworks and other policies to encourage the development and uptake of fintech are paramount to fulfill the optimistic expectations that they have generated (Chapter 2). As shown in the case of Abu Dhabi, for example, the government can offer a regulated and controlled environment to fintech start-ups to safely test innovative solutions (Chapter 14–Bin Hendi).

The market for ideas and IP is growing, but barriers remain

IP has long been used to signal the quality and viability of an innovation project. This has proved useful to reduce financing costs, attract new investors, qualify for government programs, and enter international consortia. IP also constitutes a sort of "insurance policy": should the company go bust, its ideas and intangible assets can still be sold or licensed. IP is also increasingly used as collateral for loans, with many governments around the world facilitating these practices to reduce firms' difficulties in collateralizing their investments in IP (Chapter 15–Hall). As this edition of the GII argues, IP can also be used as a tool that directly generates money (Chapter 16–Radauer).

Today, there are still neither IP marketplaces that have the size and volume of the New York Stock Exchange nor large Internet platforms for trading physical goods—despite numerous initiatives to establish IP marketplaces emerging and some seemingly succeeding in niche markets (Chapter 16). So why do so many initiatives fail, and none reach a considerable size?

Several issues still endanger markets for ideas and IP (Chapters 15 and 16). The first and most important is valuation: IP differs from common stocks and commodities for which there are exchanges. The value of IP is highly context-specific and heterogeneous. This creates substantial information asymmetries, which essentially prevent "commoditized" trading. Valuation is also hampered by the fact that, to date, there is still no standard method for valuing IP that is uniformly accepted (Chapters 15 and 16). Until IP is properly and systematically valued, the potential asset value of innovative companies might be seriously undervalued—including, and especially, for companies that do not consider themselves technology or knowledge-based, such as creative brands and manufacturers (Chapter 15). Other barriers to the establishment of IP marketplaces include a lack of a clear inventory of IP and intangibles, lack of awareness of IP's role as a valuable asset, banking regulations, and other issues related to the re-deployability of intangible assets (Chapters 15 and 16).

Despite these challenges, there is, however, growing evidence that incentives to invest in IP-rich companies are strengthening (Chapter 15). Governments have a role to play in supporting this trend: IP audits, for example, can provide a good impression of the IP situation of a firm and identify potentially valuable assets. IP audits are currently implemented with various degrees of success in countries such as Austria, France, and the United Kingdom (U.K.) (Chapters 15 and 16). These instruments can and should be used more. In the U.K., for example, there are fewer than 5000 IP valuation reports commissioned per annum, and the market is somewhat underdeveloped versus what might be considered optimal (Chapter 15). At lower income levels, challenges are even more evident. Yet countries are becoming increasingly aware of the value of IP, as shown, for example, by the Philippine Innovation Act, which aims at promoting a vibrant intellectual property culture (Chapter 8–de la Peña).

A carefully designed policy mix is essential to improving the innovation finance landscape

An overarching policy message emerges from the chapters of this GII: no single innovation policy instrument can solve all the issues that a country might face in relation to its innovation financing landscape. Governments across the world should think of a carefully designed policy mix that tackles the various obstacles to innovation financing while maximizing complementarities between financing mechanisms and sources of funds. Indeed, government support can be direct or indirect. Similarly, sources of funds can be public, private, or a mix of the two (Chapter 4). Some combinations might stimulate innovation, while others might make related efforts useless.

Three additional policy actions are recommended in the GII 2020.

First, governments can play a significant role in de-risking technologies.

Historically, when start-ups with substantial technology risk were successfully commercialized by VCs, government helped with de-risking the technology and/or reducing market risk (Chapters 5, 6, and 11). This role of the government is even more important today, given the current decline in fundamental innovation coming from large corporations and the reduced appetite of VCs for early-stage ventures and science-based sectors (Chapters 5 and 6).

Examples of how governments can intervene in this area include the use of subsidies to finance prototyping, new firms, and SMEs—along with grants (including challenge grants, as in the case of India, Chapter 11), procurement, and advance purchase commitments (Chapters 4, 5, 8, 9, 10–Braga de Andrade, 11, and 13). These instruments can be used in developed and developing countries alike. In France, for example, a new legal status—the "profit-with-purpose company"—has been created to protect and reinforce the capacity of a company to explore less researched and highly strategic technological fields (Chapter 6). In the Czech Republic, together with funds for basic research, purpose-specific support is channeled into industry—in particular, towards science-intensive industries including medical sciences and biosciences (Chapter 9). Similarly, and as Chapter 11 on India shows, these instruments can effectively be used to foster investments in important sectors that are receiving relatively less funding, including biotech. In Kenya, procurement has helped micro and small enterprises to access new markets (Chapter 13).

As the work of the GII over the past years has shown, continuous investment in R&D and science, including from public organizations, is important to fuel innovation and counteract business cycles. Because "tough tech" ventures, as labeled in Chapter 5, are often based on new science or technology developed in universities, academic institutions can play a central role in helping to de-risk technologies prior to start-ups raising risk capital from investors (Chapter 5 and Chapters 8 and 9, in the cases of the Philippines and the Czech Republic). Investments in basic science are also a way to produce "unexpected knowledge" that, while not driven by daily problems or necessities, might still have a tangible impact on innovation processes (Chapter 6).

SWFs are also contributing to the effort of de-risking innovation. Examples include the Russian Direct Investment Fund, the Ireland Strategic Development Fund, and the Abu Dhabi Investment Authority, which are playing a pivotal role in implementing government's innovation policy (Chapters 3 and 14, in the case of the Abu Dhabi Investment Authority). Second, acknowledging the persistent financing gaps across the world, governments are making concrete efforts to develop vibrant VC markets (Chapter 12).

Beyond providing tax incentives to venture capitalists, governments might decide to become venture capitalists. Examples of governments that have set state-owned venture funds include Australia, Israel, China, Malaysia, Jordan, Morocco, and Senegal (Chapter 7). Brazil also has some public initiatives for venture capital investment funds, albeit still incipient (Chapter 10). Israel is among the earliest and most well-known cases of success in government-run venture capital funds. Established in the 1990s, the Israeli program managed to build a vibrant venture capital industry from scratch. After roughly seven years from its inception, private investments surpassed public ones (Chapter 12). While some of these programs, including those in Australia, Israel, China, and Singapore, have proved relatively successful, government VC funds are less effective than private VC.

The unfortunate outcomes from government attempts at promoting entrepreneurial activity can be reconnected to structural characteristics of government VC funds, which make them inherently different from private VC funds. First, lack of business and technical information on the part of the government makes it challenging to assess potential investees and permits opportunistic behavior. Second, over time, private venture capitalists have developed an efficient screening process that enables them to select the best investment opportunities. Third, private venture capitalists usually make investments with other investors, who provide a second opinion and help avoid mistakes. Finally, compared to government VCs, private VCs are free from political pressures (Chapter 4).

To overcome these bottlenecks, governments might decide to insulate entrepreneurial policymaking from policy pressures by, for example, establishing a separate organization dedicated to venture capital. Matching funds, including by foreign venture capitalists (as in the case of the Israeli program, Chapter 4), are another way to reduce risks and possibly improve the results of these programs.

Governments also support business angels by, for example, providing financial support for the creation and operation of business angel networks and federations. Policies of this sort are available in a variety of countries, including in Europe, Turkey, the Russian Federation, India, and Malaysia. As Brazil shows, angel investors can flourish where VC markets have still not taken off, providing important sources of innovation funding (Chapter 10).

Another innovation in entrepreneurial finance is accelerator and incubator programs (Chapters 2, 5, 11, and 12). On the rise since the mid-2000s, they provide short- or medium-term support and resources to start-ups, helping them speed up their product development and time to market. Today, China and India have particularly active accelerator ecosystems (Chapter 11, in the case of India). Accelerator programs are also proliferating in several countries in Africa, Asia—including in the United Arab Emirates (UAE) and the Philippines—and Latin America (Chapters 2, 8, and 14). In the UAE, for example, the Ghadan 21 accelerator program is investing US$13.6 billion to boost Abu Dhabi's knowledge- based economy, supporting over 50 initiatives that promote the establishment of start-ups and spur innovation and R&D efforts (Chapter 14). Another well-known initiative in this area is the Israel Innovation Authority's Incubators Program, which awards millions of dollars to promising start-ups, allowing them to access early- stage financing (Chapter 12).

Thirdly, and specifically in regard to developing and emerging economies, policies are needed to enable financial markets to become mechanisms that spur innovation.

For example, several legal and regulatory barriers to the development of the VC market persist, even in a large middle-income economy such as Brazil (Chapter 10). Inadequate taxation, the lack of tax incentives for venture capitalists, as well as lack of regulation for entrepreneurial capital and other business-related regulations are clear obstacles to the establishment of a fully functioning VC market in the country. But making progress in these areas is not "mission impossible". India, for example, has made great progress in nurturing its start-up ecosystem and, today, over 280 Indian investors are ready to support local start-ups (Chapter 11).

The GII 2020 identifies a number of specific policy actions that could help countries in these endeavors. First, to foster access to loans, lenders need to have access to accurate and timely credit information, with clearly defined legal rights in secured transactions. Turning to the equity side, and as shown by the GII over its history, the protection of minority shareholders is paramount to foster VC activity and innovation overall. Shareholder protection has to go hand in hand with developing a market for initial public offerings (Chapter 2, and Chapters 10 and 12, in the cases of Brazil and Israel).

Finally—and as shown in the cases of the Czech Republic (Chapter 9), the Philippines (Chapter 8), India (Chapter 11), Kenya (Chapter 13), and the UAE (Chapter 14)—entrepreneurship policies might aim at more than finance, and include initiatives to promote a culture of innovation and entrepreneurship and skills development. In this regard, financial literacy training is a key skill to develop financial capability and to understand and consume financial products. In the Philippines, for example, the Philippine Innovation Act is an action plan for the development of the country's capacity for, and success in, innovation through improvements in science, technology, and innovation (STI) culture, awareness of R&D activities, and improvements in human capital (Chapter 8). In the UAE, a key pillar of the National Innovation Strategy is promoting skills and establishing a national culture of ideas and entrepreneurship (Chapter 14). Spreading information about public and private instruments to finance innovation projects can also help to strengthen the innovation finance landscape. In Brazil, for example, a periodic publication summarizes the innovation support mechanisms available in the country (Chapter 10).

The current economic scenario poses a number of questions on the evolution of the innovation finance landscape in the short and long run. In this uncertain scenario, policies that stimulate investments and innovation and encourage the pursuit of longer-term goals will be key for future growth and well-being.

Notes:

1 NVCA, 2019.

2 This section has benefited importantly from comments and suggestion of Peter Cornelius (Chapter 2), Josh Lerner (Chapter 4), and Carsten Fink (WIPO).

3 For a review of this literature, see Guadagno, 2020.

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SOURCES OF FUNDING INNOVATION AND ENTREPRENEURSHIP

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Economic development and financial development are inextricably intertwined. Originating from Schumpeter's "Theory of Economic Development,"[1] finance and growth literature identifies several channels through which the financial sector may spur economic prosperity.[2] Innovation is believed to play a particularly critical role, with well-functioning financial markets allocating capital to companies with the greatest potential for productivity gains thanks to the implementation of innovative processes and the commercialization of new technologies.[3] Additionally, the funding of innovation itself requires sophisticated financial markets, with the allocation of risk capital found to shape the focus and nature of research and development (R&D).[4]

Much of the earlier finance and growth literature has focused on traditional financial markets.[5] However, even in advanced economies, bank loans and capital intermediated through public equity markets and bond markets are generally available only to mature companies. Financial constraints are particularly acute in the early and expansion stages of the life cycle of a company when their business model is still untested. This includes tech start-ups that aim to disrupt entire industries by developing new products, services, and production processes. Their survival usually depends on their access to entrepreneurial finance in their early stages and subsequently to growth capital to scale up their businesses.

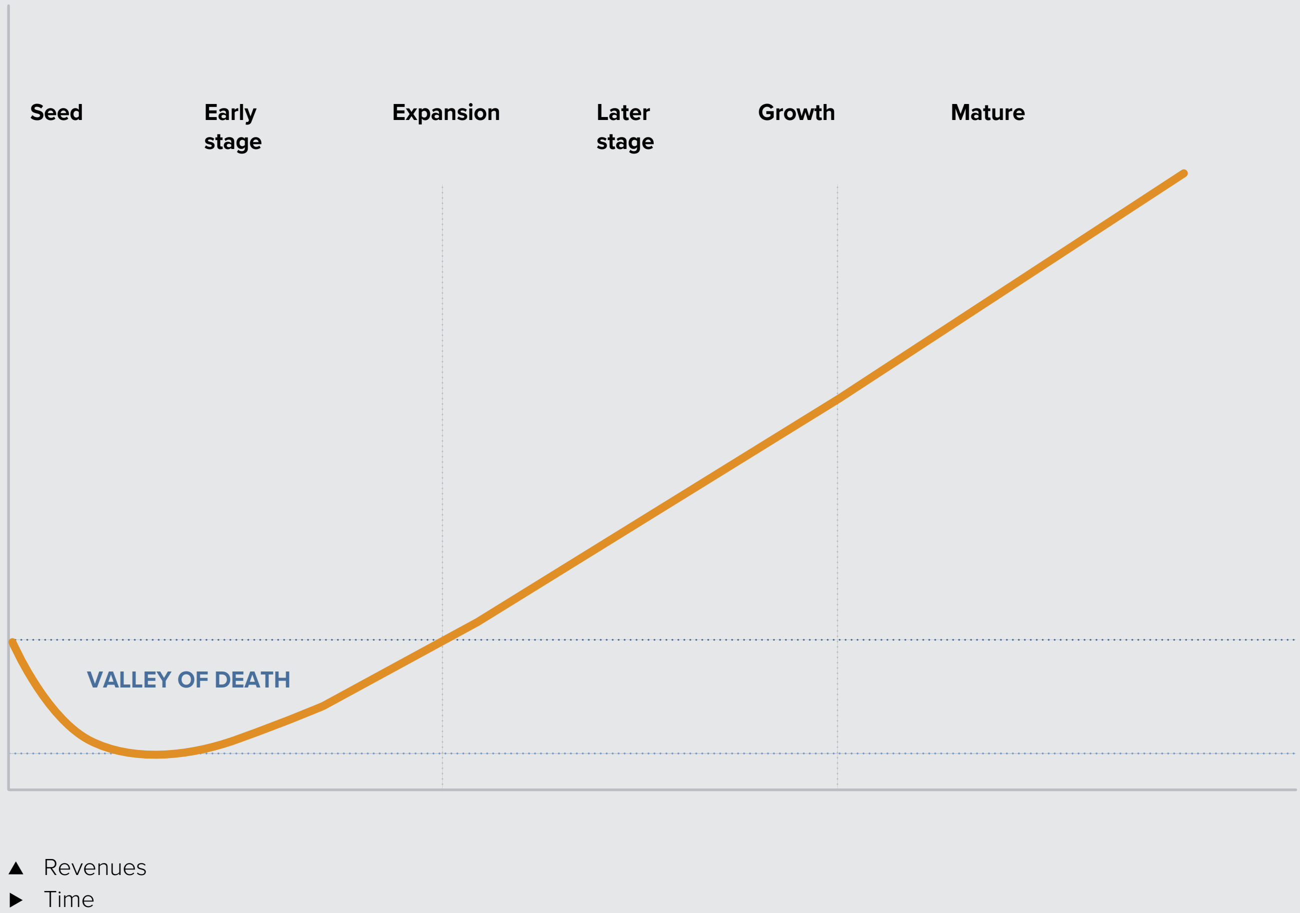
Many of the world's largest and most innovative tech companies, including Amazon, Apple, Facebook, Google, Microsoft, and Tencent, have initially been backed by venture capital (VC), helping explain why this form of funding has attracted substantial interest among researchers and policymakers alike. However, over the past couple of decades, the financing of innovation has been subject to significant changes as new funding sources have emerged and important advances in financial technology (fintech) are transforming the way capital is intermediated. These developments affect companies in all stages of their life cycle. In developing a taxonomy of funding sources for innovation, this paper focuses especially on the start-up phases when young firms face particularly severe financing challenges, paying particular attention to non-traditional forms of entrepreneurial finance.

A taxonomy of funding sources for entrepreneurship and innovation

In organizing a taxonomy for the funding of innovation, one can think of a matrix along two dimensions: 1) the company's age and maturity and 2) the position of funding in the company's capital structure. As far as the first dimension is concerned, six phases can be distinguished. In the *seed* phase, entrepreneurial start-ups usually do not generate revenue, and as they build their business, their cash flow becomes increasingly negative (Figure 2.1). In the *early stage*, companies are typically completing development, with products being in testing or pilot production. In the *expansion stage*, companies are already producing and have growing accounts of receivable and inventories. In the *later stage*, start-ups have already reached a fairly stable growth rate. In the *growth* phase, companies begin to generate positive earnings.[6] Finally, companies reach their *mature* phase.

FIGURE 2.1

Revenues during different stages of a company's life cycle



Source: Author.

Companies typically have access to different forms of finance throughout their life cycle. Initially, the most common form is the entrepreneur's own resources, which may be provided as a personal loan from the entrepreneur, who then holds levered equity claims in their firm.[7] Additionally, start-ups may have access to resources from their family and friends, may receive government grants or philanthropic grants from foundations, or obtain funding through reward-based crowdfunding platforms.[8]

While many entrepreneurs would prefer to avoid borrowing or diluting equity by bringing on board external investors, their own resources are often insufficient to build their business in the absence of revenues. In the seed phase, cash flows are increasingly negative. This phase is particularly critical, and it is not without reason that this is often described as the "valley of death." According to the Global Entrepreneurship Monitor, one of the most common reasons for discontinuing a business is the lack of capital, especially in emerging and developing economies.[9]

To bridge the valley of death, entrepreneurs must identify alternative funding sources. On the debt side, these generally include credit card debt, loans from microfinance institutions, crowdlending, venture debt, and government loans (Figure 2.2). On the equity side, VC is widely considered as the money of invention, which may be provided by independent VC firms or corporate venture capitalists. In several countries, governments themselves have become venture capitalists.

Although VC remains the most important funding source for tech start-ups, in recent years the focus of VC investing has shifted from seed capital to expansion- and later-stage rounds. Several VC firms also provide growth capital to allow nascent companies to scale their businesses. This is particularly true in emerging economies where companies are challenged to access capital to exploit opportunities in rapidly growing markets.

The void created by the shifting investment focus of VC firms from seed to expansion- and later-stage rounds has been filled, to some degree, by the proliferation of angel investor groups and the emergence of Internet-based equity crowdfunding. At the same time, accelerators have supported an increasing number of entrepreneurs, and although their financial contribution is generally minimal, they do provide important mentorship and critical networking opportunities.

For entrepreneurial start-ups that succeed in bridging the valley of death, different forms of financing become available in their expansion and later stages. Apart from retained profits, banks are likely to become more willing to lend as companies have accumulated tangible assets and shown a viable business model. In the growth stage, companies may also gain access to non-traditional lenders, such as private credit funds. Similarly, external investors could include sovereign wealth funds who have recently shown significant appetite for backing technology-driven companies At the same time, growth equity funds can provide significant amounts of capital, typically taking minority positions in a company.

As companies reach their mature stage, the universe of available debt capital becomes even wider—at least in advanced economies with well-developed financial markets—encompassing leveraged loans, subordinated debt, mezzanine debt, and corporate bonds. Companies that decide to go public gain access to a broad investor base that includes both institutional and retail investors. Finally, as institutional investors have substantially increased their investments in private equity funds, this source has become increasingly important for companies seeking capital. In fact, in some markets, there are more private-equity backed companies than publicly listed firms.

Based on this taxonomy, the following sections discuss entrepreneurial finance options in the early stages in more detail.

Fintech and the emergence of new debt solutions

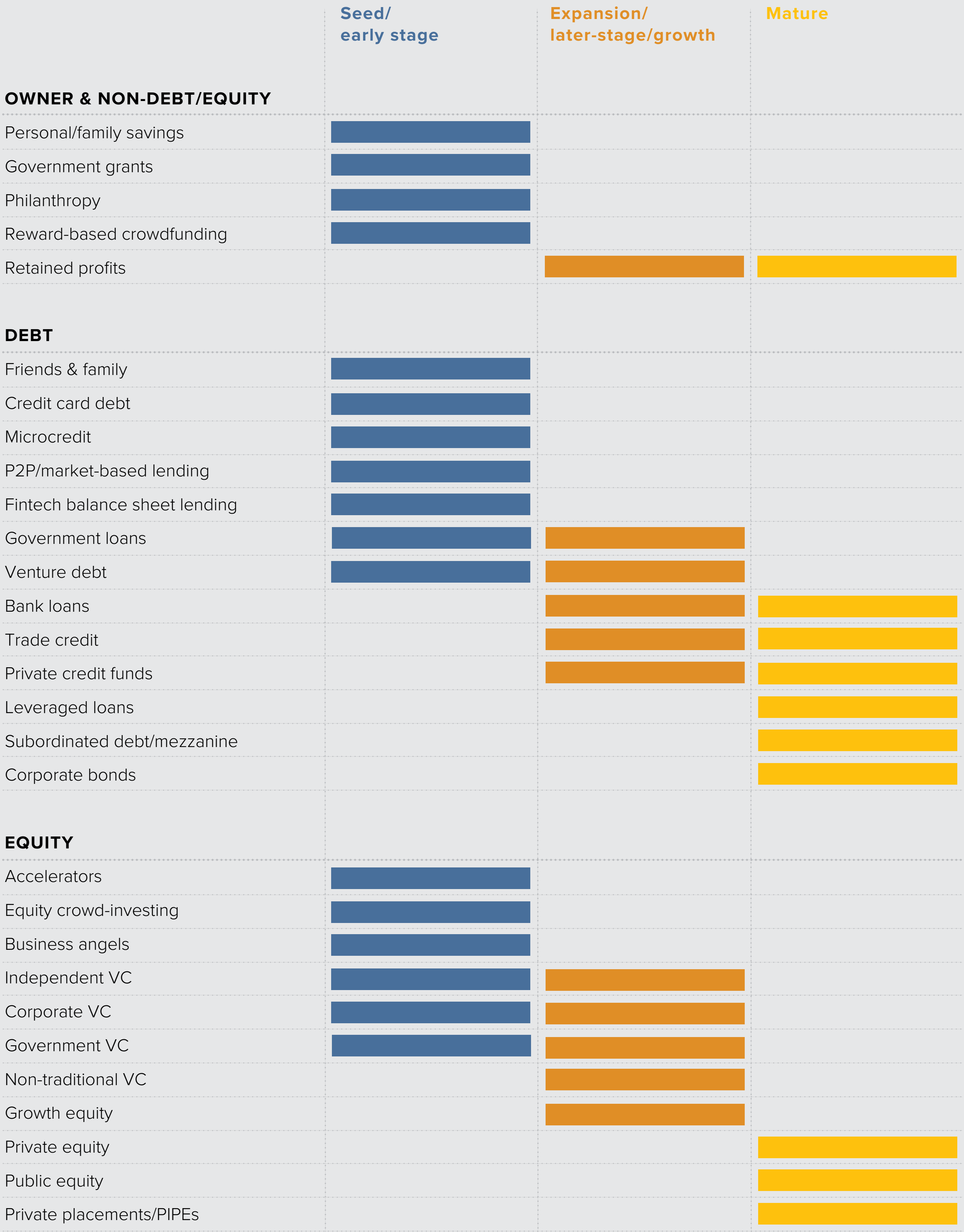
Traditional bank loans are generally difficult to obtain by young companies whose risk profile is typically inferior to that of more mature companies. In emerging markets, credit constraints tend to be particularly severe, impeding firm growth and helping explain why these countries usually show a higher density of micro and small firms.[10] Against this background, microcredit has been hailed as a major financial innovation, helping to alleviate credit constraints faced by underserved communities in both developing and advanced economies.[11] However, the main idea behind microcredit is the alleviation of poverty rather than the support of transformational entrepreneurship and innovation. In fact, as randomized controlled experiments have shown, many borrowers turned out to be subsistence or "reluctant" entrepreneurs who started a business because they were unable to find a job.[12]

Another factor impeding the role of microcredit as a source of entrepreneurial finance is seen in the limited efficiency of such operations. By relying primarily on manual processes and cash, microcredit organizations generally have high transaction costs that restrict their ability to achieve scale and act as lenders beyond their original business model. Looking forward, however, it is believed that advances in digital finance could help not only traditional bank lending but also microcredit lenders to play a more meaningful role as a funding source for entrepreneurs.[13] Importantly, new technologies enable businesses and individuals to become connected to a digital payments infrastructure via mobile phones, computers, and point-of-sale devices, replacing cash transactions and bridging long distances.

Digital finance refers to a system in which financial services are delivered over digital infrastructure, with fintech enhancing the efficiency and reducing the costs of such transactions. At the same time, fintech has helped develop new forms of intermediation. Around the world, fintech lenders have emerged that employ new technologies in artificial intelligence and machine learning. Thanks to these technologies, fintech lenders are expected to be in a superior position to address friction in the traditional lending market and help narrow the credit gap faced in particular by young companies.[14]

FIGURE 2.2

Main funding sources over the life cycle of a company



Source: Author.

Fintech lending comes in different forms. To begin with, fintech lenders may provide loans from their own balance sheets. Alternatively, borrowers may obtain loans through Internet-based platforms from individuals, called peer-to-peer (P2P) lending, or institutional funders, referred to as marketplace lending. While the first fintech lenders emerged in the early 2000s, fintech has gained significant momentum after the global financial crisis of 2008–2009. Since then, the number of fintech lenders has risen progressively. According to the Cambridge Center for Alternative Finance database, balance sheet fintech lending totaled around US$14.2 billion worldwide in 2017. This amount was dwarfed by P2P/marketplace lending, which amounted to almost US$100 billion.[15]

In both areas, fintech lending has shown substantial momentum in recent years, which could hold steady or even accelerate, especially if fintech credit innovations were increasingly adopted by traditional banks.[16] However, for fintech and crowdlending to continue to follow its steep trajectory, it will be important to put in place a regulatory framework that fosters market entry and competition, ensures adequate risk management policies, and protect lenders and investors.

Finally, entrepreneurial firms may have access to venture debt to fund working capital or capital expenses. Venture debt is provided by specialized banks and venture debt funds. Borrowers are usually VC-backed start-ups and growth companies whose cash flows are still negative. While they typically lack tangible assets at this stage, patents are frequently pledged as collateral.[17] Furthermore, venture loans are usually combined with warrants to compensate lenders for the higher risk of default in such transactions. Between 2010 and 2019, venture debt funds raised an average annual amount of US$1.3 billion from investors globally, a fraction of the US$72 billion of annual commitments to VC funds.[18]

Equity-based innovations in entrepreneurial finance

Venture capital

Venture capital has been described as the money of invention.[19] Focusing on investments in tech companies, this form of funding seems to be particularly predestined to foster innovation and growth.[20] While these investments are highly risky and subject to significant agency problems,[21] robust due diligence, appropriately designed VC contracts and the staged infusion of capital help mitigate these risks. Very few start-ups qualify for VC investments—for the United States of America (U.S.), Kaplan and Lerner estimate that only around a sixth of 1% of new businesses obtain VC.[22] However, the economic impact of VC is much larger than this small percent suggests. In fact, of all U.S. companies that went public in the past 20 years, around 60% were VC backed.[23]

In the past, information technology (IT)—including hardware and software, Internet-related services, cloud computing, mobile applications, and e-commerce—have absorbed the bulk of VC investments. While a significant number of start-ups in the life sciences have also been backed by VC, investments in this sector are more challenging. Generally, VC is intermediated by limited partnership funds that have a life of 10 to 12 years, which is often too short for biotech where the journey from basic scientific discovery to fully approved drugs may take 15 to 20 years. Given that the VC model may not be appropriate for long-gestation, science-based businesses and hence fail to solve R&D funding issues in biotech and similar industries,[24] it has been proposed to set up "project-focused organizations" to conduct a specific R&D project.[25] However, such organizations come with their own important challenges as they do not address the agency problems that are inherent in funding high-risk ventures.[26]

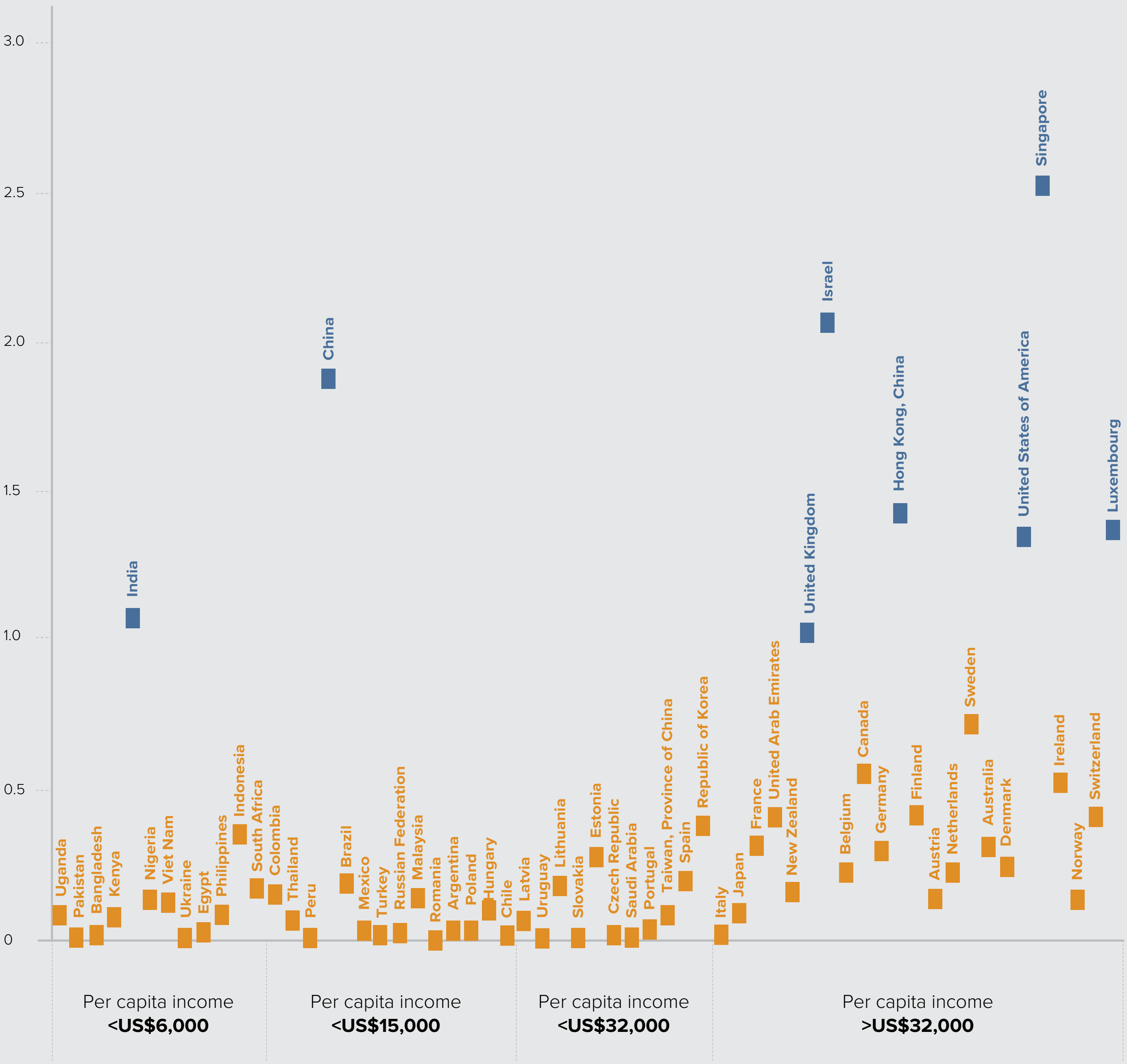
As an asset class that emerged after World War II, VC has been subject to important changes in the past two decades. For starters, there has been a shift from seed funding to later-stage- and expansion rounds, with the latter generally perceived to be less risky—albeit at the expense of less upside potential on the return side. At the same time, nontraditional investors—such as sovereign wealth funds and mutual funds—have entered the VC market, focusing on investment opportunities in companies in their expansion and growth stages. The most visible sign of this is the rise of unicorns—young and generally tech-focused companies valued at US$1 billion or more—whose access to expansion and growth capital has allowed them to stay private for longer than was previously the case.

But perhaps most importantly, the VC model has been exported to other regions. New VC hotbeds have emerged first in Israel and in Europe, and more recently in emerging economies—especially in China and India and, to a lesser extent, in some countries in South-East Asia, Latin America, and Africa. This process has benefited from the cross-fertilization between leading VC firms from the United States that have expanded abroad and the rise of an indigenous VC industry in these countries. However, penetration rates have remained uneven across countries at different stages of development—but even across countries that have reached a similar level of economic prosperity (Figure 2.3). While it is too early to tell whether the huge increase in VC investments in some countries can be absorbed without compromising investors' returns, there appears to be substantial potential in many other economies to play catch up, with a growing VC industry fueling innovation and economic growth.

Independent VC firms are not the only suppliers of venture capital. Many mature companies have implemented corporate venture capital (CVC) programs, complementing internal R&D programs by investing in external knowledge.[27] There are several reasons why CVC may achieve superior results over R&D alone.[28] First, corporate venturing provides an insight look at new technological developments and a path to possible ownership or use of new ideas, allowing companies to respond quickly to market transformations. This is particularly important in science-based industries that require large long-term and risky R&D investments in an environment where companies face considerable capital market pressures for short-term financial results. Second, corporate venturing can serve as an intelligence-gathering initiative, helping a company identify

FIGURE 2.3

Venture capital penetration in selected economies, 2016-2018



▲ %, Venture capital investments/GDP

Source: Author's calculations based on data from Pitchbook and IMF WEO database, 2019.
Notes: Penetration rates refer to the annual average from 2016 to 2018. The x-axis refers to average per capita income figures for the years 2016-2018.

emerging competitive threats. Third, by pooling its own capital with that of other venture capitalists, it is possible for a CVC program to magnify its impact, which can be particularly advantageous when technological uncertainty is high. Finally, corporations may use CVC as leverage to encourage technologies that rely on the parent company's platform.[29]

Angel investing

As venture capitalists have focused more on opportunities in expansion and later stages, angel investments in entrepreneurial start-ups have become more prominent. Angel investors, or *business angels*, typically invest in relatively early stages of development, with their investments usually not exceeding US$1 million per start-up—in most cases, significantly less. Increasingly, angel investors are organized as semi-formal networks, allowing them to make larger investments as a group and permitting each individual angel to diversify their investment portfolio.[30]

Angel investors are often entrepreneurs—or former entrepreneurs—themselves and share several important features with venture capitalists. Like VC firms, angels and their networks fund entrepreneurial companies in their start-up phases, following intensive due diligence. They usually provide concrete guidance to the entrepreneur, as venture capitalists do. As mentors, angels often adopt a hands-on role in the transactions in which they engage, offering industry-specific insights based on their own experience and knowledge, and facilitating new business connections that help start-ups grow.

On the other hand, angel investors might be more risk-averse than venture capitalists, whose investment portfolios tend to be well-diversified. Thus, angels might be less willing to invest in truly disruptive and highly complex technologies. In fact, while most VC investments have funded high-tech start-ups, angel investments have historically funded a broader range of industry sectors.[31] Further, angel investors themselves might be subject to idiosyncratic liquidity shocks, implying that entrepreneurs relying on angel investments could face higher funding risk.[32]

Research on angel investing has remained scarce.[33] While there is some evidence that angel funding could be a stepping stone for VC investing, there is little systematic information about the size of the global angel market. However, anecdotal evidence suggests that angel investing has gained in importance over time. In the United States, 275 angel networks are members of the Angel Capital Association. In Europe, the European Trade Association for Business Angels counted 115 organizations as members at the beginning of 2020. In emerging economies, angel groups are proliferating, as evidenced by the number of seed financing rounds in which these groups are reported to have been involved.[34]

Accelerators

Another innovation in entrepreneurial finance in recent years is accelerator programs. These programs provide short- or medium-term support and resources to start-ups, helping them speed up their product development and time to market. Typically, they have a fixed time span, lasting no more than a few months. Offering mentorship, education, networking opportunities, and co-working space in many cases, accelerator programs culminate in a public pitch event. Many accelerator programs—but not all—provide a stipend or small seed investment. In return, the accelerator receives an equity stake in the venture, typically ranging from 5 to 8 percent.[35] Improved access to potential follow-on investors, including angels and venture capital firms, is an additional, and perhaps even more important, advantage for start-ups participating in an accelerator program.

Since the foundation of Y Combinator in 2005, accelerator programs have become increasingly widespread, not only in the United States but worldwide. While some programs operate internationally, including in emerging economies, others are run nationally. China and India have particularly active accelerator ecosystems, with their programs generally following the structure of their counterparts in advanced economies. However, accelerator programs are also proliferating in several countries in Africa and Latin America. While accelerators are a relatively recent phenomenon, early evidence suggests that accelerators may have a significantly positive impact in the sense that they do accelerate venture development.[36] The key driver of these accelerator effects is found to be a novel learning mechanism, which could also be relevant for independent entrepreneurs, educational programs, and corporate innovation.

Equity crowdfunding

Finally, entrepreneurial start-ups in their seed phase may seek finance from equity crowdfunding platforms, which have emerged in parallel with other crowdfunding mechanisms. Like its cousin on the debt side, equity crowdfunding is an Internet-based mechanism that is designed to reduce search friction and improve matching between start-ups and potential investors. Start-ups looking for funding may list themselves on the platforms and post relevant information about themselves, while potential investors can screen their investment proposals. In the equity-based version of crowdfunding, funders receive compensation in the form of the fundraiser's equity-based revenue- or profit-share arrangements. Importantly, online platforms are not financial intermediaries and hence are not involved in investment decisions. Instead, the ultimate decision to back a company is made by the individual crowdinvestor, a characteristic they share with business angels.

Equity crowdinvesting has been described as the democratization of entrepreneurial funding.[37] While historically investing in start-ups has been reserved only for venture capitalists and highly connected angel investors, these online platforms allow a broader investor community to access start-up investment opportunities with small amounts. Interestingly, VC funds and business angels often use equity crowdfunding as a screening mechanism to identify attractive investment opportunities.

While equity crowdfunding has been welcomed as a business model with the potential to reshape the VC landscape and early-stage funding as a whole,[38] it entails important risks both for entrepreneurs and investors. Entrepreneurs must understand that no investor is willing to provide funds for a start-up without first assessing its potential value. When seeking funding from venture capitalists and angel investors, the entrepreneur usually provides detailed information about the business idea on the basis of a legally binding nondisclosure agreement (NDA). However, the basic idea of crowdinvesting excludes individual NDAs, requiring entrepreneurs to publicly disclose their business ideas and strategy. This early disclosure might harm start-ups with an innovative business model that can easily be copied. Thus, one might expect equity crowdfunding to be more industry-diverse than VC, which has been actively focused on tech start-ups.

As far as crowdinvestors are concerned, their ability and incentive to perform detailed due diligence is likely to be limited. Given the lack of necessary resources and experience to undertake proper due diligence and post-investment monitoring, individual crowdinvestors may decide to free ride on the investment decisions of others. However, this raises the risk of herd behavior and the risk of selecting underperforming entrepreneurial projects.[39] Additionally, while angels and venture capitalists typically use covenants in their contracts with entrepreneurs, crowdinvesting is usually based on standard contracts that are provided by the crowdinvesting platforms. The staged infusion of capital, a key management tool in venture investing, is usually not available in crowdfunding, and to the extent that crowdinvestors are unable to participate in follow-on investment rounds, their shares get diluted. Moreover, while venture capitalists typically develop a clear exit strategy at the time when they make an investment, crowdinvestors have little, if any, influence and may wait considerably longer for their invested capital to be returned. Finally, there remains considerable regulatory risk as regulations must catch up with evolving forms of alternative finance.

According to data reported by the Cambridge Centre for Alternative Finance,[40] the market for equity crowdfunding has remained far smaller than the market for crowdlending. In 2017, the global volume was estimated at around US$800 million. While the United States, Europe, and Asia Pacific accounted for around US$225 million each, the rest was due to investments in emerging markets in Africa, the Middle East, and Latin America.

Conclusions

Innovators enjoy an increasingly broad spectrum of funding sources across different stages of their companies' life cycles. However, while the emergence of new sources has helped alleviate funding gaps, it has not eliminated them. This is particularly true for many developing and emerging economies where financial markets have remained underdeveloped. But there is ample evidence that many entrepreneurial firms in advanced economies face severe funding constraints as well. New research suggests that these constraints are felt especially by female entrepreneurs and minority groups.

To alleviate existing bottlenecks in entrepreneurial finance, it is imperative for emerging and developing economies to put in place appropriate policies that aim at developing financial markets. Individual circumstances vary substantially from country to country, which makes it difficult to identify priorities that are applicable across the board. Thus, the following examples are meant to be illustrative rather than to imply specific recommendations.

First, to foster access to loans, lenders need to have access to accurate and timely credit information, with clearly defined legal rights in secured transactions.[41] Second, while sovereign bonds generally serve as risk benchmarks, such markets have remained embryonic in many countries. Third, turning to the equity side, it is critical for minority shareholders to be adequately protected. Countries where investors are better protected, for example, through disclosure requirements and liability standards, typically enjoy more VC activity.[42] Given that the vast majority of VC investments focus on tech companies, enhancing minority shareholder protection may help spur innovation and growth. Finally, shareholder protection goes hand in hand with the importance of developing a market for initial public offerings (IPOs). There is considerable evidence that VC activity is closely related to the depth and breadth of stock markets.[43] Unless VC firms are able to exit via an IPO, they will need to convince new shareholders to buy the stock of their portfolio companies. However, investors are likely to be reluctant to purchase stakes in an environment with sub-par shareholder protection.

Recent advances in fintech are expected to help overcome some of the current constraints in entrepreneurial finance. However, for fintech to fulfill these optimistic expectations, it will be critical for governments to put in place a regulatory framework that fosters fintech lending, equity crowdinvesting, and other emerging forms of financing start-ups. This need is equally important for developing countries and advanced economies. For countries that are "getting it right," new technologies offer substantial potential to leapfrog, unleashing growth forces by facilitating the funding of entrepreneurship and innovation.

Notes:

1 Schumpeter, 1934.

2 For a discussion of the various channels between economic and financial development, see Levine, 2005.

3 Kerr et al., 2015.

4 Scherer, 1999; Hall et al., 2010.

5 An exception is Allen et al., 2013.

6 Ritter, 2020; In the United States, only 35% of tech companies that went public in 2001–2019 were profitable. In the biotech industry this percentage was even lower (5%).

7 Rob et al., 2012.

8 Estimate by the Cambridge Centre for Alternative Finance, 2020; In the reward-based crowdfunding model, backers provide funding to individuals, projects or companies in exchange for non-monetary rewards or products. Reward-based crowdfunding platforms enable "project creators" to post project or product descriptions and videos in order to solicit funding. Project creators set a funding goal and a deadline. Importantly, crowdfunding campaigns are all or nothing. If the

target funding goal is met within the given timeframe, the pledges are automatically collected from the donors; otherwise no money changes hands. However, although the volume of reward-based crowdfunding has increased in recent years, it is still relatively small, totaling around US$1.2 billion. The vast majority of this amount is due to transactions in China.

9 Global Entrepreneurship Monitor, 2019.

10 Chavis et al., 2012; The SME Forum estimates that more than 40 percent of micro-, small- and medium-sized enterprises in emerging markets are financially constrained, with an estimated credit gap totaling $4.75 trillion. SME Finance Forum MSME database, 2020.

11 Casanova et al., 2018.

12 Banerjee et al., 2011.

13 McKinsey Global Institute, 2016.

14 Mills, 2018.

15 Cambridge Centre for Alternative Finance, 2018; Of this amount, $97 billion was due to lending in China.

16 Claessens et al., 2018; Philippon, 2016.

17 Nguyen & Hille, 2018; As companies grow and start to accumulate tangible assets, patents typically lose in significance as collateral. While patents are often the most valuable asset of tech companies, traditional banks are found to show a significant aversion against their use as collateral in their lending operations.

18 Preqin Database, 2020.

19 Gompers et al., 2001.

20 Kortum et al., 2000; Kortum and Lerner find a significant impact of VC on innovation across different industries in the U.S. While the U.S. remains the world's largest VC market, there is less systematic evidence for other economies.

21 Kaplan et al., 2003; Agency problems in VC are fourfold: (a) the entrepreneur may not work hard enough to maximize value after the investment is made; (b) the entrepreneur may know more about his capabilities than the venture capitalist; (c) after the investment is made, there may be circumstances in which the venture capitalist disagrees with the entrepreneur and wants the right to make decisions; and (d) the entrepreneur may "hold up" the venture capitalist by threatening to leave the venture when the entrepreneur's human capital is particularly critical to the company.

22 Kaplan et al., 2010.

23 Jay Ritter IPO Database, 2020.

24 Nanda et al., 2017.

25 Lo et al., 2016; Fagnan et al., 2013.

26 Lerner, 2016.

27 Dushnitsky & Lenox, 2005; Companies will prefer CVC if the marginal innovative output is expected to be higher than that of internal R&D; Ma, 2020; However, the differential between the marginal innovative output of CVC and internal R&D may not be static. Instead, firms searching for innovation use the knowledge in their portfolio companies to jumpstart internal R&D and terminate their CVC programs when the informational benefit diminishes.

28 Lerner, 2013.

29 To attain this goal, companies have chosen different organizational forms of CVC. Some companies have established internal corporate venture groups to analyze VC opportunities and invest in start-ups. As an alternative, other companies have set up external CVC funds as a separate entity outside the company. Finally, other CVC programs involve commitments to IVC funds, with the option to co-invest in entrepreneurial start-ups alongside these funds.

30 Kerr et al., 2014.

31 OECD, 2012.

32 Lerner et al., 2018.

33 Exceptions are Kerr et al., 2014; Hellmann et al., 2019; Lerner et al., 2018.

34 Casanova et al., 2018.

35 Hochberg, 2016; Some accelerators offer a larger, guaranteed investment in the start-up upon graduation, usually in the form of a convertible note.

36 Hallen et al., 2020.

37 Afuah et al., 2012.

38 For a detailed description of equity crowdfunding platforms, see Bernstein et al., 2017.

39 To help mitigate this risk, some platforms, such as AngelList in the United States, offer the opportunity for investors to form syndicates. These syndicates usually include experienced angels and venture capitalists. Less experienced investors may co-invest with a syndicate, in exchange for a share in the profit, a model that could help reduce the information asymmetry problems that arise due to the lack of appropriate due diligence by the majority of the investors.

40 Cambridge Centre for Alternative Finance, 2018.

41 World Bank, 2019.

42 Lerner et al., 2009; Consistent with this evidence, Lerner & Schoar (2005) find that VC deals in low-enforcement countries are based to a comparatively larger degree on equity and board control as opposed to convertible preferred stock with covenants, a more common form in high-enforcement countries.

43 Black et al., 1998.

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CHAPTER 3

SOVEREIGN WEALTH FUNDS AND INNOVATION INVESTING IN AN ERA OF MOUNTING UNCERTAINTY

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Sovereign wealth funds (SWFs) have become a major factor in technology and innovation investing globally. They have emerged as important sources of capital to traditional venture capital firms and increasingly, as direct investors. SWFs differ from many other investors in their character, risk tolerance, priorities, and time horizons. Understanding their characteristics and behaviors is increasingly important for all participants in the technology and innovation investing marketplace.

Over the past decade, a rapidly evolving investment climate has required SWFs to change with the times. Some major SWFs have become sophisticated long-term technology investors as they have reacted to the impact of disruptive technologies and business models. These disruptive factors have been compounded by the uncertain investment climate and emerging geopolitical trends, such as increasing nationalism and trade wars.

How are SWFs evolving? Increasingly these investors are looking to:

- Identify disruptive ideas or technologies—particularly in growing, proven technology sub-sectors, such as enterprise software and services.
- Allocate capital for investment in companies at earlier stages of capital formation.
- Use their investing capacity to enhance domestic economic competitiveness and well-being. This is being accomplished by investing globally in opportunities for technology transfer and business models extension, and increasingly in direct investing in domestic opportunities.
- Expand adoption of co-investment strategies, often side by side with venture capital funds.
- Consider investing in evergreen-style funds to better align with SWF long-term time horizons.
- Seek more active and constructive investor roles given current concerns over valuations, governance, and initial public offerings.
- Move towards attractive sectors with significant public policy, foreign policy, public safety, national defense, and security implications.
- Develop their internal human capital and management structures to manage the complicated financial landscape.

The rapid pace of change in the technology and innovation sector, exemplified by recent political, environmental, and global health challenges, assures that SWFs will need to continue to evolve to respond responsibly and proactively to these important challenges and opportunities.

Innovation investing strategy and tactics

The State of Alaska is known for its soaring mountain ranges and glaciers, grizzly bears, salmon, and perhaps its huge reserves of crude oil. Cutting-edge biotechnology is unlikely to be on your list of Alaskan features. But, since 2013, the Alaska Permanent Fund Corporation (APFC), the state's sovereign wealth fund,[2] has seeded innovative life-science companies with hundreds of millions of dollars, often alongside venture capital specialists ARCH Venture Partners: Codiak Biosciences (based at the Massachusetts Institute of Technology), San Francisco-based Denali Therapeutics, and Juno Therapeutics, headquartered in Seattle. Despite their diverse locations, their names reveal their Alaskan roots.

APFC is one of many sovereign wealth funds that has been allocating a greater part of their portfolios to stakes in early-stage and unlisted innovative technology companies. Although Alaska's sovereign wealth fund was a relatively early entrant to the sector, by 2016, this trend could not go unnoticed. This was the year when SoftBank established its now beleaguered Vision Fund with the backing of major Middle Eastern government investors. It was also the year when Saudi Arabia's Public Investment Fund made a headline-grabbing US$3.5 billion investment in another rather ill-fated company, ride-sharing app Uber.

Since then, sovereign wealth funds have shown a continued appetite for unlisted high-tech companies both in the United States of America (U.S.) and Asia. This has been an active choice for sovereign wealth funds that invest capital abroad with a multi-decade return horizon and view the lack of liquidity as an opportunity to earn higher returns. Their patient capital is also a competitive advantage for the early-stage firms in which they invest as, unlike venture capital firms and private equity companies, they don't have to exit investments to provide liquidity for their stakeholders on a fixed deadline, typically no longer than 10 years.

Equally, for these early entrants, sovereign wealth funds are attractive co-investors. Many new technology companies[3] with capital-light business models have chosen to defer achieving profitability for the sake of fueling growth. Time to liquidity for early-stage investors has always presented a challenge. But in today's global economy, where winner-takes-all companies such as Google and Amazon have become a model, tech companies that appear fixed-capital light become vast consumers of liquid financial capital to support customer acquisition. The fickle initial public offering (IPO) market may not be receptive when investor patience is in short supply. Consequently, investors often rely on a sale to a commercial buyer or another private equity fund to exit ("pass-the-parcel") or choose to hold onto these companies for a longer period. On the New York Stock Exchange, 2019 was meant to be a bumper year for IPOs, but Uber and its competitor Lyft debuted in the first half to limited investor appetite over concerns about the companies' prolific losses. During 2019, some of the fastest growing and most highly valued start-ups in the world, including Pinterest, Slack, and SmileDirectClub, failed to excite investors due to their failure to generate profits. Other much-vaunted IPOs, including WeWork's parent company and talent agency behemoth Endeavor, failed to list at all. The story was much the same in Hong Kong, China, which despite being the leading destination for IPOs in 2019,[4] saw a drop of 7% in overall value of IPOs and 28% in volume overall from 2018, even accounting for the US$11.3 billion debut of China e-commerce giant Alibaba.[5] Indeed, globally IPO activity fell by 20% to 1,242, and capital raised fell 8% to US$206.1 billion, according to law firm Baker McKenzie.[6]

But in a climate of resurgent nationalism and trade wars, politicians are becoming more cautious about foreign direct investment (FDI), particularly in those sectors that they perceive to have greater strategic sensitivity. Concerns about sovereign wealth fund investments do not have to be sparked by SWF behavior. In 2006 and 2007, it was the Dubai Ports World controversy that pushed FDI up the U.S. political agenda and catapulted the newly named category of sovereign wealth funds into public consciousness. In 2019 and 2020, the most high-profile case of this type of reaction has been the ban on China's leading telecom firm, Huawei, being involved in the construction of 5G networks in several countries, including the United States, Australia, and New Zealand. For investors like SWFs that acquire assets overseas and are linked to governments, it is a balancing act to be able to invest without getting caught up in political disputes.

But while there are emerging challenges for sovereign wealth funds investing abroad, over the past half-decade, a new trend has been the formation of SWFs specifically to invest in their domestic economies—to foster economic development and diversification and to improve the lives of their citizens. Governments from all over the world, for example, France, Ireland, Turkey, Kazakhstan, Morocco, Oman, and Singapore have established such institutions. Additionally, many sovereign wealth funds that have a traditional mandate for overseas investment are increasingly being encouraged by their owners to look at more investment opportunities in the local economy—or use their international investing to encourage technology transfer or business model extension into the local economy. Internet-based services are increasingly pervasive in modern life across the planet, and, as a result, innovation is not just relevant in a narrow range of science-based activities, high-tech activities, or manufacturing. SWFs investing at home, therefore, have greater opportunities to invest in companies with innovative products that can potentially be a potent force of change in all parts of society, including service industries, creative industries, and the public sector.

We are only at the beginning of this trend. While domestic investments are still a small proportion of the whole, they have grown in number year-over-year since 2015. Nevertheless, these investments come with their own challenges: avoiding conflicts of interest and unsound, politically motivated investments, and preventing crowding out private capital.

In this article, we will describe these two trends and explain how and why SWF investment behavior in the unlisted technology space has changed over the past half-decade.

The innovation investment boom: harnessing the power of Silicon Valley...and China

Before 2015, SWFs had been increasing their investment activity in unlisted technology businesses employing a combination of fund investments, such as private equity or venture capital, and direct equity holdings, such as co-investments, standalone stakes, and club deals.[7]

Of course, SWFs were far from alone for increasing their exposure to technology and other types of illiquid assets, including infrastructure, direct lending, and private equity.

Pension funds and endowments have similarly been drawn by three key attractions:[8] perceived higher return potential, diversification from traditional return streams towards idiosyncratic growth drivers, and insight into how today's major technological developments will affect the investor's wider portfolio. Sovereign wealth funds had similar advantages, including being perceived as financially stable and able to act as patient capital. They also had unique advantages, for example, helping their domestic political and business networks support the growth ambitions of investee companies, as the China Investment Corporation (CIC) has done with its CIC Capital unit.[9]

Recently, however, there have been some significant shifts to the underlying dynamics of the market. Capital inflows to the unlisted technology and innovation investment arena have increased from new "non-traditional" participants—investors that do not focus exclusively on venture capital investments, including corporations, private equity firms, mutual funds, family offices, and SWFs. These non-traditional investors contributed to nearly 3,000 U.S. venture capital deals in 2018, influencing deal valuations and structures in transactions totaling over US$100 billion (81.5% of the U.S. total deal value).[10] These investors often invest at the later stages of the venture capital cycle and have thereby contributed to the spike in the number of *unicorns*—portfolio companies with valuations of greater than US$1 billion. In the face of this disruption, it is, perhaps, important to note that certain SWFs are emerging as sophisticated technology investors. As a result, the overall picture of how SWFs allocate capital in this space requires deeper analysis. Although it is almost impossible to track the changing patterns of SWF technology investment activity conducted through private equity and venture capital funds, we can examine direct deals in considerable detail, thanks to the research undertaken by the International Forum of Sovereign Wealth Funds.[11] This data can provide a window on recent SWF innovation and technology investment trends.

SWF technology investments are primarily focused on the U.S. and Asia, with the European Union (EU) remaining somewhat less attractive as a destination. This reflects a broader theme, as opposed to an SWF-specific concern: the current distribution by home region of the value of technology companies reveals the big gap that exists between the EU (5%), the U.S. (65%) and China (35%).[12] A recent report to the European Commission by the Expert Group on Regulatory Obstacles to Financial Innovation attributed this laggard status to lack of regulatory harmonization across EU states, although it cited other factors, including the structure of the venture capital ecosystem and an unconducive tax framework.[13]

A shifting focus from consumers to intellectual property

In the mid-2010s, SWFs direct investment focused on consumer services with high-tech elements, such as e-commerce and consumer technology, as illustrated in Figure 3.1. Over the last five years, however, SWF investment in e-commerce has slowed from its 2016 peak of 17 equity investments with a total value of US$6 billion to 7 investments in 2019 valued at US$185 million. E-commerce, particularly in emerging markets, has become less attractive to sovereign wealth funds.

The slowdown has been the result of several factors. Some SWFs felt overexposed to the Chinese economy and had already chosen their regional champions. The e-commerce sector has largely consolidated with a few global champions impeding new entrants, such as Amazon in the U.S. and Europe and Alibaba in China. The only regional market with more competition is India, where, in 2018, U.S. retail giant Walmart acquired 77% of Indian e-commerce company Flipkart, whose original backers included Singapore's GIC and the Qatar Investment Authority, among others.

With these more accessible sectors becoming of less interest to SWFs, they are now thinking more systematically and pragmatically about disruptive innovation. Rather than trying to find the platform that could create the next transformational technology ecosystem, they are looking to invest in a disruptive idea or technology that several potentially winning companies might be developing. The strategy allows active monitoring, making a judgment on which will be the strongest opportunities, and consolidating their investments as the markets and products develop.

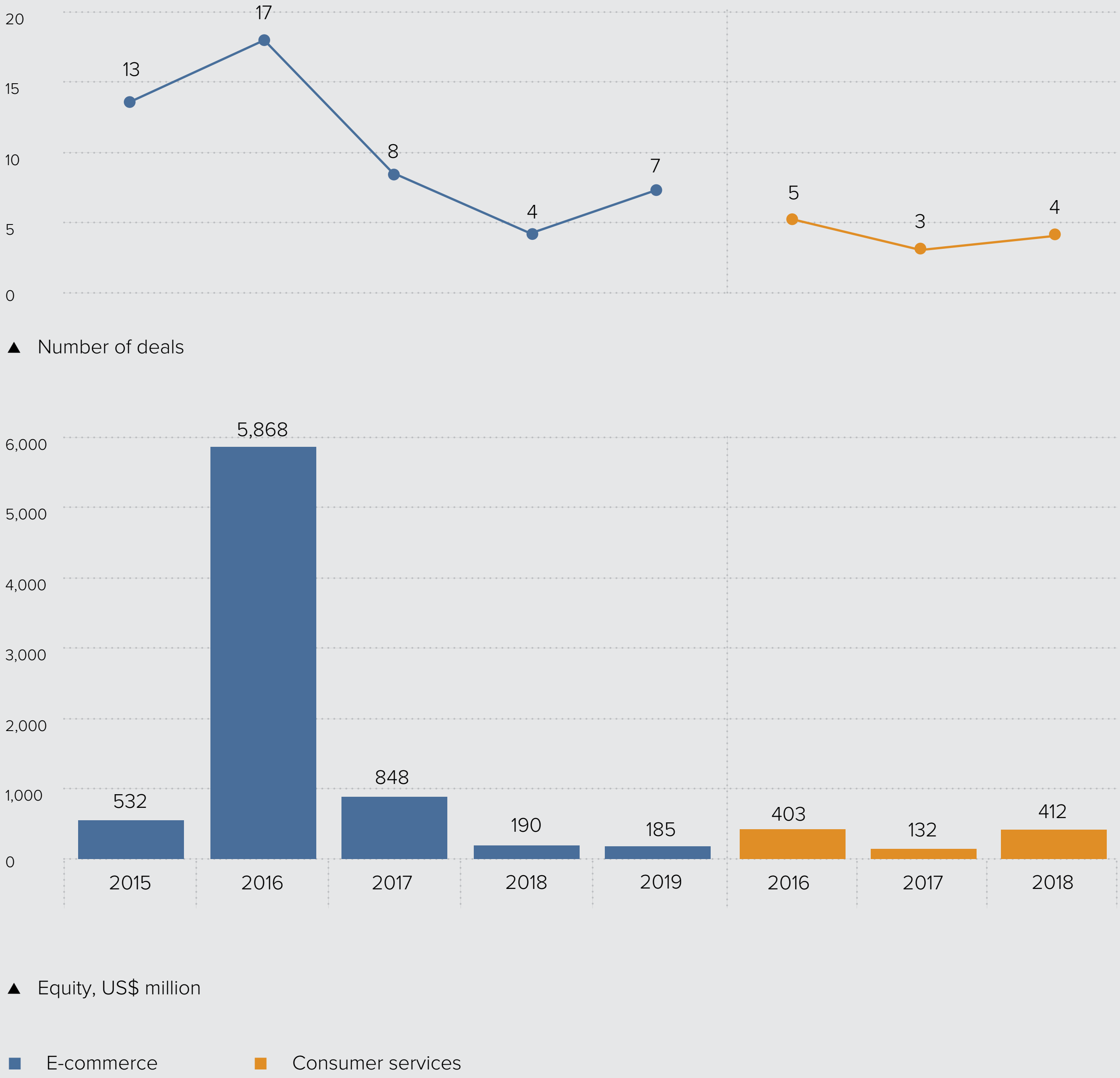
As illustrated in Figure 3.2, SWFs often identify these businesses in growing subsectors, such as enterprise software and services—advanced, practical technologies that solve problems and create opportunities for customers. Such companies are often more reliant on their intellectual property for success and benefit from scale and network effects as they become established. Consequently, they are potentially less vulnerable to competition and remain highly capital efficient, while requiring relatively large capital investment to support initial customer acquisition and global expansion. This makes them a good fit for long-term investors willing to put additional capital to work in successive rounds. In 2018 and 2019, these niches attracted 10% of all SWF direct investments. A notable example of this is Singapore's Temasek Holdings' US$250 million acquisition of Israeli cybersecurity services provider Sygnia. Saudi Arabia's Public Investment Fund continues to produce the most high-profile deals, such as its US$400 million commitment to the Series D round for augmented reality giant Magic Leap, which had previously attracted investments from Temasek.

APFC is not the only SWF interested in life sciences. Healthcare technology is another sector where activity has risen in the past half-decade, as shown in Figure 3.3. In this industry, SWFs are focusing on a few highly disruptive niches, such as biotechnology, and avoiding overly competitive sectors or those with significant regulatory risk, such as pharmaceuticals or medical equipment and supplies. Biotechnology is attracting huge interest, partly because investors have realized the commercial opportunities arising from developments in innovative FDA-approved gene editing technologies.

SWF investment in companies developing cutting-edge biotechnology has recently been brought into sharp relief by the coronavirus pandemic. Vir Biotechnology—backed by three

FIGURE 3.1

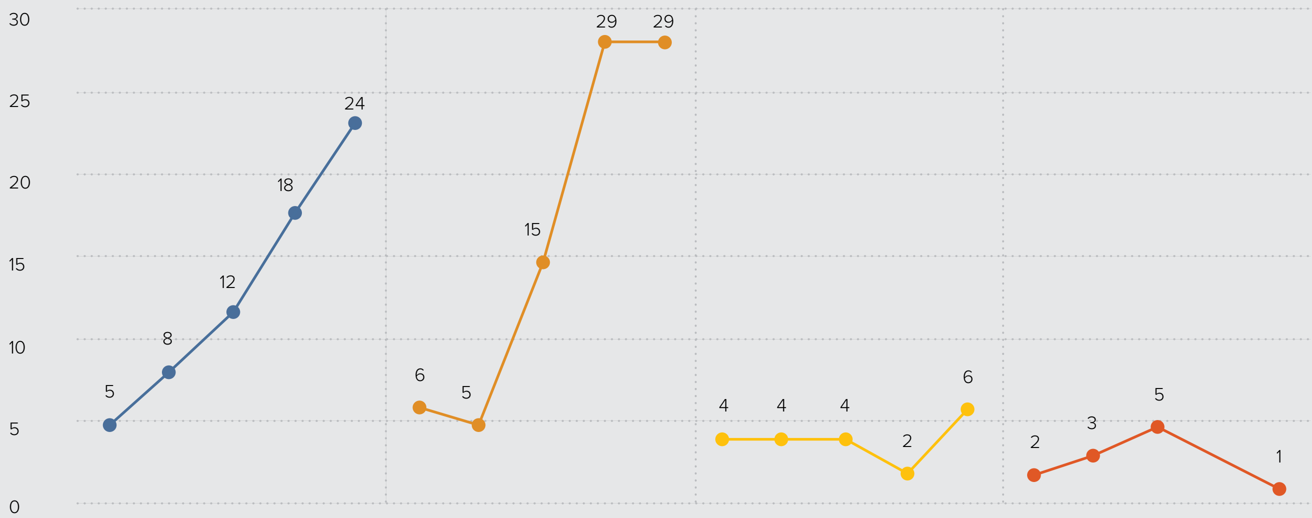
SWF direct investments in e-commerce and consumer services



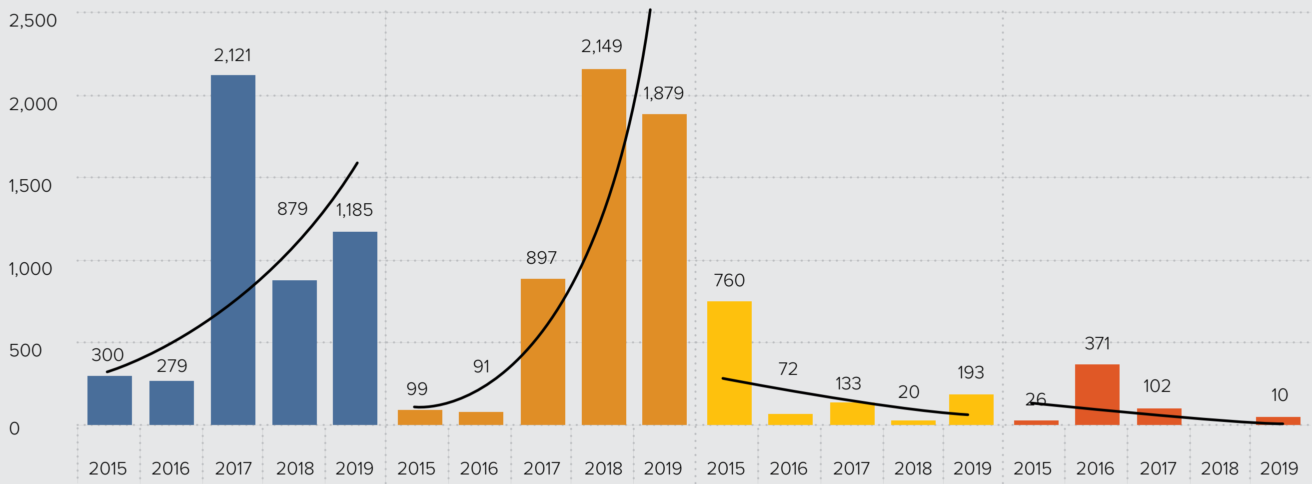
Source: International Forum of Sovereign Wealth Funds (IFSWF) Database, 2020.
Note: IFSWF's data to 31 December 2019, is provisional as of 31 January 2020. There may, therefore, be discrepancies between the figures used here and those in future publications using this data. The data collection methodology is accessible at https://ifswfreview.org/2018/about-our-data

FIGURE 3.2

SWF direct investments in technology sectors



▲ Number of deals



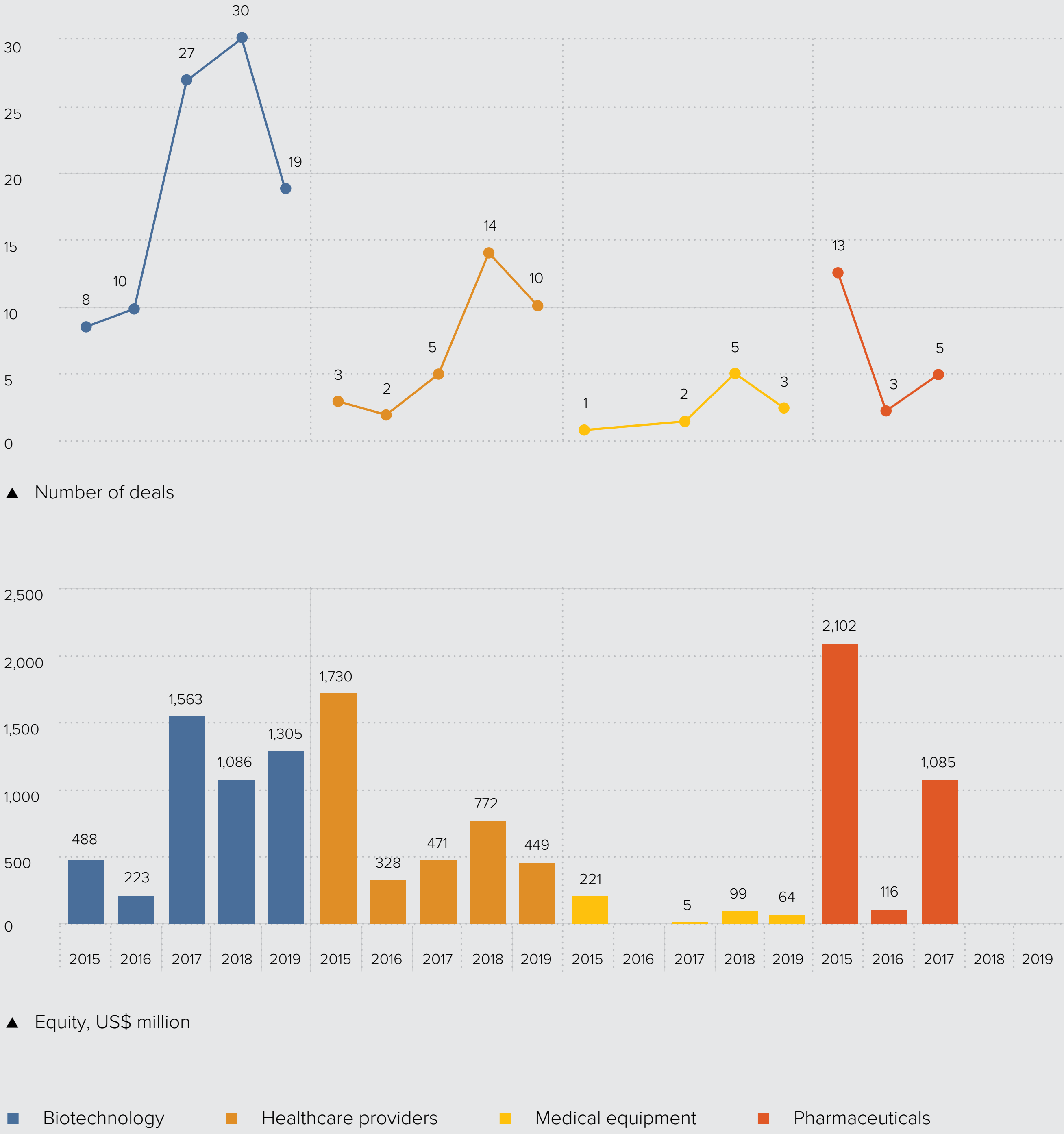
▲ Equity, US$ million

■ Internet ■ Software & services ■ Hardware ■ Mobile & telecom

Source: IFSWF Database, 2020.
Note: SWFs made no direct investments in mobile & telecom companies in 2018.

FIGURE 3.3

SWF direct investments in healthcare



Source: IFSWF Database, 2020.
Note: In 2016, SWFs made no direct investments in medical equipment. In 2018 and 2019, they made no direct investments in pharmaceutical companies.

SWFs (Abu Dhabi Investment Authority, APFC, and Temasek)—announced in January 2020 that it was working on a vaccine to help neutralize the outbreak and announced a partnership with Alnylam Pharmaceuticals to develop and commercialize RNA interference (RNAi) therapeutics targeting severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes coronavirus disease (COVID-19).[14] As a result, the stock of this previously obscure NASDAQ-listed start-up initially surged from US$16 to US$75, as stock markets responded to fears of a global outbreak. Even amid the market rout of March 2020, the company's share price remained robust (Figure 3.4).

Earlier stages

In a low-return environment, more institutional investors are looking to increase their returns by allocating to private equity and venture capital. Consequently, private equity and venture capital firms have a record amount of uncommitted capital, or "dry powder", to put to work. With competition rising in the buyout and mid-market spaces, experienced SWFs are developing the skills to allocate capital for direct investment in companies at earlier stages of capital raising. As illustrated in Figure 3.5, in 2018, SWFs completed 29 transactions at growth-capital stage (series C, D), up from 19 the previous year, and doubled their commitments at early stage (A, B, B+), with 20 deals versus 11 in 2017.

Although early-stage and growth companies are becoming more interesting to SWFs, this doesn't preclude investments in later-stage or pre-IPO companies in cases where they see value; in 2019, for example, SWFs invested in 18 late rounds of capital raising (from Series E to H), up from 3 only two years before.

Collaboration, co-investment, and lead financing

SWF approaches to sourcing these direct deals vary. An increasingly common strategy is for SWFs to co-invest with their venture capital managers—an approach also adopted by other institutional investors. However, some SWFs can, and do, lead transaction financing at early- or growth-stage, with or without venture capital or private equity firms. In 2019, SWFs led a total of 27 funding rounds—7 early stage, 12 growth, and 8 late stage—representing an increase of more than 100% versus the previous year (Figure 3.6).

Over the last five years, SWFs have invested alongside a range of partners. In 2019, the trend of sovereign funds investing as part of consortia reached its highest level, particularly in sectors such as healthcare and technology: sovereign funds' involvement in consortium deals in technology companies has more than tripled since 2016. In 2019, the trend continued with SWF preferring to partner or co-invest in innovative industries. Eighty-three deals in healthcare and technology were completed as part of a consortium, versus sixteen as solo investors.

The healthy activity in direct investment is supported, to some extent, by the limitations of the conventional limited partner/general partner (LP/GP) fund structures. Fee structures, fund life cycles, and other aspects of the private equity model do not necessarily create alignment of interest or maximize long-term benefits to SWF investors—although access to co-investment can help. We note a rise in newer, innovative models such as deal-by-deal co-investment structures and even evergreen-style funds.

The last few years have seen the emergence of many innovative venture capital structures to incentivize research commercialization on a specific campus or university basis. Founded in 2015, Oxford Sciences Innovation (OSI) is one noteworthy example. OSI achieved scale, raising US$700 million in its initial fundraising and bringing together SWFs Temasek and the Oman Investment Fund, along with value-added tech investors Google Ventures and Sequoia Capital. Structured as a corporation, in which the University has an equity interest, it is an evergreen fund, which frees it from many of the time constraints of a traditional venture capital firm. Operating in partnership with the University of Oxford, OSI provides investment assessment and perhaps financing to research originating from the University in return for a certain percentage of a portfolio company's equity, even where OSI has chosen not to invest capital. Here the investors are not limited partners but hold equity in the business and receive returns in the form of stakeholder dividends and potential capital appreciation.

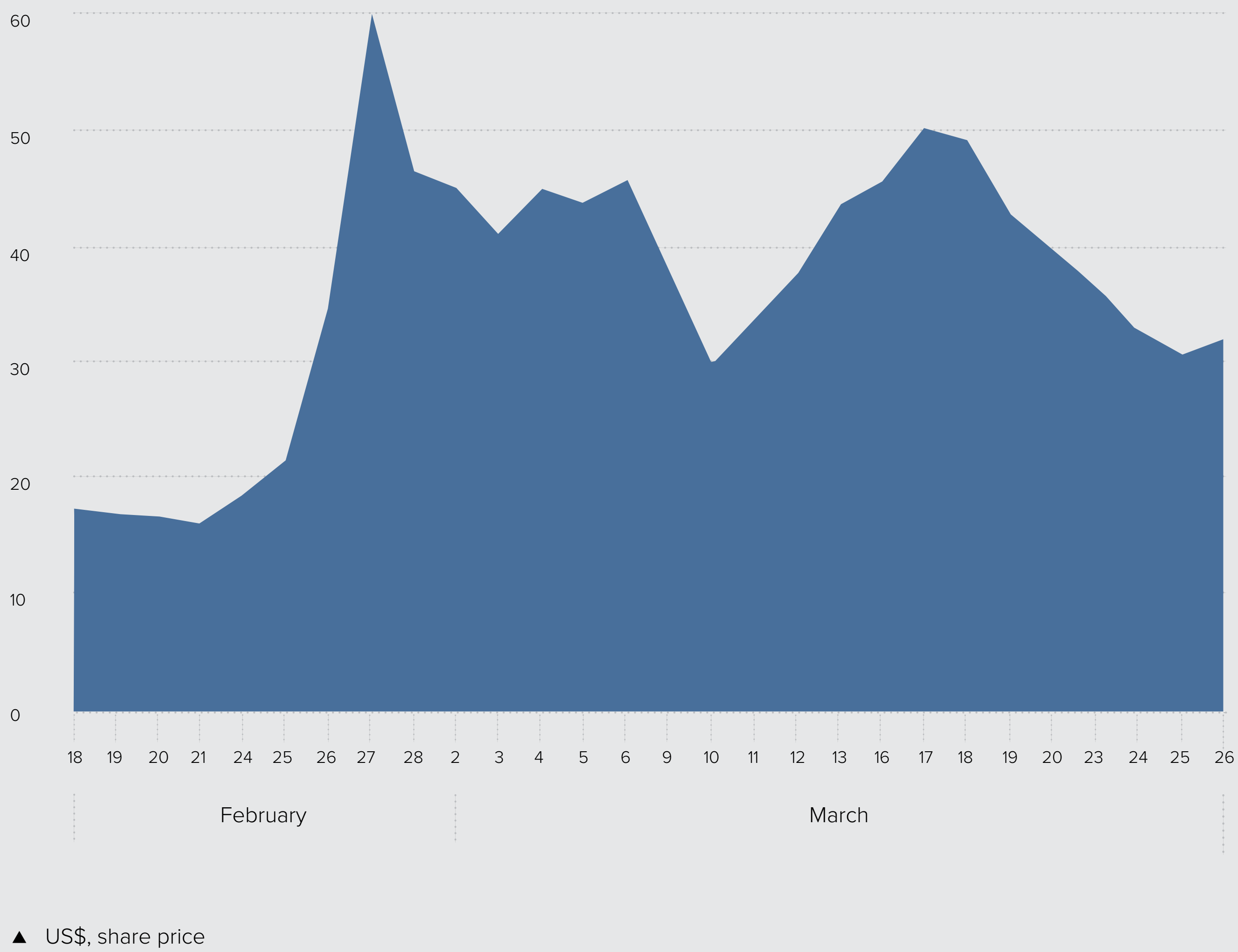
The individual structures that an SWF adopts when investing with partners largely depend on its internal private equity or venture capital capabilities. Research by the International Forum of Sovereign Wealth Funds published in 2016 noted that hiring the right people is key to the success of private-market investing, and this is particularly true for complex and evolving businesses in the technology space. As many sovereign wealth funds are based outside major financial centers, attracting and retaining talent that can successfully invest in technology requires creative solutions.[15] To attract this talent, obtain a detailed understanding of the ecosystem, and develop high-quality deal flow, some SWFs, such as Singapore's GIC and Temasek, Malaysia's Khazanah Nasional, Abu Dhabi's Mubadala Ventures, and the Qatar Investment Authority (QIA), have set up offices and subsidiaries in Silicon Valley.

Improving skill sets and rethinking teams

The most prolific SWF innovation investors—Mubadala, Temasek, and (historically) Khazanah,[16] which together are responsible for half of all the SWF investments in this sector from 2015 to 2019—have their roots in running operational businesses. Temasek and Khazanah were initially formed to manage and improve the performance of government-linked companies in 1974 and 1993, respectively. Similarly, Mubadala was established in 2001 to diversify and develop the economy of Abu Dhabi and has deep experience in building industrial clusters and running operational businesses, including in the

FIGURE 3.4

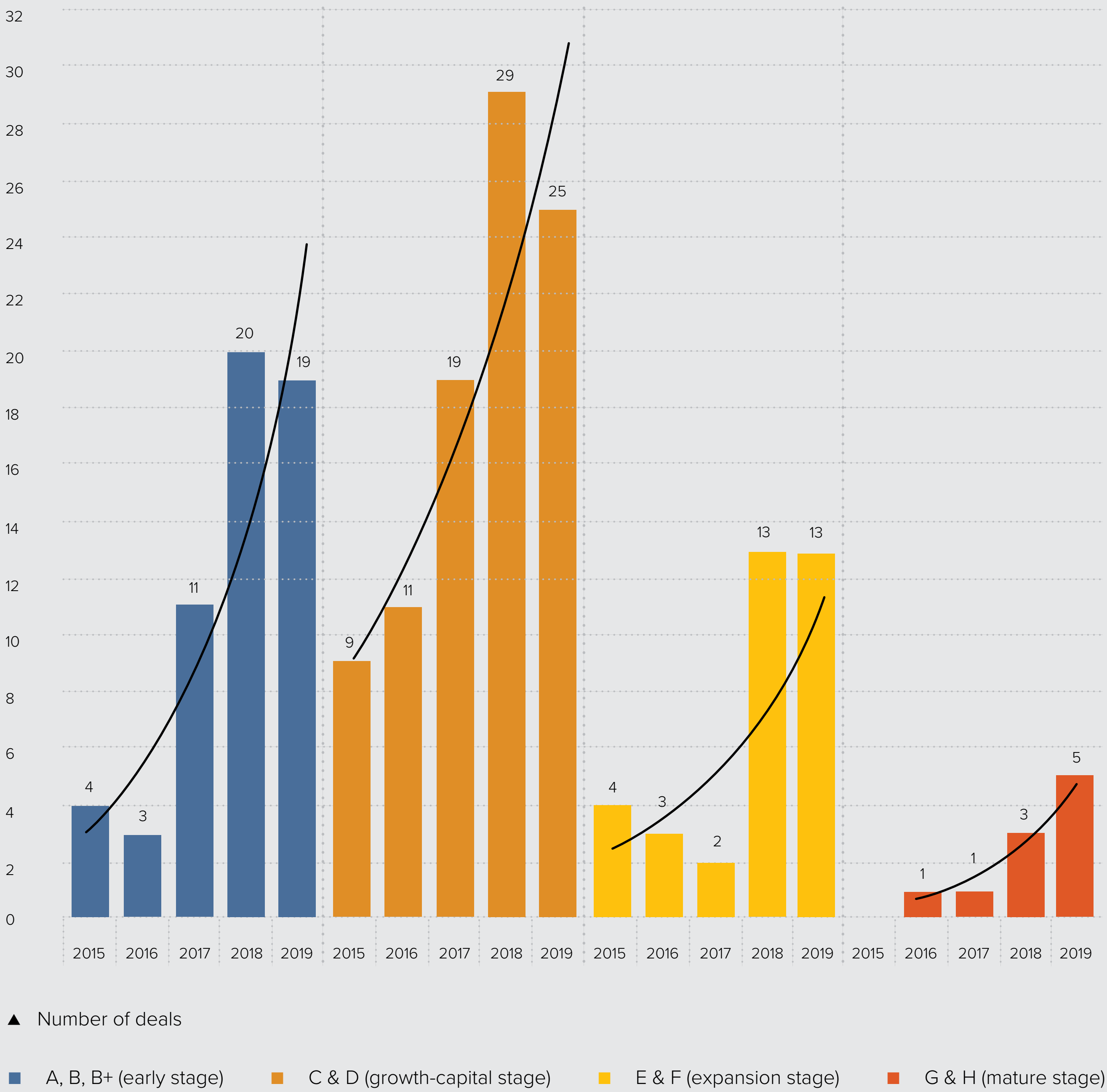
VIR Biotechnology, NASDAQ stock values, February to March 2020



Source: Bloomberg.

FIGURE 3.5

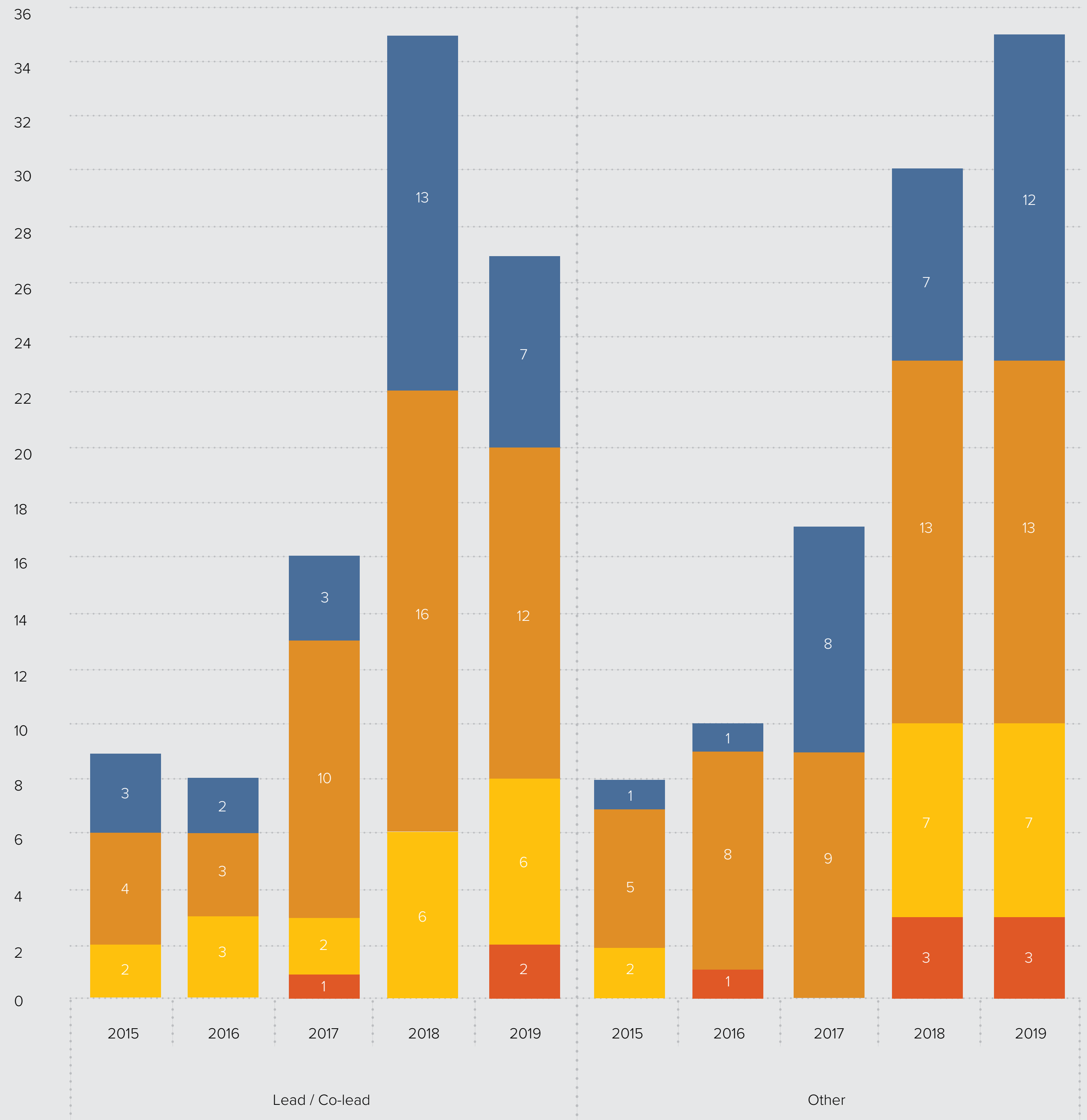
SWF direct investments at different stages of venture financing, 2015-2019



Source: IFSWF Database, 2020.
Note: SWFs made no G&H round investments in 2015.

FIGURE 3.6

SWF investments as a lead, by stage of financing



▲ Number of deals

■ A, B, B+ (early stage) ■ C & D (growth-capital stage) ■ E & F (expansion stage) ■ G & H (mature stage)

Source: IFSWF Database, 2020.

information and communications technology sector. It appears that, in the unlisted tech arena, this insight and corporate culture provides them with a competitive advantage over their peers that invest excess reserves in international markets and build such capabilities from scratch.

Highlighting the character of the three most prolific SWF investors in early-stage technology companies reveals the importance of developing human capital with appropriate skills and mindsets. In 2016, the authors identified several best practices that remain relevant, including building long-term, multi-vintage relationships with fund managers; developing competence to participate meaningfully in board governance; and learning and practicing value-added behaviors with fund managers and portfolio companies.[17]

To successfully execute more direct, early-stage, and multi-stage investments, SWFs need to develop hands-on skills in every aspect of portfolio construction and governance. Investing in technology and innovation requires a diverse range of people with different skills and backgrounds. SWFs are increasingly aware that cognitive diversity in teams helps them better understand the relevance of the business's products, markets, and financial potential as well as non-traditional issues, such as data privacy. These skills can be developed organically, but the pace of change may require an infusion of experienced venture capital-sector operators to augment the process. Such changes need to be made with intention and care. The recent move toward more fundamental technology and innovation platforms may also call for new skill sets in technology and intellectual property assessment as well as corporate governance and deal management. The rapidly evolving nature and manner of SWF technology and innovation investment will require heightened and continuing attention to SWF governance structures, investment team competency, behavior, and development. However, for SWFs, which are public-sector institutions, the cost and complexity of recruiting these skills may be out of their reach. Consequently, SWFs are likely to avoid investing directly and instead continue to rely on more traditional fund investments with co-investment rights.

Another upgrade that SWFs need to make to enhance investment outcomes in the unlisted technology is in governance and decision-making frameworks. Research from the International Forum of Sovereign Wealth Fund (IFSWF) in 2016 also revealed that to be successful in private markets generally, sovereign wealth funds needed to improve these processes to balance the markets' complexity. For investment opportunities at the cutting edge of innovation, this is even more important, as the risk is undeniably higher. Therefore, sovereign wealth funds need to build strong and deep due diligence frameworks to enable them to move decisively when opportunities arise.[18]

Geographic disparity: "technology transfer" yet to yield fruit

The concept of technology transfer used to be an important driver for SWFs. Abu Dhabi's Mubadala was an early and leading proponent of this strategy as it sought to build a semiconductor cluster in Abu Dhabi, forming the GLOBALFOUNDRIES semiconductor manufacturing company with Advanced Micro Devices (AMD) in 2009.[19]

While this strategy is perhaps less important for SWFs today, there is anecdotal evidence that some are now choosing—or encouraged—to invest at home to spur local industries. One example of this home market technology and innovation investment strategy is in Nigeria, where the Nigeria Sovereign Investment Authority (NSIA) has invested heavily in healthcare technology in the country. In 2019, NSIA invested US$11 million, in partnership with the Lagos University Teaching Hospital, to rebuild and equip the hospital's cancer center for the provision of cutting-edge radiotherapy and chemotherapy treatment services. Equipping the cancer center required building strategic partnerships with leading oncology equipment manufacturers, including Varian Medical Systems and GE Healthcare. While this is a new investment with an obvious social need, it has, so far, been "very profitable" for NSIA, according to senior executives.

Domestic technology investments make up only a fraction of the overall total, as shown in Figure 3.7. However, the number of domestic tech investments is growing as sovereign wealth funds like the Russian Direct Investment Fund and the Ireland Strategic Development Fund (ISIF) seek to encourage foreign direct investors to help build innovation clusters. These sovereign wealth funds thus play a key role in implementing a government's innovation policy by de-risking projects that would otherwise have proved difficult to finance. For example, in 2018 and 2019, ISIF invested in Vectra, an artificial intelligence cybersecurity company, to establish and then expand its research and development center in Dublin.[20]

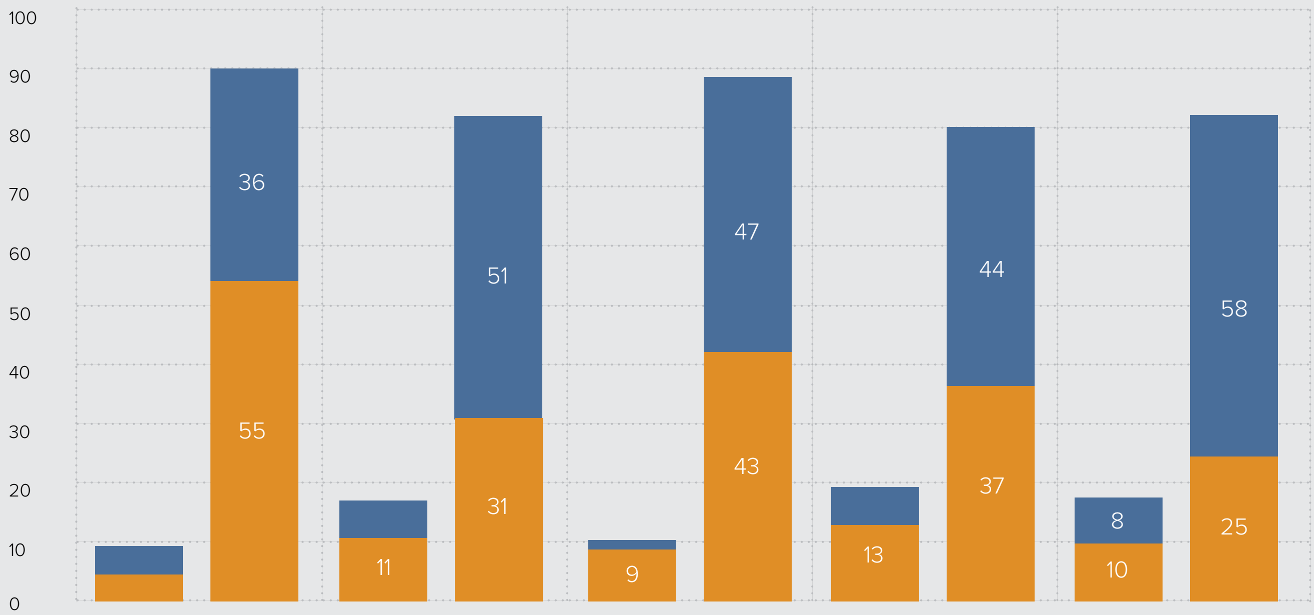
Postscript: new political challenges?

The evolving political and economic climate since 2008 has brought about a revival in political and economic nationalism. Although SWFs have largely avoided being caught in high-profile disputes, we hear substantial anecdotal evidence that U.S. investors have been less welcoming of Chinese and Saudi SWF money during recent periods of heightened political sensitivity. This trend is also likely to be reinforced by geopolitics, such as exogenous developments including the U.S.-China Phase One Trade Deal agreed to in January 2020, which explicitly requires China to avoid pressuring U.S. companies to share technology with local joint venture partners or sell licensing to their technology at below-market prices for access to China's market. Looking more broadly, the decline in foreign direct investment is evident: Chinese FDI in U.S. industries fell in 2019 to an estimated US$3.1 billion—a fraction of the US$46.5 billion in 2016, and a decline of 42% from the US$5.4 billion in 2018, according to Rhodium Group.[21]

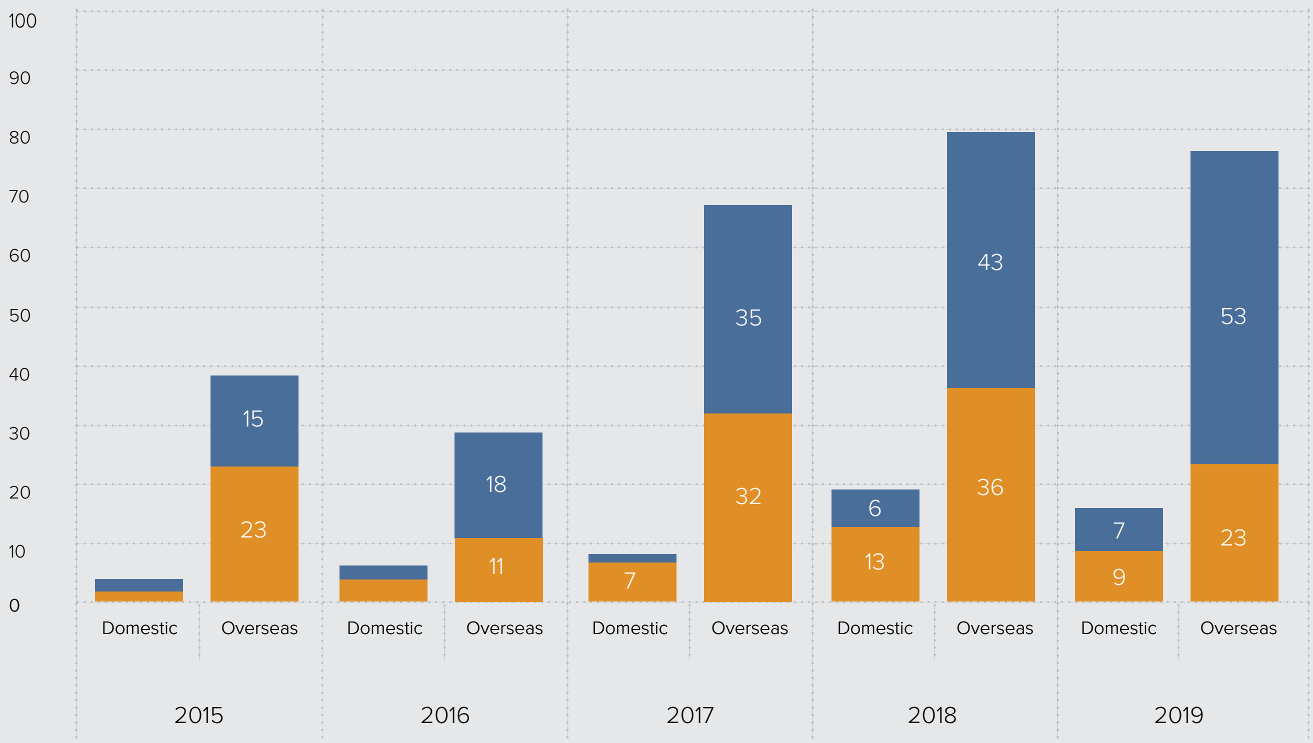
In today's investment climate, sovereign wealth funds with high-quality technology investment programs are likely to be attracted to sectors that may have significant public policy, foreign policy, public safety, national defense, and security

FIGURE 3.7

Domestic SWF investments in technology



▲ % of total number of deals



▲ Number of deals

■ Technology ■ Healthcare

Source: IFSWF Database, 2020.

implications. This is not a politically motivated move; in a market where many tech businesses struggle to turn a profit, these types of products and services often have more robust intellectual property-based business models and income streams.

However, while geopolitics remains a major consideration for SWFs investing in foreign technology companies, there is a new frontier for political considerations—those of major global technology companies. As firms such as Alphabet, Facebook, and Amazon gather ever more data about their users, they are increasingly shaping people's lives and politics. For a government-owned investor looking to back major new technologies in an era where start-ups can quickly emerge as dominant global players—and big data can have unforeseen or unintended consequences—it is essential that they look ahead to these considerations and understand the potential reputational and political implications, both for them as an investor and for their government as an owner.

Additionally, SWFs may be seeking a more active investor role, given current concerns over valuations, governance, and IPOs. The latter implies more access to company data, board or observer seats, and use of voting rights. All these elements increase the likelihood of drawing greater negative attention from policymakers, perhaps creating more impetus for regulatory intervention in cross-border activity.

This is also a relevant question for SWFs investing in technology companies at home. Financial technology (fintech) and social media demonstrate that innovation is ubiquitous in our daily lives, and, in many countries, the role of the government in these companies could potentially raise questions from home citizens. SWFs can provide a strong governance framework, risk appetite, investment expertise, financial capacity, and culture to help grow these companies. However, if governance is compromised, then there is a particular risk that these institutions are captured by politicians to pursue non-commercial technology ambitions.

In 2008, SWFs developed the Santiago Principles of best practice for governance, investment, and risk management as a proactive response to heightened political concerns.[22] These investors now need to be aware that in a world where technology is global—but nations are becoming more nationalist and protectionist—there are additional risks to investing in technology companies, particularly as they invest in more sensitive technologies at an earlier stage. If they do not, then all the benefits they can bring to these companies—long-term financial stability, networks to benefit the business, and access to new markets—will be lost. It is a challenge worthy of the effort required.

Summary of policy recommendations

Given the discussion above, SWFs—as patient and strategic investors in technology and innovation—appear to have the opportunity to assert a positive and proactive force for good. They are emerging as a new, competent, and increasingly effective tool of fiscal policy. Given this significance, the following policy recommendations should be considered:

- SWFs should become more aware of how they can invest to help address the increasing vulnerability of the global economy to major macroeconomic, political, environmental, and health shocks and disruptions, and become more proactive in enhancing their capabilities to do so.
- SWFs should continue to invest in enhancing technology development and business model innovation, both globally and domestically. For example, cross-border technology transfer to enhance domestic and global economic well-being should continue to be explored.
- SWFs are an under-exploited resource to engage with social challenges. More can be done, perhaps without significant (if any) sacrifice to financial returns. While this premise may be controversial, it is certainly worth exploring.
- Globally, financial market regulation should adapt to the increasing impact of larger investors, such as SWFs, in the later-stage private equity market.
- The changing nature and manner of how SWFs invest in technology and innovation require heightened and continuing attention to SWF governance structures, investment team competency, behavior, and development. This might be facilitated through institutions like the IFSWF, which can create a venue for shared identification, development, and deployment of best practices—especially qualitative factors that go beyond the traditional measure of financial returns.

The financial markets in technology and innovation investing are rapidly evolving. Sovereign wealth funds must now be recognized as a unique, substantial, and permanent member of the technology and innovation landscape.

Notes:

1 The authors would like to thank Enrico Soddu, Head of Data and Analytics at the International Forum of Sovereign Wealth Funds for his assistance in analyzing the data in this article and for generating the graphics. Any views or opinions represented in this article are personal and do not represent those of the institutions or organisations that the authors are associated with unless explicitly stated.

2 "Sovereign wealth fund" is a term subject to definitional differences. In the case of the cited 2016 report, the definition was kept very restrictive, focusing on long-term, internationally invested, intergenerational savings vehicles. Stabilization vehicles (to subsidize budgetary shortfall when necessary) and development funds (with explicit domestic economic development missions) were explicitly exempted. The following section, which features data on deals from the International Forum of Sovereign Wealth Funds, incorporates a broader group of government funds with a wider variety of mandate types. Among that broader group, only a minority invest in unlisted technology businesses.

3 Technology is "broadly defined" in this article—we do not mean the more restrictive venture capital-type classification, that is often IT-centric, but technology in its wider sense.

4 KPMG, 2020.

5 Baker McKenzie, 2019.

6 Baker McKenzie, 2019.

7 Engel et al., 2016.

8 Private Capital Research Institute, 2019; A recent report, *The Rise of the Asset Owner-Investor in Private Markets*, illustrated this trend with data covering the surge of activity, particularly in private equity co-investments.

9 IFSWF Annual Review, 2017.

10 PitchBook, 2019.

11 All the SWF direct investment data provided in this section is provided by the International Forum of Sovereign Wealth Funds (IFSWF), which maintains the largest and most comprehensive database of such activity in the world.

12 Covington, 2019; The data relates to technology companies with a market capitalization over US$10 billion.

13 Expert Group on Regulatory Obstacles to Financial Innovation (ROFIEG), 2019.

14 Financial Times, 2020.

15 International Forum of Sovereign Wealth Funds, 2016.

16 Khazanah underwent a major strategic change in 2018 following the historic election of 2018, which saw it roll back its international technology investment programme, and shuttering offices in London and Istanbul.

17 Engel et al., 2016.

18 International Forum of Sovereign Wealth Funds, 2016.

19 Mubadala, 2009.

20 ISIF, 2018.

21 Hanemann et al., 2019.

22 International Working Group of Sovereign Wealth Funds, 2020.

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CHAPTER 4

GOVERNMENT INCENTIVES FOR ENTREPRENEURSHIP

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In the dozen years since the global financial crisis of 2008–2009, there has been a surge of interest on the part of governments in promoting entrepreneurial activity, largely by providing financing. This essay explores these policies, focusing on financial incentives to entrepreneurs and the intermediaries who fund them.

Despite good intentions, many of these public initiatives have ended in disappointment or actually been counterproductive.

- The United States Department of Energy's (DOE) clean energy initiative was created in 2005 but remained unfunded until 2009, when it received financing as part of the American Recovery and Reinvestment Act (also known as the Stimulus Act).[2] The program was to provide loan guarantees and direct grants to risky but potentially rewarding energy projects that may otherwise be too risky to attract private investment. More than US$34 billion was spent in less than four years, which was almost US$2 billion more than the total private venture capital (VC) investment in the field. The proposed investments were controversial at the time. As one organization protesting the program noted, "DOE has minimal experience administering a loan guarantee program, and its one test case ended with taxpayers paying a heavy price. In the late 1970s and early 1980s, DOE offered billions in loan guarantees for the development of synthetic fuels. Due in large part to poor administration and market changes, the federal government was forced to pay billions to cover the losses."[3] These worries proved prescient. The enormous scale of the public investment appears to have crowded out and replaced most private spending in this area, as venture capitalists waited on the sideline to see where the public funds would go. Moreover, in the wake of extensive industry lobbying, the investment decisions of government administrators have led to a number of embarrassing bankruptcies (e.g., Solyndra, A123 Systems, and Beacon Power).[4] Rather than being stimulated, cleantech has fallen from 14.9% of venture investments in 2009 to 1.5% of capital deployed in the first nine months of 2019.[5]

- The government of the Kingdom of Saudi Arabia (KSA) has spent many tens of billions of dollars seeking to promote venture capital activity in the Kingdom.[6] These have included a wide variety of regulatory reforms: creating, for instance, a second-tier market for entrepreneurial listings and facilitating the business registration process; establishing venture funds and regional hubs, often in conjunction with new universities; and making global venture capital investments. In the last regard, the most notable was a commitment of US$45 billion by the Saudi Public Investment Fund—a Saudi sovereign wealth fund whose stated mission is to be "the engine behind economic diversity in the KSA"—to the SoftBank Vision Fund.[7] Yet the level of venture capital in the KSA has remained very modest. According to the consulting firm MAGNiTT, only US$50 million of venture capital was raised in 2018 by Saudi firms, and 2019 was on a very similar pace.[8] The 2018 value represented 0.006% of gross domestic product, a level one sixtieth of that of Israel and akin to that of the lowest nations tracked on this measure by the Organisation for Economic Cooperation and Development (e.g., Italy, the Russian Federation, and Slovenia).[9]

- The Chinese government, after a series of adept moves to promote venture capital over two decades, made a major commitment in the middle part of the 2010s to promoting venture capital.[10] Under the Government Guidance Fund program, over US$231 billion was invested in government-sponsored venture funds in 2015 alone, largely by Chinese government bodies and state-owned enterprises. By way of context, this amount was more than five times the total amount committed to venture funds worldwide by all other investors in 2015. The government stated it had raised US$1.8 trillion for these funds by the end of 2018.[11] The result appears to have been a significant bubble, followed by a quick collapse and slowdown. Between the fourth quarter of 2016 and the fourth quarter of 2019, fundraising dropped by nearly 90%—a trend that has continued into 2020. As a result, Chinese companies have fallen from a peak of 45% of venture capital invested worldwide to 15% in the second quarter of 2019.[12]

In this chapter of *The Global Innovation Index* (GII), I argue that these failures have not simply been a matter of bad luck. Instead, the unfortunate outcomes have reflected the fundamental structural issues that make it difficult for governments to launch successful efforts to promote entrepreneurship over sustained periods. I highlight several critical challenges and suggest two principles that might render these efforts more effective.

The underlying motivation

The motivation for these efforts is clear: the well-documented relationships between economic growth, innovation, entrepreneurship, and venture capital. Financial economists have highlighted the major challenges that entrepreneurial firms pose to their would-be financiers and the way that these are overcome by venture capital firms.

Public bodies have been motivated to undertake these efforts by the perceived relationship between entrepreneurial activity on the one hand and employment opportunities, innovation, and economic growth on the other. The reader, by this point in the GII, should be convinced of the importance of innovation to entrepreneurial growth. But the roles that entrepreneurship in general—and venture capital in particular—play in promoting innovation have been much less thoroughly discussed so far.

Initially, economists generally overlooked the creative power of new firms: they suspected that the bulk of innovations would stem from large industrialized concerns. For instance, Joseph Schumpeter, one of the pioneers of the serious study of entrepreneurship, posited that large firms had an inherent advantage in innovation relative to smaller enterprises.[13]

These initial beliefs have not stood the test of time. Rather, today they look like the intellectual by-product of an era that saw large firms and their industrial laboratories—such as IBM and AT&T—replace the independent inventors who accounted for a large part of innovative activity in the late nineteenth and early twentieth centuries.

In today's world, Schumpeter's hypothesis of large-firm superiority does not accord with casual observation. In numerous industries, such as medical devices, communication technologies, semiconductors, and software, leadership is in the hands of relatively young firms whose growth was largely financed by venture capitalists and public equity markets. Think, for example, of Boston Scientific, Cisco, Intel, and Microsoft. Even in industries where established firms have retained dominant positions, such as finance, small firms have developed an increasing share of the new ideas and then licensed or sold them to larger concerns. Large firms are, if anything, cutting back their investments in basic science.[14]

This pattern of new ventures playing a key role in stimulating innovation has been especially pronounced in the past two decades. The two arenas that have seen perhaps the most potentially revolutionary technological innovation—biotechnology and the Internet—were driven by smaller entrants. Neither established drug companies nor computer software manufacturers were pioneers in developing these technologies. Small firms did not invent the key genetic engineering techniques or Internet protocols. Rather, the enabling technologies were developed with government funds at academic institutions and research laboratories. It was the small entrants, however, who first seized upon the commercial opportunities. Even in areas where large firms have traditionally dominated—such as energy research—start-up firms appear to be playing an increasing role.

Not only do Schumpeter's arguments fail the test of experience, but systematic studies have generated little support for his belief in the innovative advantage of large firms. Over the years, economists have tried repeatedly to measure the relationship between firm size and innovation. While this literature is substantial, it is remarkably inconclusive. While this essay will not inflict upon the reader a detailed review of the hundreds, if not thousands, of papers on this subject, it is worth highlighting that they give very little support to the claim that large firms are more innovative.[15] Much of this work has related measures of innovative discoveries—for example, R&D expenditures, patents, or inventions—to firm size. Initial studies were undertaken using the largest manufacturing firms; more recent works have employed larger samples and detailed data, such as studies employing data on firms' specific lines of business. Despite the improved methodology of recent studies, the results have remained inconclusive: the studies seem as likely to find a negative relationship as a positive one, and even when a positive relationship between firms' size and innovation has been found, it has had little economic significance. For instance, one study concluded that a doubling of firm size increased the ratio of R&D to sales by only 0.2%.[16]

Recent studies have also pointed to the special advantage in innovation enjoyed by young entrepreneurs backed by venture capital firms. Considerable evidence shows that venture capitalists play an important role in encouraging innovation. The types of firms that they finance—whether young start-ups hungry for capital or growing firms that need to restructure—pose numerous risks and uncertainties that discourage other investors.

Where, then, does this advantage come from? The financing of young firms is a risky business. A lack of information makes it difficult to assess the potential of these firms and permits opportunistic behavior by entrepreneurs after financing is received. To address these information problems, venture investors employ a variety of mechanisms that seem to be critical in boosting innovation.

The first of these devices is the screening process that venture capitalists use to select investment opportunities. This process is typically far more efficient than that used by other funders of innovation, such as corporate research and development laboratories and government grant-makers. In addition to careful interviews and financial analysis, venture capitalists usually make investments with other investors. One venture firm will originate the deal and look to bring in other venture capital firms. Involving other firms provides a second opinion on the opportunity. There is usually no clear-cut evidence that an investment will yield attractive returns. Having other investors approve the deal limits the likelihood of funding bad deals. The result of this detailed analysis is, of course, a lot of rejections: only from 0.5% to 1% of business plans are funded.[17] Inevitably, many good ideas are rejected as part of the assessment process.

When venture capitalists invest, they hold preferred stock rather than common stock.[18] The significance of this distinction is that if the company is liquidated or otherwise returns money to the shareholders, preferred stock is paid before the common stock that entrepreneurs—as well as other less privileged investors—hold. Moreover, venture capitalists add numerous restrictive covenants and provisions to the preferred stock. They may be able, for instance, to block future financings if they are dissatisfied with the valuation, to replace the entrepreneur, and to have a set number of representatives on—or even in control of—the board of directors. In this way, if something unexpected happens, which is the rule rather than the exception with entrepreneurial firms, the venture investor can assert control. These terms vary with the financing round, with the most onerous terms reserved for the earliest rounds.

The staging of investments also improves the efficiency of venture capital funding.[19] In large corporations, research and development budgets are typically set at the beginning of a project, with few interim reviews planned. This contrasts with the venture capital process: once they make a decision to invest, venture capitalists frequently disburse funds in stages. The refinancing of these firms, termed "rounds" of financing, is conditional on achieving technical or market milestones. Proceeding in this fashion allows the venture capitalist to gather more information before providing additional funding, thus helping investors separate investments that are likely to be successful from those that are likely to fail. Managers of venture-backed firms have to return repeatedly to their financiers for additional capital, which allows venture capitalists to monitor that their money is not being squandered on unprofitable projects. Thus, an innovative idea continues to be funded only if its promoters continue to execute well.

Finally, venture capitalists provide intensive oversight of the firms they invest in. Survey evidence suggests that over 25% of venture capitalists interact multiple times per week and an additional one-third interact once a week.[20] These interactions can have profound impacts. One intriguing study shows that when an airline adds a direct flight between the city of a venture capitalist and one of his or her existing portfolio firms, which presumably facilitates face-to-face interactions, the firm is likely to experience a boost in innovative and financial performance.[21]

With support from venture capitalists, start-ups can better invest in the research, market development, marketing, and strategizing they require to attain the scale necessary to go public. The importance of this backing can be illustrated in stylized facts, such as that of the ten most valuable companies in the world in November 2019: fully seven—five based in the U.S. and two in China—were originally venture backed.

The positive impact of venture capital is also corroborated in large-sample research. Especially relevant is the finding that, even after addressing the concern that venture capital investments are highly targeted, venture funding does have a strong positive impact on innovation.[22] The estimated coefficients vary according to the techniques employed, but on average, a dollar of venture capital appears to be *three to four* times more potent in stimulating patenting than a dollar of traditional corporate R&D. While venture capital has historically been small relative to corporate research, it is responsible for a much greater share of U.S. commercial innovations.

The challenges

Given the apparently strong relationship between entrepreneurship, innovation, and growth, it is not surprising that governments worldwide have sought to promote new ventures. But as the examples in the introduction suggest, many public efforts have gone astray.

In this section, I highlight three aspects of the nature of entrepreneurial ventures that pose substantial challenges to government policymakers. In the final section, I will turn to potential solutions to these challenges.

The geographic dilemma

The first challenge is the tight geographical focus of entrepreneurial businesses. Entrepreneurial businesses are often clustered geographically;[23] venture-backed businesses are even more so.[24] These patterns characterize such businesses around the world.

The highly skewed distribution of venture capital investment can be illustrated by a tabulation of Pitchbook data between 2015 and 2017.[25] The authors concluded that the top ten urban areas for venture financing—six in the U.S. and three in China, London, and Bangalore—accounted for 62% of venture disbursements worldwide. In comparison, the top 25 urban areas accounted for 75% of all disbursements.

This disbursement is not accidental but rather reflects the nature of investment performance. The Sand Hill Econometrics index of gross (pre-fee) returns from venture capital investments between 1980 and 2019 highlights a substantial discrepancy between Silicon Valley and other U.S. regions. Northern California transactions reported an annualized return of 25.6%, substantially more than other regions, such as New England (14.3%), mid-Atlantic (15.4%), and non-California Pacific States (13.5%).[26] While accurate regional return data is not available worldwide, undoubtedly this pattern would repeat itself elsewhere.

The desire of policymakers to share the wealth and boost venture capital in economies where it has not traditionally thrived—from Australia to Saudi Arabia—is understandable. Yet many efforts to boost high-potential entrepreneurship end up directing far too much funding to unpromising areas. Much of the funding ends up in areas where it is not useful.

The timing dynamic

The second challenge stems from the boom and bust cycles that frequently characterize entrepreneurial markets. The venture market is extraordinarily uneven, moving from cycles of feast to famine and back again. In some periods, far too many firms can get access to financing, while in others, worthy companies languish unfunded. Policymakers have too often added "fuel to the fire," by intervening at precisely the times when the market is overheated.

It is natural to wonder why pensions and others seem to put most of their money to work almost inevitably at the wrong time. Why don't venture groups pull back from investing in market peaks, rather than continuing to invest capital? While much remains uncertain about these cycles of boom and bust, several drivers of these patterns have been documented.

At least some of the deterioration of performance stems from the phenomenon of "money chasing deals." As more money flows into their funds from institutional and individual investors, venture capitalists' willingness to pay more for deals increases: a doubling of inflows into venture funds led to between a 7% and 21% increase in valuation levels for otherwise identical deals. These results do not reflect improvements in the venture investment environment. When we look at the ultimate success of venture-backed firms, the success rates do not differ significantly between investments made during periods of relatively low inflows and valuations and those of the boom years. The findings, while suggesting how these cycles work, do not explain why they come about.

Whatever the precise mechanisms behind these cycles, their impact on innovation is most worrisome. Skeptical observers of the venture scene frequently argue that these cycles can lead to the neglect of promising companies. For instance, during the deep venture trough of the 1970s—in 1975, no venture capital funds at all were raised in the U.S.—many companies seeking to develop pioneering personal computing hardware and software languished unfunded. Ultimately, these technologies emerged with revolutionary impact in the 1980s, but their emergence may have been accelerated had the venture market not been in such a deep funk during the 1970s.

Nor is the overfunding of firms during booms necessarily a good thing. While it can stimulate creativity,[27] it can also lead to wasteful duplication as multiple companies pursue the same opportunity, with each follower often being ever more marginal. Often, the initial market leader's staff is poached by the me-too followers, disrupting the progress of the firm with the best chance of success. As a result, these periods are incredibly disruptive to all firms within the affected industries.

In many cases, however, political leaders interpret these surges in activity as a signal that it is appropriate to intervene with new subsidies. Public funds can have the effect of pouring gasoline on an already overheated market. Many illustrations over time highlight such ill-timed interventions: The decision of the Chinese government to subsidize venture activity after the boom in the first half of the 2010s is one recent example.

The human dimension

The final challenge reflects the nature of people who often are associated with the greatest entrepreneurial success. Government officials may have many valuable talents and play incredibly important roles, but the skill sets associated with successfully identifying and funding entrepreneurial businesses are very different from those encountered in their typical daily work. The ambiguity, complexity, and specialization associated with these ventures make these tasks quite challenging.

In many instances, officials may be manifestly inadequate to selecting and managing entrepreneurial or innovative firms. Many examples can be offered of government leaders who did not think carefully about realistic market opportunities, the nature of the entrepreneurs and intermediaries being financed, and how the subsidies they offered would affect behavior. Whether they affect the ability of firms to accept outside financing, offshore routine coding work, or the response to shifts in customer demand, well-intentioned officials can make rules that prove to be very harmful to those they mean to help.

But beyond the inability of governments, much of economists' attention has been focused on a darker problem that affects these and similar programs: the theory of *regulatory capture*. This hypothesis suggests that entities, whether part of government or industry, will organize to capture the direct and indirect subsidies that the public sector hands out. Subsidies geared towards entrepreneurial firms are no exception.[28]

These issues are exacerbated by the fact that the most creative entrepreneurs are often outsiders. For instance, extensive literature has documented the disproportionate representation of immigrants in U.S. entrepreneurship, both in general and among high-potential enterprises.[29] These may be people who are less likely to be well connected or less able to lobby successfully for public grants.

The search for solutions

How can these seeming disconnects be addressed? In the final part of this essay, I offer two suggestions that can address some, though not all, of these issues: the need for independence and the reliance on matching funds.

The need for independence

Policymakers must emulate central banking and seek to insulate entrepreneurial policymaking from day-to-day political pressures. A long list of economists has extolled the need to separate monetary policy from political pressures, lest the temptation to "do the wrong thing" prior to an election be too strong. Establishing an organization to implement new venture policies where the leadership has independence from day-to-day political pressures can similarly lead to longer-term decisions that can address some of the challenges delineated above. Such a step may also make it easier to terminate a program when it is no longer needed. Small experiments along these lines have been reasonably successful in the entrepreneurial promotion business, such as the New Zealand Venture Investment Funds program,[30] and it is my hope that these can be expanded. Another advantage of independence is more flexibility in setting pay. Setting competitive compensation is even harder for public institutions in Western democracies, where the media may be overeager to engage in sensationalism.

While independence does not guarantee effective policymaking, it can increase the likelihood that decisions avoid political fads, relying instead on rules-based approaches and experimental evidence. All too often, in a rush to boost entrepreneurship, policymakers make no provision for the evaluation of programs. In an ideal world, the future of initiatives should be determined by their success or failure in meeting their goals, rather than considerations such as the vehemence with which supporters argue for their continuation. Independent governance can facilitate better decisions.

An added benefit of such efforts has to do with time frames. Democracies worldwide are shaped by the ebb and flow of election cycles. This inevitably leads to a short-term orientation. Even leaders in office for life are often anxious to display progress and look for quick fixes. But building a venture capital industry is a long-term investment, which takes many years until tangible effects are realized. To cite one example, historians date the birth of the modern U.S. venture capital industry to 1978, a full twenty years after the enactment of the Small Business Investment Company (SBIC) program. This is not a process that can be accomplished overnight.

As a result, an entrepreneurship or venture capital initiative requires a long-term commitment on the part of public officials. The one certainty is that there will be few immediate returns. If programs are abandoned after a few months or years, they are highly unlikely to bring any benefits. There has to be a commitment to be undaunted by initial failures—for example, the low rate of return that early publicly-subsidized investments or funds garner—and instead to fine-tune programs in the face of early discouragements. An independent governance structure can limit these distorting effects.

Matching funds

Far too often, decisions about fund allocation are distorted by a lack of understanding of how the market works or by political, rather than economic, considerations. Policymakers may make decisions based on "buzz" or incomplete information. By requiring that matching funds be raised from the private sector, the dangers of uninformed decisions and political interference can be greatly reduced.

The vast majority of efforts by the public sector to target particular industries seem to have not been successful. If dozens of PhDs poring for years over econometrics models with mountains of historical data have been unable to show how to target industries, how can the typical government leader identify good prospects in a compressed time period and with limited information?

But there is a way to address this problem—at least partially. The most direct way is to insist on matching funds. If venture funds or entrepreneurial firms need to raise money from outside sources, organizations that will ultimately not be commercially viable will be kept off the playing field. To ensure that these matching funds send a powerful signal, the matching should involve a substantial amount of capital—ideally, half of the funding or more should be from the private sector. These stipulations can limit the temptation to impose geographic diversity requirements that direct funds into non-viable areas.

The power of matching funds was clearly demonstrated in what has been considered the gold standard of public venture capital initiatives—the Israeli Yozma Venture Capital fund.[31] Intriguingly, the key goal of this effort was the desire to bring foreign venture capitalists' investment expertise and network of contacts to Israel. The need for this assistance was highlighted by the failure of the nation's earlier efforts to promote high-technology entrepreneurship. One assessment concluded that fully 60% of the entrepreneurs in prior programs had been successful in meeting their technical goals but nonetheless failed because the entrepreneurs were unable to market their products or raise capital for further development.[32] Foreign expertise was seen as the key to overcoming this problem. Accordingly, Yozma actively discouraged Israeli financiers from participating in its programs. Rather, the focus was on getting foreign venture investors to commit capital for Israeli entrepreneurs. While involving foreign venture groups may not always be the answer, it does create an intriguing alternative to the normal domestic focus of these efforts.

While matching funds is a powerful idea, the devil is in the details. For example, in the government guidance funds initiative in China, the central government imposed matching fund requirements. In several top cities, the government funds were matched with capital from legitimate investors. However, in many second- and third-tier cities, where many of the funds were set up, the requirements for matching funds were relaxed. Much of the capital came not from informed private sector actors but from provincial and state governments eager to boost the local economy, or else from state-owned enterprises under these officials' control. Thus, the informative quality of the matching funds was much reduced.

Final thoughts

Many of the same policies that have driven governments to promote innovation, in general, have led to a public policy focus on entrepreneurship. The bulk of these efforts have been well-intentioned. But the substantial challenges associated with the promotion of entrepreneurial businesses have meant that the success rate is not as high as desired.

At the same time, the numerous efforts around the globe suggest some clear principles for maximizing the success of these funds. In particular, I highlight here two clear lessons. First, rather than distributing public funds haphazardly, a requirement for matching funds can ensure market validation for the ideas. Second, placing the key actors responsible for disbursing capital under the aegis of an independent body can help buffet these long-term initiatives from the ebbs and flows of political fashion.

Notes:

1 Harvard Business School and National Bureau of Economic Research. Parts of this essay were adapted from Lerner (2009), Lerner (2012) and Ivashina and Lerner (2019). I thank Ben Jones and Ralph Lerner for helpful comments, and thank Susan Woodward of Sand Hill Econometrics for access to data. I have received compensation from advising institutional investors in private capital funds, private capital groups, and governments designing policies relevant to private capital. All errors and omissions are my own.

2 See, for instance, Gold, 2009; Kao, 2013; Kirsner, 2009; Mullaney, 2009; Sposito, 2009.

3 Taxpayers for Common Sense, 2010.

4 Evaluating the return from these start-up investments is very difficult. The numerous evaluations of these programs by government agencies and academics have not attempted to compute one. Much of the difficulty stems from the fact that payments were made under a variety of programs (e.g., the 1705 Loan Guarantee Program and the Advanced Technology Vehicle Manufacturing Loan Program) and payment to start-ups were funded were mingled alongside those to established entities like Goldman Sachs and NRG Energy, where the bankruptcy risk was presumably much lower (though the rationale for public funding may have been so as well (Lipton and Krauss, 2011)). But given that public funding went to some of the most spectacular start-up bankruptcies in the sector, and that even independent venture capital investments in this sector between the beginning of 2008 and the third quarter 2019 have yielded (according to Sand Hill Econometrics) an annualized loss of -2.6% (before accounting for fees), it is hard to be optimistic about the performance of the investments in entrepreneurial firms as part of this initiative.

5 Based on the author's analysis of data from Sand Hill Econometrics.

6 This paragraph is based on Seoudi et al., 2016; Sindi, 2015; and assorted press accounts.

7 Kingdom of Saudi Arabia, 2019.

8 MAGNiTT, 2019.

9 OECD, 2019.

10 This paragraph is based in part on Oster & Chen, 2016; Feng, 2018; and Yang, 2019.

11 Based on the author's compilation of Preqin data.

12 Rowley, 2019.

13 Schumpeter, 1942.

14 See the evidence in Arora et al., 2015.

15 The interested reader can turn to surveys by Azoulay et al., 2012 and Cohen, 2010.

16 Cohen et al., 1987.

17 Kaplan et al., 2004.

18 Kaplan et al., 2003.

19 Gompers, 1995; Neher, 1999.

20 Gompers et al., 2020.

21 Bernstein et al., 2016.

22 Kortum et al., 2000.

23 Glaeser et al., 2010.

24 Chen et al., 2010.

25 Florida et al., 2018.

26 Based on the author's compilation of Sand Hill Econometrics data.

27 Ewens et al., 2018.

28 Akcigit et al., 2018.

29 Kerr et al., 2017.

30 For a detailed history and analysis of the program, see Lerner et al., 2005.

31 The discussion of Yozma is based on Avnimelech et al., 2004; Organisation for Economic Cooperation and Development, 2003; Senor et al., 2009; and Trajtenberg, 2002.

32 Jerusalem Institute of Management, 1987.

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CHAPTER 5

FINANCING "TOUGH TECH" INNOVATION

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Venture capital investment across the world has surged in the past two decades but has been disproportionately directed towards a subset of innovations that can generate returns in a short period of time. More complex technologies that are expensive and time-consuming to de-risk have received relatively less capital in recent years, despite great societal need. This is particularly true for nascent technologies building on new science, but without a well-defined market—so-called "tough tech" ventures.

The government's role—as a customer that reduces market risk and as a financier of early-stage experimentation that reduces technology risk—has been shown to be effective in addressing challenges faced by such start-ups in other contexts.

Moreover, new funding and organizational models at the nexus of research universities, philanthropy, and "patient" private capital have the potential to unlock vibrant, tough tech innovation ecosystems that are urgently needed to solve some of the most pressing problems facing societies today.

Venture capital as a growing source of financing

The most important source of financing available for start-ups engaged in innovation is venture capital (VC),[1] which has seen extremely rapid growth across the world in the last decade. VC investors deployed over US$250 billion into start-ups globally in 2019, compared to less than US$40 billion just ten years before in 2009.[2] Moreover, a substantial share of this growth in global VC over the past decade has come from outside the United States of America (U.S.) and particularly from China. The U.S share of global venture capital deal value fell from three-quarters to half over the same period.

Beyond the rise in the number and value of VC investments, the past decade has also seen the contemporaneous rise in several new types of financial intermediaries entering the venture financing ecosystem. Intermediaries range from crowdfunding platforms and accelerators helping new ventures access early-stage capital,[3] to the growing presence of public market investors making direct investments into late-stage, venture capital-backed start-ups while they are still private.[4]

This unprecedented growth of venture capital is a significant validation of VC's role in financing high-risk ventures and its potential for reducing financing constraints faced by technology entrepreneurs. However, a growing number of observers have begun to note concern about a lack of "big ideas" in terms of the innovations that are being financed by VC today.[5] With the backdrop of lagging productivity growth in many Western societies, less corporate investment in R&D, and important breakthroughs needed to solve societal challenges—such as climate change, food and water security, and human health—understanding the degree to which venture capital can effectively address this gap is extremely important for policymakers.

Breakdown of VC investments from 2010 to 2019

Based on data from Pitchbook on global venture-capital investments, Figure 5.1 examines the sectors which have seen the most rapid growth in venture capital financing in the 2010s. It lists the total dollar value of all deals reported in 2010 and 2019, categorized by the main industry sectors reported in Pitchbook. Figure 5.1 shows the remarkable growth in the value of venture capital deals over this period, rising more than fivefold from 2010 to 2019.

Figure 5.1 also shows that growth was largely driven by increases in investment towards IT software and services, consumer products and services (B2C), business products and services (B2B), and financial services. The figure looks virtually identical if restricted to only U.S. venture capital deals, implying that this is driven by an across-the-board change, rather than due to the composition of deals in countries such as China, which have seen faster growth of VC in recent years.

Due to the ubiquity of software, many innovations classified as IT software, B2C, and B2B cut across traditional industry sectors. For example, Uber disintermediated the taxicab business by more efficiently connecting passengers with drivers, and in less than ten years from founding, Airbnb had more listings than the largest hotel chain in the world, despite owning no assets itself. Hundreds of other such VC-backed start-ups serving consumers and enterprises across a range of industries have been financed in the last decade, bringing immense value to their users in many instances, as well as being adopted or replicated across many countries around the world.

However, Figure 5.1 and Figure 5.2 also show that investments in three sectors have not kept up with the overall growth: healthcare; IT hardware—comprising communications and networking equipment, computer hardware, and semiconductors; and energy, materials, and resources. As shown in Figure 5.2, the share of investments in these sectors fell from over 50% of total spending in 2010 to below 25% in 2019. Energy, materials, and resources and IT hardware combined accounted for less than 5% of capital invested by VCs in 2019.

To some extent, these ebbs and flows of funding across sectors reflect technology life cycles, the huge wave of application-related innovations made possible by the Internet revolution in the late 1990s, and the subsequent rise of cloud computing in the mid-2000s.

However, the introduction of cloud computing services in the mid-2000s also had another important effect: it dramatically lowered the cost of learning about the ultimate potential of risky web-based start-ups. Specifically, it allowed those start-ups to rent hardware in small increments from providers like Amazon Web Services, use this to quickly gauge customer demand, and postpone expensive investments to scale up until after learning about the size and nature of demand from consumers.[6] This, in turn, led to a disproportionate rise in the number of start-ups that could benefit from such lowered cost of experimentation.

The increase in such start-ups is reflected in the changing shares of industries shown in Figure 5.1 and Figure 5.2, and also in the development of crowdfunding, accelerators, angel groups, and other early-stage investors who finance the lower initial capital needs of such ventures and promote effective learning about product-market fit using frameworks, such as the *lean start-up model*.[7]

While technological advances, such as rapid prototyping and the advent of advanced simulation and prediction tools, have also lowered the cost of learning and experimentation beyond software and web-based start-ups, growing academic research has begun to articulate certain characteristics of start-ups that make them a poor match for the venture capital model of financing innovation. Three particularly salient elements include: 1) the longer timelines required to build such companies, 2) capital intensity associated with de-risking these ventures, and 3) the nature of market and technology risk faced by new ventures.

Start-up characteristics that pose challenges to the VC model of finance

Long timelines

VCs typically raise closed-end funds, implying that VC investors are required to invest the money they raise from limited partners and return the proceeds within a fixed period, usually 10 years. Given that investments are made over the first few years, this implies that VCs are naturally drawn to investments where they can realize a return through an exit—either an acquisition or an IPO—within a short time.

Not all ventures are amenable to this timeline. For example, start-ups that have a physical component to generating cash flows often take longer to build, particularly if the venture needs to build factories to produce new products—as is the case with computer hardware, energy production, energy storage, advanced materials, and robotics. Although VCs have some leeway to extend the fund life a few years, the fixed limit to a fund's life can become a binding constraint for investors.[8] When VCs know that start-ups, such as those noted above, take longer to mature and are less likely to be ready for an exit when the fund's 10-year period ends, it becomes less likely that VCs will invest in such firms.

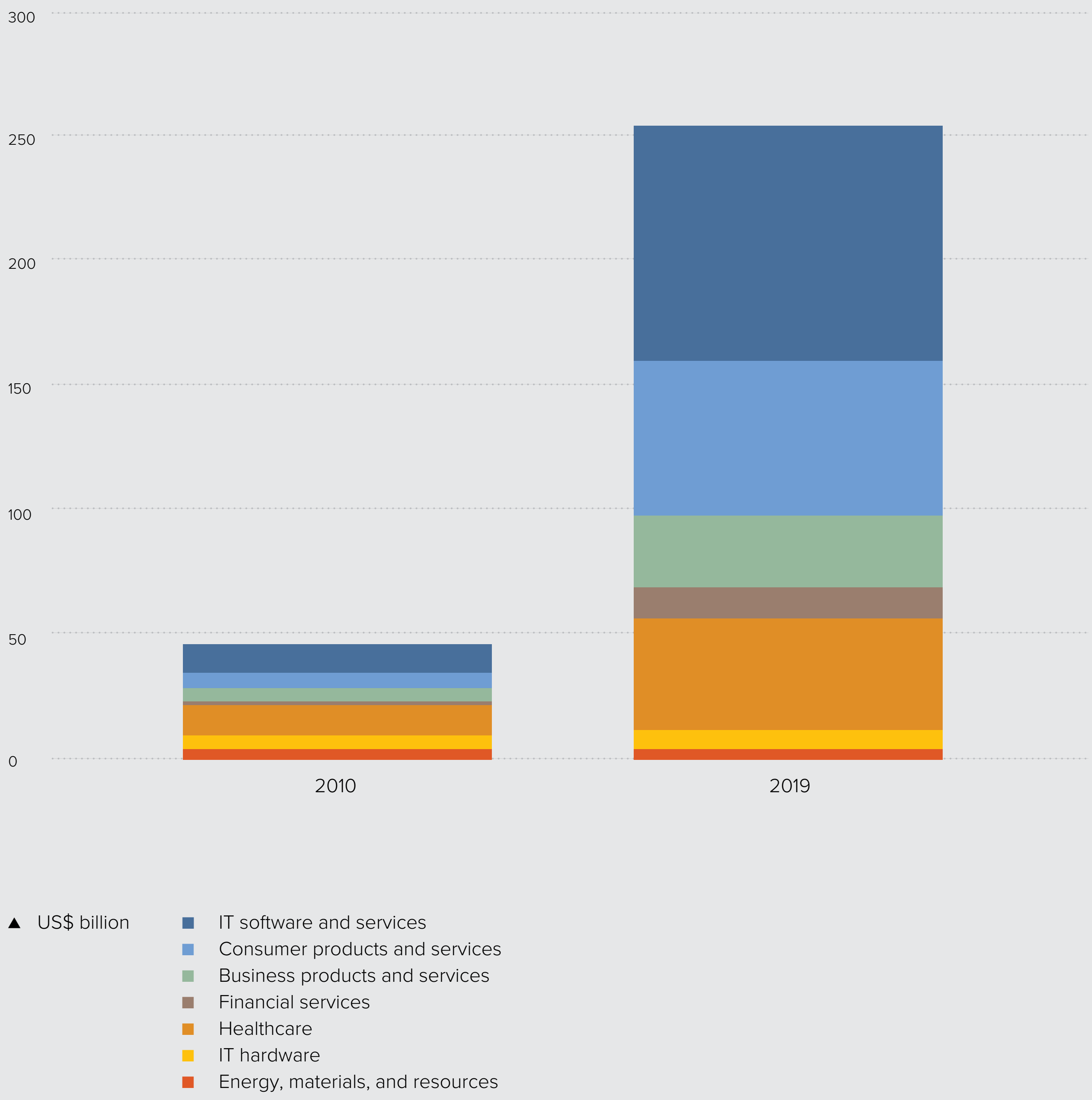
Capital intensity to de-risk ventures

Venture capital investors do not shy away from investing large sums of money, particularly when financing the scale-up of successful ventures. Many B2C social networks and B2B enterprise software firms have raised hundreds of millions, or even billions, of dollars of equity financing from venture capital investors (e.g., Uber raised over US$7 billion in equity financing before its IPO). Indeed, the proliferation of start-up *unicorns*—start-ups raising a large round of venture capital and valuing them above US$1 billion—in recent years is a testament to the ability of hundreds of such firms to raise substantial sums of money from venture capital investors.

However, VCs are particularly sensitive to how much capital it takes to achieve initial milestones in order to de-risk a venture and learn about its ultimate potential.[9] To see why, it is useful to recognize the skewed nature of risk and return in VC: over half of investments that even the most successful VCs make fail entirely, while the majority of return for VC firms is generated by one or two extremely successful investments that are very hard to predict.

FIGURE 5.1

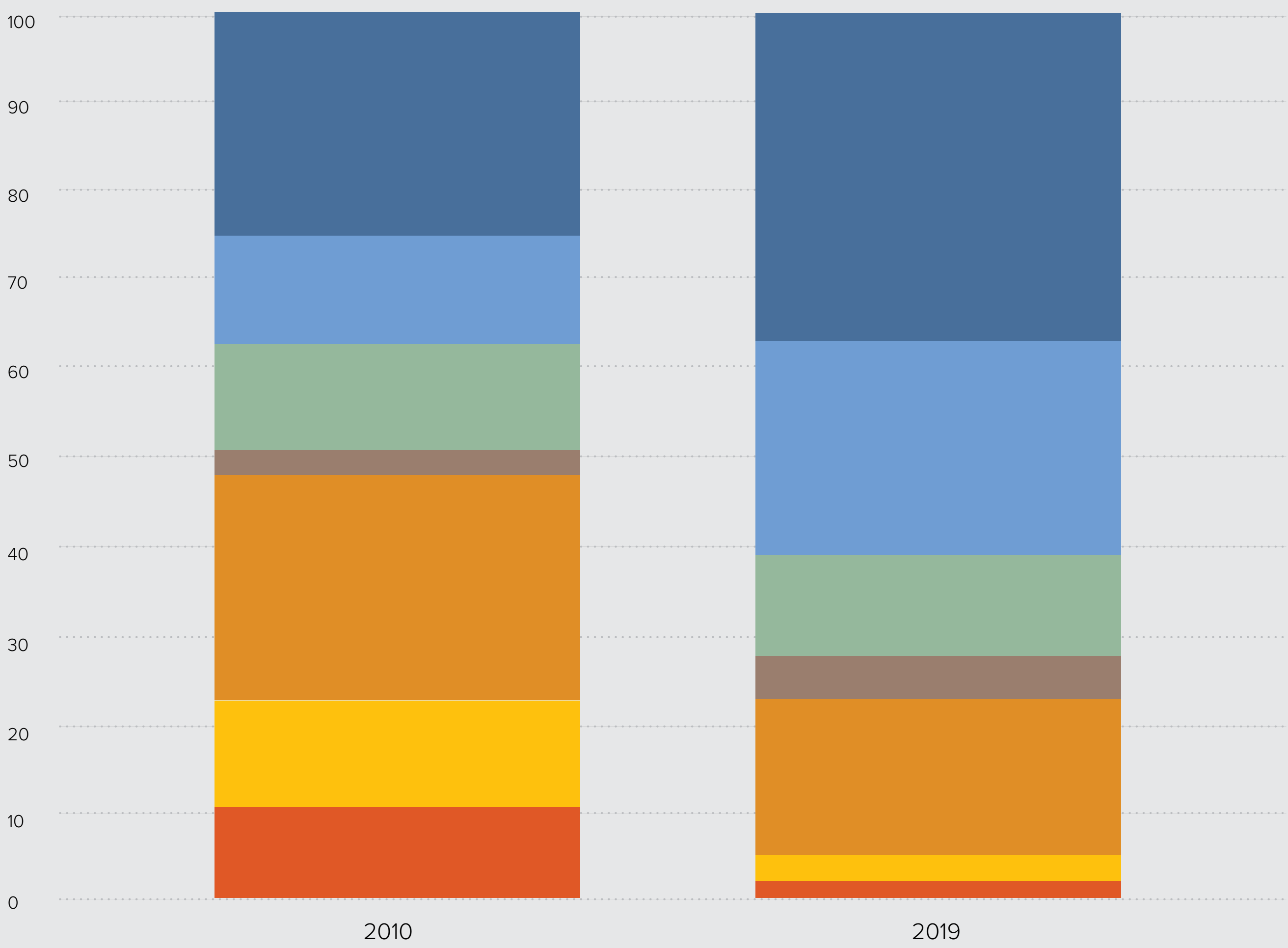
Venture capital investment globally, by sector



Source: Pitchbook, accessed February 20, 2020.

FIGURE 5.2

Share of global venture capital investment, by sector



▲ % share

- IT software and services
- Consumer products and services
- Business products and services
- Financial services
- Healthcare
- IT hardware
- Energy, materials, and resources

Source: Pitchbook, accessed February 20, 2020.

VCs, therefore, invest in stages, where each stage or round of financing by the VC can be thought of as an experiment that generates information about whether or not a start-up can achieve its promised potential. Staged financing is tied to milestones and effectively gives VCs *real options*—they can choose to invest further in the next round of financing when start-ups achieve milestones, or they can choose to abandon follow-on financing if they do not feel the start-up is showing sufficient promise.

VCs are naturally drawn to start-ups where early experiments are cheaper since it means their real option to reinvest or abandon at the next round is less expensive. Their real options are also more valuable in sectors where initial experiments generate more information—in other words, where achieving or missing initial milestones helps VCs learn more about the ultimate potential of a venture. This is because more informative experiments help VCs learn faster about firms that might ultimately fail, enabling them to "throw less good money after bad". More informative experiments also show firms achieving their promise earlier in their life, enabling start-ups to raise their next round of financing at much higher valuation step-ups. VCs who fund the initial rounds of financing in these ventures are therefore less diluted—that is, they maintain greater equity ownership—and hence generate a larger return for any given exit value.

A particularly important milestone VCs focus on is the point at which a start-up gets traction with customers, often referred to as achieving "product-market fit". Beyond this milestone, start-ups are focused less on de-risking, or understanding the true potential of the business, and more on scaling the business to achieve their potential. It can be seen from this discussion that start-ups in sectors where it is harder to achieve product-market fit—because initial experiments are more expensive or less informative—are far less appealing to venture capital investors.

The nature of technology and market risk

What leads to variation in the degree to which ventures can be de-risked? Two important drivers are the amount of technology risk and market risk faced by a venture. For example, forecasting the unit costs associated with storing energy at scale using a new battery material can be extremely difficult, even if the technology has been shown to work in a controlled laboratory environment. Since demand is tied to the ability of firms to produce at certain price points, this also implies that technology and market risk can often be intricately tied to each other. In such instances, the costs and timelines associated with the learning and de-risking process can be prohibitively large for VC investors, as they may need to finance a full-scale prototype—potentially costing tens, if not hundreds, of millions of dollars—before learning whether the technology is sufficiently good to disrupt a market.

Beyond technology risk, the risk that there will not be sufficient interest from customers for the product to generate a large return for VCs (market risk) is also substantial in some sectors—particularly sectors that are regulated or have substantial involvement from government because of their importance to the economy. Even when the government is not involved, the end customer in some industries may be a large incumbent with substantial market power, thereby making it hard to command high profit margins when selling to them.

Because of these challenges, VC investors usually back well-understood technologies in sectors with less regulatory risk and focus their efforts and skills around helping portfolio companies achieve product-market fit. Indeed, history suggests that instances where start-ups with substantial technology risk were successfully commercialized by VC also had substantial government involvement that helped with de-risking the technology and/or reducing market risk.[10] For example, while VC was intricately involved in helping to finance the semiconductor revolution, the U.S. government also played a fundamental role as a key early customer that virtually eliminated market risk. Similarly, the large amounts of venture capital finance for biotechnology start-ups is tied to the drug approval and reimbursement system that enables investors to accurately assess the market value of a new drug if it is successful in passing through clinical trials.

"Tough tech"

Start-ups that share one or more of the characteristics that make them a poor fit for VC investment have sometimes been referred to as tough tech—in reference to the fact that these technologies are often tough to commercialize using venture capital. In many instances, they involve breakthroughs in fundamental science or nascent technologies, which leads to long timelines and substantial technology risk. Such ventures have sometimes also been referred to as "deep tech".

It is important to emphasize that not all science-based ventures are bad fits for VC; indeed, some ventures spinning out of university labs raise substantial venture capital, generate high returns for investors, and solve important problems for the world. Nevertheless, many of the innovations required to solve society's most pressing problems do not have solutions that fit the timelines and economic constraints of VC investors. In light of these constraints, and the growing sense that there is also a decline in fundamental innovation coming from large corporations,[11] there are several elements that policymakers and other stakeholders could consider to help support the commercialization of tough tech.

Government subsidies to financing prototypes when de-risking is hard

Governments regularly subsidize the financing of new firms and small to mid-size enterprises (SMEs). In considering the role of subsidies, it is important to recognize that the financial support required for most SMEs—who depend primarily on debt finance—is likely very different from the venture capital required to support start-up innovation. Further, the record of government involvement in trying to promote entrepreneurship and venture capital has been mixed at best.[12] Nevertheless, one setting where start-ups engaged in innovation have been shown to benefit substantially is the U.S. Department of Energy's

SBIR grant program, which has helped start-ups finance the prototyping of new technologies and thereby substantially increase the odds of receiving venture capital.[13] This ties in directly to the friction outlined above—where start-ups in some sectors cannot attract VC due to the difficulty they face in learning about the effectiveness of a new technology in the field as opposed to the lab, and hence have trouble convincing investors they can achieve product-market fit and generate sufficient customer demand.

The role of government as customer

Many successful examples of government involvement in the commercialization of tough tech have been related to the government's (often the military's) role as a customer.[14] A key reason for this may have to do with government contracts substantially reducing market risk through a willingness to pay for early versions of an emerging technology. A large military contract can also help to establish standards and coordinate the direction of technology trajectories. Finally, through their role as customers, governments can even reduce financing constraints via the timing of contract payment. For example, paying part of the contract value in advance can substantially reduce start-ups' dependence on external finance.[15] This important role of the government as customer is often underappreciated when considering the role that policymakers can play in jump-starting innovation.

New organizational and financing models

As seen from the discussion above, the challenge faced by many tough tech ventures is that they need a long period of incubation and de-risking in an environment that does not face the same time and financial hurdles as VCs or corporations. In part, this is because of the stochastic nature of technological breakthroughs, which cannot be controlled in the same way as experiments related to customer demand. Moreover, fundamental breakthroughs may require a tolerance for failure to induce innovators to try unproven paths.[16]

Given that tough tech ventures are often based on new science or technology developed in universities, academic institutions have the potential to play a central role in helping to de-risk technologies prior to start-ups raising risk capital from investors.[17] Another role that universities can play is in helping founders of tough tech ventures, who often have a technical background but less business training, to understand the appropriate customer segments, business models, and financing sources for their new ventures.

Universities, government labs, corporate R&D, VC firms, corporate venture capital firms, and longer-term "patient capital" associated with family offices each bring different incentives, funding models, ability to experiment, and tolerance for failure. Each has different benefits and constraints.[18] Understanding the degree to which these can be adapted to most effectively help commercialize tough tech—perhaps while also harnessing non-dilutive and non-market rate capital from philanthropy for initial experiments—is a promising area of further inquiry.[19]

In considering the role of non-dilutive capital helping to de-risk new technologies, it is worth noting that globally, an estimated US$1.5 trillion of philanthropic capital is managed by hundreds of thousands of foundations.[20] Providing incentives to unlock some of this capital to finance tough tech innovation may provide a unique way to bridge the "valley of death" between advanced R&D projects in universities and start-ups looking to quickly achieve product-market fit.

Notes:

1 Kortum et al., 2000; Gompers et al., 2001.

2 National Venture Capital Association, 2020.

3 Agrawal et al., 2016; Hochberg, 2016.

4 Chernenko et al., 2019.

5 Pontin, 2012.

6 Ewens et al., 2018.

7 Reis, 2011.

8 Ivashina et al., 2019.

9 Kerr et al., 2014.

10 Janeway, 2016; Nicholas, 2019.

11 Arora et al., 2017.

12 Lerner, 2009.

13 Howell, 2017.

14 Janeway, 2016; Nicholas, 2019.

15 Barrot et al., forthcoming.

16 Manso, 2008.

17 Of course, the degree to which universities should be focused on basic vs. applied science, as well as concerns about commercial bias and academic freedom, need to be appropriately balanced as universities consider how best to support the commercialization of such technologies.

18 Lerner et al., 2007; Lerner, 2012.

19 Nanda et al., 2019.

20 McGrath, 2018.

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CHAPTER 6

SHAPING THE UNKNOWN WITH VIRTUAL UNIVERSES–THE NEW FUEL FOR INNOVATION

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The new logic of financing innovation: from uncertainty reduction to shaping the unknown

Handbooks in finance, as well as literature reviews, recall that financing innovation and financing productivity investment differ in their level of uncertainty.[1] Students learn that financing production investment requires a positive net present value (NPV), whereas financing innovation requires taking into account multiple uncertainties by computing expected NPV. Models of decision-making in uncertainty helped to compute the value of *reducing uncertainty*.[2] This approach is considered the best way to value investment in research and development (R&D)—R&D being considered an activity to reduce uncertainty.[3]

In this time of "disruptive innovation" in the context of multiple socioeconomic and technological changes—such as energy transition, aging, and digitalization—it is tempting to consider that innovation dynamics tend to be characterized by an increase in uncertainty. Investments would, therefore, become much riskier, and financing might seem almost impossible. Fortunately, this "wisdom" misses a critical feature of contemporary innovation: it is not mainly about uncertainty but much more about "the unknown". In contemporary innovation, one has to deal not only with uncertain events, such as unstable markets and technological advances, but also partially unknown chimeras, such as inclusive mobility, smart cities, and sustainable energy. Therefore, it is critical for innovation success to deal with these initially unknown situations and shape them in a beneficial direction.[4] This distinction between *uncertain* and *unknown* has major consequences on innovation investment: the financing approach must not only consist of reducing uncertainty but also of *shaping the unknown*, i.e., through a capacity to design new alternatives, worlds, opportunities, markets, and usages.

Paradoxically, shaping the unknown is not necessarily "worse" in terms of risks and financing. While an increase in uncertainty might lead investors to become gamblers, dealing with the unknown requires investors to understand design logic and adopt a perspective on the new potentialities to be explored. If markets and technologies are unknown, good design does not consist of multiplying risky trials—it consists of designing technologies and markets that correspond to a winning lottery. One critical result of recent advances in design theory is that the unknown, forward-looking statements might become self-fulfilling and performative; they create a common language that supports innovation. Confronted with sacrificial dilemmas, where all given decisions seem doomed to unacceptable uncertainties, design logic enables the design of new and better decisions in the unknown.[5]

Risk from uncertainty versus risk from the unknown

Let's give a simple illustration of the difference between risk from uncertainty vs. risk from the unknown: Famous French cartoonist Jacques Rouxel imagined strange creatures, called the Shadoks, whose rockets had one chance in a million to succeed. Consequently, they "rushed to fail the first 999,999 first trials". By contrast, design logic consists of shaping the unknown to redesign a rocket that has a 100% chance to succeed—which is actually what is expected from engineering designers in disruptive innovation! Investing in deep tech today would require similar reasoning. Deep tech refers to research-based technologies whose market applications are largely unknown, with each market opportunity having a very low probability of success. But what if designers were able to design a so-called generic technology that, for example, might be generic to several markets? Then the probability that at least one market succeeds becomes high, since the probability that all the markets fail is low. This shows how design logic differs from a gambler's logic.[6] It also explains the success of platforms that are ecosystems based on a generic technological "core" made available to multiple complementors for multiple micro-applications.

Virtual universes to explore the unknown

To support this transition from uncertainty reduction to shaping the unknown, new financing approaches and new investment models are required. How do we act in the unknown? Can we orchestrate large teams developing breakthrough innovation despite the lack of knowledge on the necessary steps? How can we just pretend that all of these people are working on the same project? And why would an investor finance such a project?

Virtual universes are the keystone for these new collective behaviors. They do more than provide a shared representation: as a tool for shaping the unknown, they provide a shared capacity to present the unknown. In addition, they provide an objective basis for a comprehensive discussion of every aspect; even though the considered objects are not physically there and may be inconsistent from a scientific perspective, virtual representations don't have to obey every law of nature to be useful. Virtual universes act, therefore, both as a factual proof point—the dimensions of the virtual object can be objectively "measured"—and as a political or managerial reference, because their power comes from people believing in their performative value. In this perspective, the virtual world is not a computer game. Virtual exists because it extends and improves the real world.

Advances in research on generativity logics and design theory have shown two critical results, hinting at how virtual universes are key resources to enable and catalyze the exploration of the unknown:

1) Exploration is doomed to severe fixations—both individual and collective ones—provoking orphan innovation phenomena and speculative bubbles. But once fixation is overcome, then risk is considerably lowered by the fact that rigorous exploration of the unknown leads to the discovery and generation of diverse opportunities—across short- and long-term horizons with low and high capital expenditures (CapEx). Hence, exploration capabilities and methods that help overcome individual and collective fixations are a key resource. Today, some business units have developed such capabilities of "unknown shaping". Preliminary statistical studies analyzing their profitability show surprising results: a recent case study showed how one invested euro can bring 6 euros back to the corporation, and more than two-thirds of projects initially considered "too uncertain" to be funded are made profitable by rigorous design methods.[7] Because they provide an objective anchor for vivid imagination, virtual universes are crucial for overcoming fixations and, therefore, accelerate explorations.

2) In "unknown exploration", a critical resource is independent knowledge. This is counterintuitive for two reasons. First, it means that the unknown cannot be shaped on a "blank slate"—it requires knowledge and expertise. Second, knowledge is much more valuable if it is not self-evidently related to the issues to be explored. This second aspect is counterintuitive because, in a model of uncertainty reduction, the value of knowledge comes from dependent variables—if Y depends on X, then knowledge of X enables us to reduce the uncertainty of Y. By contrast, in design, the value of knowledge comes from independent variables—if the known Y is independent of X, then knowledge of X enables the design of disruptive Y.[8] The confrontation of these diverse sources of knowledge across many disciplines requires a shared "presentation" capacity—enabling the composition of apparently independent knowledge and expertise—which virtual universes provide.

These two results show how shared virtual presentation techniques and tools are much needed to support "de-fixation" and access to independent knowledge for the exploration of the unknown. This explains why virtual universes have a critical role to play. Not only do they contribute to the reduction of uncertainty through validation and optimization techniques—computer-aided design (CAD) systems historically played this role by decreasing costs of experimentation—but, moreover, they offer a natural "compass" to orient and support the exploration of the unknown in all its forms, from new scientific phenomena to emerging technologies, novel uses and usages, and business models. These virtual universes for generativity should not be conflated with validation techniques—their value is much more in their capacity to generate surprising alternatives. They do so by connecting apparently independent dimensions and by helping users connect heterogeneous (independent) knowledge through new uses, technologies, complex systems, basic research, production, and creation. This phenomenon is already visible in aeronautics and the automotive industry, and is now spreading to all industries—most notably to life sciences, healthcare, construction, and services. Virtual universes contribute to support design logic, and they are the fuel of contemporary innovation.

A direct consequence is that, from a macroeconomic perspective, investments for shaping the unknown will develop in independent areas. For the design process, there are at least two well-known sources of independent knowledge: downstream users and upstream research.

On the one hand, virtual universes open up the possibility of much more integration for users and usages as an engine for exploring the unknown—not only by bringing knowledge from existing uses and users but also by enabling the creation of knowledge of alternative users and usages, individual and collective experiences, and emotions. Virtual universes strengthen the possibility of integrating the demand side into the design process. One could think of virtual universes as replacing the traditional proof of concept (POC), allowing the systematic generation of (virtual) prototypes at a very large scale to explore the multiple potential applications of generic technologies.

On the other hand, the value of investing in basic research might precisely come from the fact that basic research provides independent knowledge—knowledge that is neither the result of deductive problem-solving nor of optimized strategy! Basic research appears as a critical actor able to explore the unknowns of science—and, doing so, it brings back unexpected knowledge. The value of this knowledge is not in its applicability—this would correspond to dependent knowledge—but in its originality and unexpectedness. This mechanism is virtuous if two conflicting constraints are met. First, basic research has to be maintained independently from innovation, meaning it is neither application-driven nor problem-driven. Second, basic research should also be closely related to innovation so that 1) basic research knowledge can be used in innovation processes, and 2) innovation processes can provide basic research for new unknowns to avoid fixations by scientific communities and the laws of "publish or perish". Here again, virtual universes have a role to play: they can support basic research explorations, help identify basic research questions in innovation endeavors, and help import basic research results into innovation processes. Hence, even in basic research, virtual universes transform the scientific approach and support efficient exploration of the unknown.

Institutions to support shaping the unknown

It has been largely noticed that innovation requires a trusted environment in order to blossom and spread.[9] Institutions are needed to provide this trusted environment for shaping the unknown. Because they offer common reference points for groups of people, virtual twins act as new forms of institutions, creating the conditions for shared understanding, debate, and action. For instance, an infrastructure project related to new public transportation can be represented through a virtual twin of the city: the whole mobility system and related dimensions, such as building development policy, energy, and economic development on a given territory, can be modeled and simulated in a multi-factor approach. Third parties, such as contractors, local businesses, and administrations, can contribute by providing inputs and expressing constraints, and citizens can understand the project and contribute to design choices. When coherent with the logics of unknown exploration as explicated by design theory, virtual universes can be considered as assets with infinite value because not only are they non-rival goods, but also their value increases with usage.

For instance, the generative capacity of the virtual twin of a city can increase with the number of people accessing it and contributing to enriching its exploration paths. Virtual twins are, therefore, potentially "public goods". However, they are likely to be appropriated, for instance, if their creators or owners misuse them to bias explorations, fixate on certain paths, or hide exploration paths in the unknown. The concept of the unknown might thus require new protection mechanisms, such as a new legal status for "common and non-appropriable unknowns". Intellectual property might also be useful, probably in new forms, ensuring the publication of exploration paths and ensuring forms of recognition and rights for scouts, pioneers, or providers of the ways and means of unknown exploration. Patent law has evolved regularly over time to integrate new forms of inventiveness—new IP law might support the development of capabilities to explore the unknown and leverage the power of virtual twins.[10] The global response to the coronavirus disease (COVID-19) pandemic has shown how research could share vast amounts of data and intellectual property to accelerate the creation of knowledge on the disease and the discovery of new treatments. In this context of exploring the unknown, major research institutions offered a "no-fee, royalty-free license" to their work involving the diagnosis and treatment of COVID-19 patients. Some initiatives were launched, such as the "Open COVID Pledge", urging researchers and companies to sign on "to make our intellectual property available free of charge for use in ending the COVID-19 pandemic and minimizing the impact of the disease."

The exploration of the unknown and the work in virtual universes are increasingly collective endeavors—with inevitable fixations and biases emerging either at the firm level or the ecosystem level. Appropriation, short-term profit, and shortsighted strategy can lead to severe pathologies and crises related to contemporary innovation. Examples include speculation bubbles on "killer applications" and "miracle technologies", forever technologies of the future, low success rate of market adoption, or even orphan innovation, i.e., situations where an innovation is expected by society, but companies fail to provide it.[11] Hence new institutional logics might be required, both at the firm level and the ecosystem level.

At the firm level, new governance principles might help protect and support firm capacities to shape the unknown. For instance, this has been one of the objectives of a new legal status for companies in France: the status of "profit-with-purpose company" protects and reinforces the capacity of the company to explore certain unknowns.[12]

At the ecosystem level, researchers have identified the emergence of original institutions such as "colleges of the unknown" and "architects of the unknown".[13] These actors ensure that, in a given field of innovation, explorations are launched in all imaginable directions, are rigorously generated to avoid cognitive fixations, and cover a variety of alternatives with several time horizons. These actors also create a common language in the unknown, help measure and compare progress, and support coordination and interactions between designers. In a time of sustainable development goals (SDGs) and global transitioning to new technologies in areas such as energy and the digital economy, such organizations are very useful. However, not every self-appointed group can be a relevant college of the unknown. Virtual platforms could become game changers supporting efficient collaborative exploration and the development of quality criteria for the de-fixed, complete, and robust exploration of the unknown.[14] Quality criteria for collective exploration would systematize the identification of fixation at the ecosystem level and support the development of capacities to overcome those fixations.

Investing to build the "creation heritage" of future generations

Sustainability and other planetwide challenges are the domains demanding investment in the unknown today. The available solutions to face such contemporary threats are too limited, leading to unbearable sacrificial dilemmas such as agronomic pollutants vs. famine, carbon-intensive energy vs. social riots, or, more recently, lockdown vs. epidemical diffusion. Going beyond sacrificial dilemmas is exactly the role of designers shaping the unknown. This requires huge investment—not only in intangible assets but also tangible assets, such as innovative long-term infrastructures for home improvement, mobility, cities, public health and care, etc. Digital also requires material infrastructure investment. The major question will thus be to orient rightly these investments towards challenges of the 21st century by correctly taking into account their intangible dimensions. Do these investments support unknown shaping, and are they overcoming collective fixations? Do they create long-lasting virtual assets able to capitalize on knowledge and know-how?

Moreover, how are these investments adapted to future generations? They should not only satisfy the predicted needs of future generations, but they should also provide future generations with the creative capacity and "creation heritage" to invent their own future.[15]

Investing in virtual universes is a precondition to shaping the unknown and allows us to build a creation heritage. By this logic, investment in education is strongly needed as it is the key to unlocking these virtual universes and ensuring accessibility for the largest audience. From the perspective of investing in the capabilities for shaping the unknown, could there be anything more efficient than educating people to help de-fix themselves, develop capabilities to collectively and rigorously explore the unknown, and enable them to deal with virtual universes in a powerful and creative way? Perhaps the priority in terms of financing innovation today should be to invest in a collective culture of design based on shaping the unknown with virtual universes.

Notes:

1 Kerr et al., 2015.

2 See the famous reference book of Raiffa and Schlaifer (1961) with a preface by Bertrand Fow, the Director of Research at Harvard Business School.

3 See the seminal works by Charles S. Peirce, who proposed to undertake research on the basis of the value of uncertainty reduction. This text was largely ignored when Peirce wrote it, and it was rediscovered and published in the 1960s (Peirce, 1879; reproduced in 1967 in Operations Research, 15, pp. 643-648). See also, more recently, the literature on real options.

4 Loch et al., 2006; Feduzi et al., 2014; Kokshagina et al., 2015; Faulkner et al., 2017; Jensen et al., 2017; Gillier et al., 2018; Grandori et al., 2018; and Elmquist et al., 2019.

5 Hatchuel et al., 2009; Le Masson et al., 2018.

6 Hooge et al., 2016.

7 Gilain et al., 2019.

8 Hatchuel et al., 2018.

9 Mazzucato, 2013.

10 Landers, 2010; Valibhay et al., 2018.

11 Agogué et al., 2013.

12 See in France the new corporate law on "entreprise à mission"/"mission-oriented company"; Levillain et al., 2019; Levillain et al., 2019; Segrestin et al., 2020; and Parpaleix et al., 2020.

13 Le Masson et al., 2012; Agogué et al., 2013.

14 Rémondeau et al., 2019.

15 Hatchuel et al., 2019.

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CHAPTER 7

FROM FINANCIAL GROWTH TO GENERATIVE GROWTH: A RENEWAL OF PRIVATE EQUITY

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Since its emergence, private equity has been used as a powerful tool to support economic growth, especially through financing start-up companies, whose difficulty in accessing investment—a so-called "equity gap"—was thought to be a major obstacle to innovation.[1] Nowadays, however, the nature of innovation processes has deeply changed, and start-ups are not the only firms upon which rests the imperative of inventing new products and services, as well as new knowledge and technologies. All mature companies, especially middle market ones, are indeed at the heart of a dilemma between making more of the same thing—notably through repeated acquisitions, operational scalability, or product extensions—at the risk of growing obsolete, and regularly renewing their activities through the development of (radically) new concepts. This chapter examines how the current private equity rationale tends to corner these companies into the first kind of "aggregative growth", as it commonly mitigates risks in the short term. It highlights that what these companies lack the most is not equity: they lack investors who can support their regenerative strategies in the long run. Therefore, this chapter conceptualizes a new class of investment strategies that is emerging to support this latter kind of growth, which we coin as "generative growth". Generative growth not only increases production and turnover, but generates innovative technologies, products, or services as well as organizations, methods, and competencies. Finally, this chapter discusses implications for lower-income economies and provides some policy recommendations on a way forward.

Investing in innovation—are start-ups the unique cornerstone?

The private equity industry emerged first in the United States of America (U.S.) after World War II and later spread to Europe and Asia. These three regions today account for more than 90% of private equity total assets. Private equity has become a major tool for providing capital to a wide range of businesses, from start-ups to mature or even declining firms. In 2019, private equity assets under management reached a record level of US$4.11 trillion, among which there is still a rising stock of uncommitted capital.[2]

Ever since the emergence of the private equity industry, investing in innovation has been conflated with investing in start-ups. The assumption that boosting the start-up scene would increase countries' growth and competitiveness started in the innovation powerhouse economy of the United States, followed by, among others, the European Union (EU), China, Brazil, Israel, Japan, and Chile. In this way, many economies have supported the rise of national venture capital industries through either public policies or by creating state investment vehicles. Developing countries are also following suit: in the past two years alone, Jordan, Morocco, and Senegal have all launched state-owned funds to boost start-up financing. In these and other lower-income countries, investing in start-ups has also become a cornerstone of public innovation policies.

Yet, start-ups are only one of the vehicles that facilitate firms' innovation, and the nature of innovation processes has deeply changed over the past few decades. The contemporary innovation-intensive economy requires companies to have the capacity to repeat the development of potentially radical innovations at every stage of their existence to create sustainable long-term value. To do so, enlarging the range of existing products and making them increasingly more efficient is not enough: firms also need to shape "the unknown".[3] In other words, current innovation management and design theory research insists on the crucial role of regeneration processes that do not only rely solely on the development of new profitable products but also on the extension of knowledge and exploration of unknown concepts. Mature companies are confronted with these challenges to the same extent as growing start-ups.

As an example, the French company Tefal gained international fame in 1961 after releasing an advertisement with Jackie Kennedy holding a non-stick pan in front of the cameras. The company has since undergone an incredible growth dynamic, especially from the 1980s to the 1990s, which is a prime example of generative growth in middle-market companies. Tefal not only expanded the non-adhesive property of Teflon—discovered accidentally a half-century ago at DuPont—to cooking devices that have since spread outside the kitchen; it also shaped a radically new iconic image of a convivial dinner. It accomplished this by reusing acquired knowledge to develop breakthrough competence fields for the company, such as surface treatment, plastics processes, and electronics, which resulted in new product lines for home automation and baby accessories that are very far from the initial core activities of this company.[4] It is this expansion beyond the original use of Teflon that ensured its continued success.

Among mature firms, middle market ones are increasingly attracting the interest of policy leaders as they are a significant engine of growth, notably in the top European economies as well as in other high-income countries.[5] These firms often play a leading role in regional ecosystems and certainly constitute a critical asset to national economies. Even though they are very limited in number in the above-mentioned countries, commonly comprising less than 2% of all firms, over the past few years, they have accounted for around a third of national GDP and employees and have shown strong resilience to economic crises. However, many middle-market firms are also niche market leaders that face the double bind of preserving their heritage while innovating to remain at the cutting edge of their markets. Hence they need to constantly renew their activities and develop sustained innovation processes to reach what we call generative growth paths—that is, not only growth in revenue or the number of employees but also in the variety of products and originality of concepts.

Because of this challenge, investors have a crucial role to play in sustaining the innovative capabilities of mature firms, which corresponds to the targets of buyout asset classes and, to a lesser extent, of growth capital. However, buyout investors, while managing more than twice the assets of venture capital, often grant only scant attention to firms' innovation strategies beyond aggregate contributions to financial growth.

From "buy-strip-flip" to "smart money": historical changes in buyout investment strategies and limits to sustaining generative growth

When buyout deals first boomed in the 1980s, investors started using a technique called "buy-strip-flip" that maximized quick returns on investment by dismantling the firm's long-term capacity to prosper. In a short period of time, investors would first go into debt to buy a target, then improve its short-term financial situation by slashing costs, cutting off non-productive assets, or dismantling conglomerates into smaller firms while extracting massive dividends. Lastly, they would sell the restructured company at a higher price to secondhand or public investors.

While financial leverage remains a widely-used tool, its contribution to private equity returns has shrunk. The focus switched from financial engineering to operational and governance engineering; investors now seek growth opportunities rather than only cost reduction. For the past decade, digitalization, internationalization, and buy-and-build have become popular growth strategies for investors to meet high performance. Buy-and-build aims at building value through an investment in a platform company followed by multiple acquisitions that usually extend a firm's initial market to other regions or additional product lines. In France, the former middle-market company Altrad executed more than 50 acquisitions since its creation in the late 1980s, among which 20 were made only in the past ten years. Benefits of scale coming from operational improvement or improved commercial presence represent the core value creation lever that enables quick and sharp increases in firm valuation.

In the meantime, in addition to financial resources, some hands-on private equity investors have increasingly provided other services, such as strategic advice, business expertise, and networking facilitation. These supplementary resources help turn investments into "smart money". Overall, the sources of value creation for private equity funds have, therefore, undergone a fundamental change over the past 50 years. However, they still mainly consist of either an *aggregation* of existing activities or their marginal optimization, rather than a support for *generative* growth.

Academic work has demonstrated that aggregation or optimization is not a factor of regeneration. The "research and development (R&D) paradox" that has been broadly discussed by academics states that the amount of financial expenditure in research and development is neither systematically correlated with a higher growth rate nor with an increase in firms' innovativeness, regardless of the criteria considered, for example, number of new patents, new products, etc.[6] The disconnect between R&D intensity and growth performance is strikingly epitomized by cases of "orphan" innovation,[7] i.e., situations where no innovative product, service, or solution arises despite heavy investments and high market and social expectations. While R&D investment remains obviously useful, it is, in numerous cases, not the bottleneck. On the contrary, to sustain generative growth, firms need to shape their ability to escape cognitive biases on known designs, explore unknown paths, design further opportunities, renew expectations, and search for desirable novel product properties and performance criteria.[8]

Besides, a few studies have analyzed the relationship between private equity investments and patenting strategies. They demonstrate that, contrary to common preconceptions, investors, on average, only have a slightly positive or even no impact on patent count, originality, or genericity.[9] However, they do change an invested firm's patent portfolio by making it more focused, which might appear contrary to the required breadth of exploration strategies that are needed to support generative growth. This evidence suggests that the usual private equity models struggle to sustain mature firms' constant regeneration.

The time is now ripe for a change in investment strategies for innovative, mature firms

While value creation models have changed, the fact that most private equity firms have a limited investment time horizon constrains firms' innovation strategies. The most common fund structure chosen by fund managers worldwide is the limited partnership. Although countries have specific regulatory frameworks for such vehicles, they all legally restrict the investment period to a maximum of 10 years—usually with an extension option of a few more years. This timeframe includes the search and divestment phases, thus leading to an average stock ownership period of three to five years, or eight for the most patient investors.

The search for a tangible performance increase in this limited timeframe explains the focus on productivity gains or buy-and-build strategies that succeed or fail quickly. Yet, it can be in contradiction to a firm's innovation dynamic and encourages firms to give up regeneration activities to focus, at best, on accelerating a handful of existing R&D projects. Sometimes, even if not preventing the firm from pursuing its renewal, financial constraints linked to the buyout technique can stifle them.

In France, the fall of SoLocal (previously known as PagesJaunes) is a symbolic example of the potential consequences of a traditional investment rationale that has failed to consider a firm's regeneration. Created through a merger in 2000, SoLocal was a flourishing business specializing in printing telephone directories. In 2006, two U.S. funds acquired the majority of the company, valued at EUR 6 billion, in the most expansive leveraged buyout that ever took place in France. Based on their perception of the firm's ability to generate steady profits, they used a classic buyout setting, which maximizes return on investment while making the acquired firm bear the brunt of costs. The strategy consisted of incurring a large debt to finance the acquisition and then asking the firm both for an initial special dividend, which forced SoLocal to raise debt of 2 billion euros, and yearly dividends. A year after the buyout, the firm started to renew its activities by evolving from printed directories to launching successful digital activities. However, despite this successful digital transition, excessive debt was dragging 60% of net revenue. SoLocal was close to default in 2016 and suffered significant restructuring.

The bias in the pursued rationale can be analyzed as follows. While the development of venture capital was based on the concept of an "equity gap",[10] which points out the lack of funding for risky, innovative projects, the need for innovative mature firms is different. The struggle of these firms is less a lack of financial resources for innovation—mature firms historically self-finance their innovation strategies[11]—and more on finding investors that commit to sustaining regeneration strategies whose length might exceed the investment period. This regeneration process can indeed occur over a long period while producing intangible by-products along the way, such as new concepts, increased knowledge, or shared imaginaries that are difficult to appraise on a financial market. Each time an investment period ends, this difficulty leads to an undervaluation of the inherently innovative company, therefore making it hard to find new investors that will sustain the regenerating strategy. In the end, the issue at play is one of stock liquidity, which repeats itself at the end of each investment time period: these companies face a "liquidity gap" rather than an "equity gap".

A renewed investment model to sustain generative growth

The liquidity gap challenge calls for a change in the rationale for private equity investment. A few investors have already taken the plunge. One notable state initiative is the launch in 2014 of dedicated investment vehicles by Bpifrance, a French state-owned investment bank.

Mature firms, and especially middle market firms, face the strategic dilemma of choosing between sustaining short-term aggregative growth—for example, through repeated acquisitions and increased production capacity—and fostering a generative growth that deeply renews firms' activities. Committing to support both firms' innovation portfolio regeneration and usual optimization or market extensions impacts private equity funds selection, valuation, and post-investment processes.[12] Some investors are developing original strategies in this regard. For instance, instead of focusing only on extrapolating future revenues from current activities, scouting and selection processes can also be tailored to identify creative concepts that can generate upcoming growth and assess firms' innovation capabilities to renew them over the long run. To that end, data on current innovation processes can supplement due diligence prior to buyout deals that already gather rich datasets. Rather than assessing patent applications, due diligence can instead focus on research partnerships. In addition to business plans for upcoming products, they can also map innovation fields. Lastly, beyond simply looking at market shares, they can identify whether a firm has developed breakthrough R&D skills.

Regarding post-investment strategy, instead of promoting pure financial and operational engineering, investors can at least secure a financial allowance to sustain R&D activities. However, investors' support strategies for generative growth are not limited to securing R&D funding. Alternative equity sources, such as evergreen funds that have no pre-defined termination, can facilitate investor support for firms' innovation strategies but not ensure it. Post-investment strategies can also foster networks that enable the sharing of socio-technical imaginaries, which then help to renew expectations, objects, market usages, etc.[13] This type of development strategy was, for instance, key to Intel's growth in the 1990s. Intel had developed a microprocessor whose performance capacity exceeded the needs of existing devices.[14] To better sell this core product, the firm invested in the stimulation of innovative external applications that needed high-performance microprocessors and designed the USB port—the connection interface between personal computers and these external electronic devices. If Intel had been a private-equity backed firm, it would have been in investors' interest to finance these supplementary assets to capture more value instead of traditionally composing a portfolio of independent firms.

Beyond this deep change of investor rationale, which solely depends on investors' own strategic choices, some firms opt for alternate legal frameworks called profit-with-purpose corporations, such as social purpose corporations in the U.S. and more recently "Sociétés à Mission" or profit-with-purpose companies in France.[15] By adopting these new frameworks, an increasing number of firms—no matter their size or maturity—are resolutely securing their long-term projects and raising awareness for their disruptive innovation efforts. These new corporate forms allow firms to set additional objectives, beyond profit, in the bylaws of the corporation. These objectives can be social or environmental but also scientific or innovative. Once they are in the bylaws, they are stable over any renewal of shareholders, and management must then account for how the strategies respect these objectives. Atos is a recent example of such a company. In 2019, this multinational information technology service and consulting company added a purpose to its incorporation text. According to its CEO, it aimed at sustaining academic research and launching partnerships to explore innovation fields, such as artificial intelligence, that would enable the renewal of its activity portfolio in the upcoming years.

In France, the reform introducing the purpose of the firm celebrates its first birthday in 2020. The Minister of the Economy has already announced that all enterprises benefiting from state equity will have to adopt a "purpose". This purpose could be used to secure a commitment to innovate. A few investment funds are currently developing specific vehicles dedicated to profit-with-purpose companies. We can expect that such legal frameworks will deeply change the way investors interact with their portfolio companies and potentially invite them to be more proactive, whatever the holding period, to sustain regeneration strategies.

Conclusion—the way forward

A firm's life cycle is usually depicted in four main linear steps, namely birth, expansion, maturation, and decline. Start-ups are often seen as the vehicle enabling the regeneration of the industry, by cannibalizing existing firms or by opening up new fields. However, innovation activities that sustain industry regeneration are not restricted to start-ups. While private equity support to innovation focuses on venture capital, investors also have a leading role to play in sustaining innovation in mature firms. However, current private equity investment models have not been tailored to support generative growth paths that enable the renewal of firms' activities over the long-run.

Fostering generative growth proves even more critical in lower-income countries. Regarding mature firms, most of those countries, especially in Africa, currently face what is commonly called the "missing middle", which means that they suffer a shortage of small and middle-market firms that can spur national economic growth. Tempting aggregative growth strategies, such as the consolidation of an industry sector through the acquisition of multiple small firms by a platform company, certainly boost the growth of the selected firm but lead to misleading effects at the national level and occur at the risk of impeding national development. Besides, an increasing number of lower-income economies have embarked on programs to develop venture capital funds and attract additional national and foreign financial resources in order to fill equity gaps, boost innovation, and eventually enhance national competitiveness. Successful start-ups end up as mature firms. While launching their first products, start-ups will face the challenge of developing the next generations of innovation and the need to find investors supporting these generative growth strategies. A restricted public policy focused on supporting the mere provision of financial resources based on historical private equity strategies would likely worsen the liquidity gap. Thus, on top of the focus on reducing equity gaps, the challenges set by a liquidity gap shouldn't be underestimated. States have a leading role to play in structuring private equity industry, not only by providing additional financial resources but also by fostering new rationales supporting generative growth.

Generative growth should be carefully distinguished and prioritized, especially in emerging countries. Public policies can contribute to tackling this challenge. Various stakeholders, investors, and companies can be trained to distinguish the needs of growing companies and adapt private equity strategies. The most recent strategies of innovation financing and management would help in this regard, especially to renew scouting, selection, post-investment, and exit processes. For instance, as disruptive innovation requires dealing with new design logic that goes beyond uncertainty reduction, it requires investors to master alternative reasoning on risk mitigation.[16] Besides, exploration is crucial to generative growth strategies; thus, investors can, for instance, support firms' involvement in side organizations that collectively explore innovation fields, as these ensure crucial sharing of new phenomena, technologies, uses, etc.[17] Instead of composing a portfolio of independent firms, investors can benefit from these interactions by investing in firms that are investigating supplementary innovation fields. It could also be beneficial to design and promote investment strategies that enable some firms to pull out of private equity cycles and become independent again.

Overall, the need for a balance between extension or enhancement activities on one side and regeneration strategies on the other occurs along the entire firm's life cycle and is even more significant in middle market firms. Thus, these recommendations apply, to various extents, to private equity investors of all asset classes. States can play a leading role in spreading new relevant practices, in particular through their national development banks.

Notes:

1 Private equity occurs when investors directly buy companies that are not publicly traded, including for de-listing transactions. Current private equity asset classes take the form of either venture capital, growth capital, leveraged buyouts, or turnover, depending on the maturity of the target (i.e., start-ups, expanding firms, mature firms with steady profits, or declining firms).

2 Preqin, 2020; This amount is in between Japanese and German 2019 GDP estimates by the International Monetary Fund.

3 Preqin, 2020.

4 Chapel, 1997; Hatchuel et al., 2006.

5 Middle market companies (also known as mid-sized firms) are in between large ventures and small firms in size. There is no international standard to define them. In Germany, they form the well-known Mittelstand according to sociological criteria. Following a 2008 law in France, known as "Loi de Modernisation de L'économie", they have encompassed firms answering to a set of three criteria: number of employees (250 to 5000), turnover, and total liabilities.

6 Hatchuel et al., 2001; Jaruzelski et al., 2005.

7 Agogué et al., 2013.

8 Le Masson et al., 2017.

9 Amess et al., 2016; Kaplan et al., 2009.

10 Macmillan, 1931.

11 Matouk, 2010.

12 Parpaleix et al., 2019.

13 Cogez et al., 2013; Hooge et al., 2016; Le Masson et al., 2013.

14 A microprocessor is at the heart of every computer. Every action on a computer is described by instructions. The microprocessor is the chip that executes these instructions.

15 Levillain et al., 2019a; Levillain et al., 2019b.

16 See Global Innovation Index 2020, Chapter 6.

17 Agogué et al., 2013.

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CHAPTER 8

FILIPINNOVATION: FINANCING SCIENCE FOR THE PEOPLE

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The Philippines has long experienced regional disparity in access to major resources that could potentially fuel innovation and socioeconomic growth within the country. Further widening this gap is the country's archipelagic topography of over 7,641 islands coupled with its long history of related postcolonial challenges. Added to the mix are the low telecommunications bandwidth and insufficient public infrastructure to establish and sustain synergistic connections.

This regional disparity in access to resources also extends to financing innovation because most research and development (R&D) funding is concentrated in the capital of Manila and its neighboring regions. This lack of regionally-inclusive funding for R&D poses negative effects on the country's social and economic development.

However, these regional differences, if synergized through efficient transport and communication infrastructure, can be transformed into an opportunity to stimulate creativity and innovation.[1] With local communities having unique challenges of their own, it is necessary to generate niche-adapted solutions that capitalize on local knowledge and resources. In addition, each region's challenges—and even their advantages—can serve as lessons that other regions may learn from and possibly apply to their own problems.

One of the core values of the Filipino culture is *Bayanihan*, which is the community spirit to lighten any work through cooperation and collaboration.[2] Leveraging on Bayanihan in the context of technology and innovation, key government agencies such as the Department of Science and Technology (DOST), the Department of Trade and Industry (DTI), and the National Economic Development Authority (NEDA), together with representatives from academia, industry, and civil society organizations, crafted the Philippine National Innovation Strategy and called it *Filipinnovation*—a whole-of-government approach to inclusive innovation.

In this chapter, we describe the challenges that the Philippines has faced in pursuing regionally-inclusive innovation and the collaborative efforts to address them.

Funding grassroots innovation

Based on the United Nations Educational Scientific and Cultural Organization (UNESCO) benchmark, a developing country should at least have one percent (1%) Gross Domestic Product (GDP) Expenditure on R&D (GERD). Over the years, the GERD of the Philippines has remained below one percent, but the country has remained resolute in accelerating innovation despite prevailing budgetary limitations.

While the total R&D funding of government has dramatically increased by a factor of seven in the last eight years, the economic growth of the country has increased faster. Thus GERD remained unchanged—the Philippines remains in the bottom third of the 2019 Global Innovation Index (GII) in terms of GERD.

In 2014, about 93% of DOST R&D funding was concentrated in regions near Metro Manila, and only 7% was distributed among the other 14 regions of the country.[3] Moreover, out of 2,000 Higher Education Institutions (HEIs), only 74 had partnerships with publicly funded R&D. The country also has limited science, technology, and innovation (STI) infrastructure such as laboratories, testing facilities, and R&D centers. Those that exist need upgrading to undertake research, development, and innovation activities. Likewise, industry-academia collaborations for R&D are rare, despite the incentives offered by the government. The inability of most universities to be involved in R&D stems from the lack of enabling policies, opportunities, research leaders, and funding. This is evidenced by the roster of proponents for government-funded R&D programs and projects, which remains largely unchanged across each cycle of the call for proposals.

Recognizing the relevance of grassroots innovation solutions, in 2016, the DOST initiated the Science for Change Program (S4CP) that articulates a strategy to finance regionally-inclusive innovation in the country. It aims to accelerate the development and adoption of STIs by proportionately spreading funding across all regions for capacity-building initiatives and securing partnerships across academia and industry members. The S4CP is composed of four components, namely: 1) Niche Centers in the Regions for R&D (NICER) Program, 2) R&D Leadership (RDLead) Program, 3) Collaborative R&D to Leverage Philippine Economy (CRADLE) Program, and 4) Business Innovation through S&T (BIST) for Industry Program (Figure 8.1). These are expected to stimulate growth and innovation in all regions of the country.

Niche Centers in the Regions for R&D (NICER) Program

The NICER Program capacitates HEIs in the regions to make significant improvements in regional research by integrating development needs into existing R&D research capabilities and resources. The DOST, through the NICER Program, provides institutional grants for HEIs to undertake quality research that will catalyze and promote regional development.

As of 2019, the NICER Program has established 18 R&D centers spread out across 14 of the 17 regions with total funding of US$12 million (Figure 8.2). The R&D grants were provided to state and private universities, not only for upgrading facilities and human resource development but also for regional economic development. NICERs cover niche areas and abundant commodities, such as potato at Benguet State University (Northern Philippines), crustaceans at Samar State University (Central Philippines), and renewable energy at Ateneo de Davao University (Southern Philippines).

The potato R&D center was established at Benguet State University since 84% of national production of potato is produced in this region. It is a multimillion dollar industry that significantly contributes to the Philippine economy. The center will enhance the potato production system in the region and increase the income of farmers.

Eastern Visayas is one of the poorest regions of the Philippines. It houses the province of Samar where the crustaceans R&D center is located. Crustaceans, such as crabs, are the main source of income of fisherfolk in the area. However, the region has encountered an alarming decline of these resources in recent years. Hence the center aims to develop strategies and policies to enhance productivity and sustainable utilization of commercially valuable crustaceans.

The renewable energy R&D center was established in Mindanao, as the region has been suffering from frequent power shortages. Some villages do not have electricity from the power grid due to the vast land area of Mindanao.

R&D Leadership (RDLead) Program

R&D centers, institutes, and other national government agencies (NGAs) in the Philippines vary in their capacity to pursue innovative research and development activities, due primarily to lack of facilities and inaccessibility of experts to train, direct, and support R&D goals; most experts are affiliated with established academic institutions in Metro Manila. In the 2019 Global Competitiveness Report, the Philippines ranked 72nd in terms of quality of scientific research institutions and 55th in terms of scientific publications, out of 141 countries.[4] DOST, through the R&D Leadership Program, engages local experts to lead and strengthen the research capabilities of academic institutions, R&D centers, and NGAs located in any part of the country.

The establishment of niche research centers for seaweed, halal goat, and sea cucumber are just three successes from universities in the Philippines that engaged RDLeaders through the program. These universities are located in Tawi-Tawi, Sultan Kudarat, and Misamis Oriental, respectively. All three are based in Mindanao in the southern part of the Philippines—farthest from the country's capital of business and home to some of the poorest municipalities in the country.

The RDLeaders serve as catalysts who bring out the latent talent of the universities and researchers in the province, which will lead to innovation and sustainable economic growth where they are assigned.

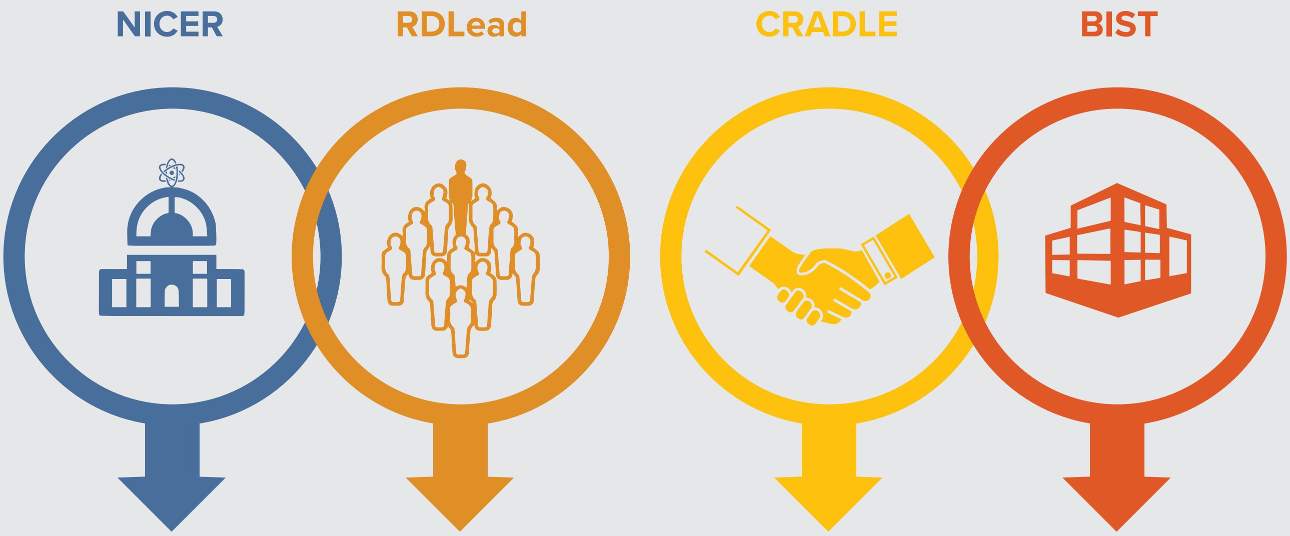
Collaborative R&D to Leverage Philippine Economy (CRADLE) Program

In the past, researchers in HEIs in the Philippines conducted R&D expecting that their outputs would be adopted by industries. However, it turned out that most R&D outputs were not tailored to fit the specific needs of industry. As a result, the majority of R&D outputs only ended up being presented in conferences, published in reports or journals, or granted utility models (UMs) for display rather than commercialization. In most cases, R&D investments were not cost-effective and did not benefit the intended user. To reverse the situation, the DOST initiated the CRADLE Program that aims to shift the academic and research practice from being publication-centric to being industry-driven, thereby maximizing its socioeconomic impacts.

In addition, most large companies in the Philippines are not open to collaborating with research institutions, and some rely on in-house R&D units. However, under the CRADLE Program, academia and industry have started to collaborate, and their reception to the program has exceeded expectations. The feedback on the successes of academia-industry collaborations is very promising, particularly in a partnership started in 2017 between Hijo Resources Corporation (HRC), a 677-hectare banana plantation based in Mindanao, and the University of Southeastern Philippines (USeP).

FIGURE 8.1

The four components of the DOST Science for Change Program



Niche Centers in the Regions (NICER) for R&D

Establish R&D centers in the regions to promote regional development.

R&D Leadership (RDLead) Program

Engage R&D experts to lead in strengthening the research capabilities of the Higher Education Institutions (HEIs), Research Development Institutions (RDIs) and National Government Agencies.

Collaborative Research and Development to Leverage Philippine Economy (CRADLE) Program

Create synergistic academe-industry relationship to invigorate Philippine R&D.

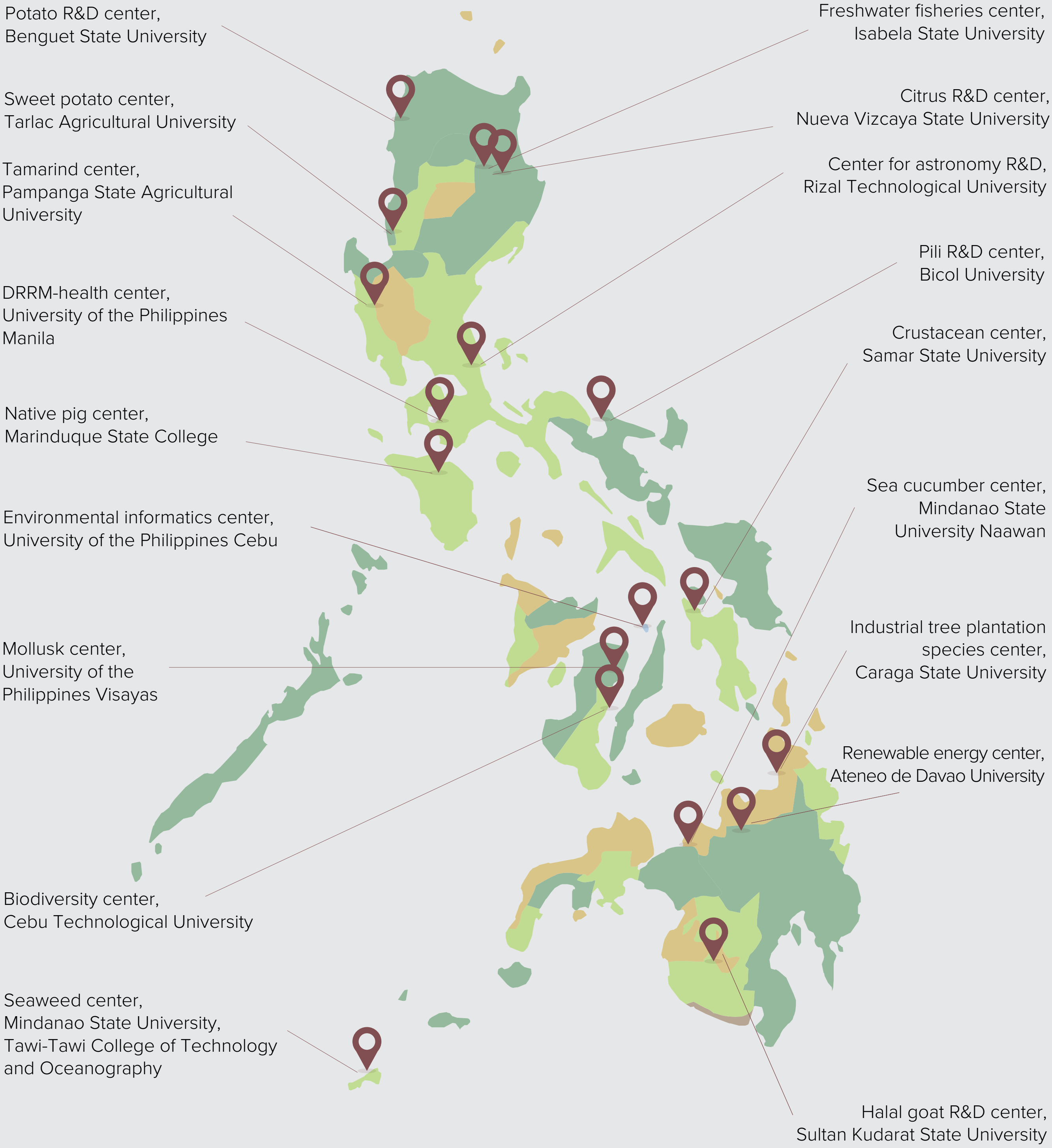
Business Innovation through S&T (BIST) for Industry Program

Facilitate the acquisition of strategic and relevant technologies by Filipino companies to support R&D activities.

Source: Philippine Department of Science and Technology (DOST), 2020.

FIGURE 8.2

DOST R&D centers with corresponding universities across the Philippine archipelago



Source: Philippine Department of Science and Technology (DOST), 2020.

Before the project, HRC needed to frequently spray pesticides on the entire plantation, costing millions of pesos each year. Recognizing the expertise of the university, HRC collaborated with USeP and successfully developed an innovative surveillance system that will map the spread of banana diseases in the plantation. The system has reduced pesticide spraying without affecting the fruit quality, resulting in significant savings for HRC.

To date, HRC has adopted the technology and continues to collaborate with USeP to fine-tune it using HRC funds. Furthermore, HRC formalized USeP as their “research arm” through a Memorandum of Agreement that resulted in the establishment of an R&D center for banana disease control located at USeP and financed by HRC.

The partnership of HRC and USeP paved the way for collaboration opportunities with other private companies located in the area. To date, USeP has 18 research engagements worth US$1.5 million—roughly a third of which were funded by private companies.

A government investment of US$100,000 in the HRC-USeP CRADLE project led to more private companies trusting and investing in research and development done in partnership with HEIs. The HEIs, on the other hand, have learned to conduct industry-driven research.

Business Innovation through S&T (BIST) for Industry Program

DOST is pursuing an initiative to level-up the innovation capacity of Filipino-owned companies while promoting R&D-based industry. In November 2019, financial assistance amounting to US$200,000 was given to the first private company under the Business Innovation through S&T (Science and Technology) for Industry Program. The company, based in the Western Visayas region of the Philippines, will use the financial assistance to acquire technology to semi-purify herbal extracts to develop pharmaceutical-grade ingredients. The BIST Program is designed to assist Filipino-owned companies to innovate and develop competitiveness through the acquisition of new and relevant technologies for research. The proposed technology acquisition and corresponding research run for three to five years, with a refund to the government at zero interest commencing on the third year of project implementation.

Within three years of implementing the S4CP, there have been increases in the pool of researchers, the scale of research in almost all regions, the accessibility of research facilities, and industry-academia research collaborations. Specifically, the program has almost doubled the number of HEIs engaged in R&D from 74 in 2014 to 149 in 2019. R&D funding to regions beyond Metro Manila has increased from 7% in 2014 to 20% in 2019. The Philippines’ ranking in university/industry research collaboration also rose from 56th in the GII in 2018 to 25th in 2019. With the dramatic increase in research outputs from HEIs all over the country, DOST has established over 30 additional technology business incubators to accelerate technology transfer from academia.

Innovating to solve pressing problems

Coconut is considered to be the tree of life—all parts have economic value from coconut sugar, virgin coconut oil, vinegar, and wine, to activated carbon and nanocrystals. From 2009 to 2013, the Philippine coconut industry suffered significant economic losses due to an outbreak of coconut scale insect (CSI) affecting approximately 1.2 million trees. There are 3.5 million coconut farmers, and they are among the poorest in the country. To address the urgent crisis of producing quality planting materials to accelerate the replacement of CSI-infested trees, the development of the coconut somatic embryogenesis technology (CSet) was started in 2014. CSet is a technique for rapid, mass propagation of superior genetic stocks for high yielding, pest- and disease-resistant coconut. After five years of exhaustive R&D involving seven different Research and Development Institutes (RDIs), production of over 200 coconut plantlets per seednut is now possible; this is an enormous improvement over the traditional production of one single plantlet per seednut. The advancement in propagation of coconut will ensure that the materials are enough for massive planting and re-planting in the country. This collaboration proved that R&D and innovation can solve pressing national problems.

Filipinnovation

Before 2007, the Philippines struggled to develop a system for innovation. The old linear model of innovation states that any technology generated will eventually be commercialized when it becomes fully developed and infused with generous financial capital. Ideally, any publicly funded R&D activity should generate new knowledge to advance current understanding in a particular field. The major challenge for R&D institutions and public incubators in the country is how to transfer and commercialize the new knowledge in fulfillment of the government’s role as the main facilitator of technology and knowledge diffusion. This implies, however, that any drive to diffuse developed technologies is limited by the availability and extent of investment.

There have been many instances where Filipino researchers avoid the process of commercialization due to lack of policies that will protect their intellectual property rights (IPR). Due to unfamiliarity or lack of proper financial means to engage in such activities, the output of some researchers has never reached commercialization.

To address this concern, Republic Act (RA) 10055 or the “Philippine Technology Transfer Act of 2009” was enacted. The law aims to promote and facilitate the transfer, dissemination, and effective use, management, and commercialization of intellectual property, technology, and knowledge resulting from R&D that was funded by the government for the benefit of the national economy and taxpayers. The Technology Transfer Act of 2009 endeavored to create an attractive and financially rewarding environment for RDIs and scientists by providing them the IPR for output arising from government-funded research, which in turn encourages them to commercialize the technologies produced from their research.

However, the enactment of RA 10055 did not accelerate technology transfer as expected. There were two missing ingredients—enabling policies and funding.

In 2015, DOST released its intellectual property (IP) policy followed by policies on data sharing, IP management, and technology transfer protocols; guidelines for the fairness opinion board; and the provision of a revolving fund for implementing rules and regulations of the Philippine Technology Transfer Act of 2009. The weight of these policies was clear and apparent in the succeeding years as the Philippines' IP products expenditure as a percentage of GDP steadily increased from 1.0% in 2016 to 1.2% in 2017 and 1.4% in 2018. In 2018, the country's targets for IP were met as there were 466 national patent applications and 2 international applications under the Patent Cooperation Treaty (PCT), 2,069 utility models, and 875 industrial designs (IDs), all filed by Filipinos.

In the past, there have been cases where national government agencies were not coordinated or familiar with each other's programs. It is possible that an agency may not even be aware that other agencies have the same concerns; each agency acts without regard to the involvement of others, which duplicates effort and resources used. Complex problems stemming from these information asymmetries thus call for the expertise and resources of different agencies to come together—inclusive innovation being a case in point.

Filipinnovation provides a framework for collaboration among government agencies, academic institutions, industry, and civil society organizations. The interaction of these stakeholders has created and transferred knowledge that has enabled new products and business models to catalyze economic transformation and development. It has also enabled the integration of more stakeholders in the Philippine innovation and entrepreneurship ecosystem, such as local government units (LGUs); startups; micro, small and medium enterprises (MSMEs); R&D laboratories; S&T parks; incubators; fabrication laboratories (FabLabs); and investors.[5]

For example, the DTI and DOST have established regional inclusive innovation centers (RIICs)—with the assistance of the Science, Technology, Research and Innovation for Development (STRIDE) Project through the United States Agency for International Development (USAID)—and with support of regional agencies, chambers of commerce, HEIs, and other stakeholders. RIICs serve as venues for collaboration among government, education, and industry players to collectively pursue market-driven research. RIICs have been piloted in the Bicol, Central Visayas, Northern Mindanao, and Southern Mindanao regions.

The tandem of NICER and RIIC is an enabling mechanism built on knowledge developed through R&D. First, the NICER Program supports universities—as technology generators and capacity builders in the locality who develop niche commodities and knowledge through R&D. Investments are being poured in to set up infrastructure to improve market competitiveness, production yield, and valorization of commodities as well as to strengthen the absorptive capacity of local producers. The RIIC then aids in the commercialization and mass adoption of innovative technologies through its accelerators, incubators, and innovation hubs. It capitalizes on the industry clusters in the regions and provides support for innovation and entrepreneurship.

In effect, the synergistic efforts of NICER and RIIC might provide growth and opportunities for innovation in all the regions of the archipelago by building on the region's unique characteristics and boosting the push for technology from the laboratory to the market.

Stakeholders in RIICs reported significant strides under the initiative. One of the success stories is the launch of the Optimizing Regional Opportunities for Business Excellence through Science, Technology, and Innovation (OROBEST) in Northern Mindanao. OROBEST seeks to enhance regional industry productivity and competitiveness through the adoption of scientifically developed technologies. Upon implementing OROBEST, an industry needs assessment was conducted, and relevant local research outputs were identified.

This is also similar to the Negosyo Center Program, a banner program of the DTI responsible for promoting ease of doing business and facilitating access to services for MSMEs. Negosyo Centers are business centers that stimulate entrepreneurship development for MSMEs, which contribute substantially to driving the Philippine economy. They are found in strategic areas convenient for existing and would-be entrepreneurs, such as DTI offices, LGUs, academic institutions, non-government organizations (NGOs), and malls.

For technology upgrades, the DOST provides funds through the Small Enterprise Technology Upgrading Program (SETUP). SETUP is a nationwide program aimed at encouraging MSMEs to adopt technology innovations to improve their operations, which will result in increased productivity and competitiveness. In 2019, a total of 784 MSMEs received funding support, and these firms have generated 13,358 jobs. Funding for SETUP has expanded with the collaboration between DOST and the Development Bank of the Philippines, which offers very low interest rates for technology acquisition under the program. In a similar manner, DOST and the Landbank of the Philippines co-fund inventors. All these programs are implemented with the goal of solidifying the country's efforts to accelerate regional innovation across the Philippines (Table 8.1).

In addition, collaboration among these actors also resulted in the development of policies, particularly the Philippine Innovation Act and the Innovative Startup Act, that attempt to create an enabling environment to accelerate STI in the country:

TABLE 8.1

Summary of DOST innovation funding mechanisms, 2017–2019

Program	Budget 2017–2019, US$
Niche Centers in the Regions for R&D (NICER)	6,200,000
Collaborative R&D to Leverage Philippine Economy (CRADLE)	1,200,000
R&D Leadership (RDLead)	600,000
Business Innovation through S&T (BIST) for Industry	200,000
Small Enterprise Technology Upgrading Program (SETUP)	54,000,000
Other Grants-in-Aid Programs (DOST-GIA)	151,000,000
Total	213,200,000

Source: Philippine Department of Science and Technology (DOST), 2020.
Note: Figures are converted from Philippine pesos to US$ and rounded to the nearest hundred thousand.

Philippine Innovation Act

Recognizing that R&D and appropriating funds for it are essential for national development, the Philippine Congress pushed for the approval of the Philippine Innovation Act. The law gives priority "to generate and scale up actions in all levels and areas of education, training, research, and development towards promoting innovation and internationalization activities of micro, small and medium enterprises as drivers of sustainable and inclusive growth."

One of the goals of the law is to implement an action plan for the development of the country's capacity for and success in innovation, as measured by the GII and other similar indices.[6] Through the Philippine Innovation Act, the following hurdles in the STI sector will be addressed:

- weak STI culture,
- absence of a vibrant intellectual property culture,
- slow commercialization of STI outputs,
- lack of awareness of R&D activities,
- low government spending on R&D,
- difficulty in increasing employment opportunities,
- retention of S&T human capital,
- inadequate STI infrastructure, and
- lack of collaboration among players in the STI ecosystem.

For instance, the Department of Foreign Affairs (DFA) will facilitate the participation of qualified members of the Filipino *diaspora* in the country's innovation drive. The Filipino diaspora consists of 10 million overseas Filipino workers. The DOST will lead in mobilizing Filipino talents for innovation and S&T efforts, and the Intellectual Property Office of the Philippines (IPOPHL) will promote the registration of patents, trademark, copyrights, and industrial designs among scientists, inventors, and innovators to ensure the protection of innovation against misappropriation.

Innovative Startup Act

In pursuit of innovation that propels economic growth, the Philippines enacted the Innovative Startup Act (ISA). It is a joint initiative of three national government agencies, namely the DOST, DTI, and Department of Information and Communications Technology (DICT). Through the law, the state shall provide incentives to new businesses to engage in innovative entrepreneurial activities.

The ISA shall provide incentives and remove constraints aimed at encouraging the establishment and operation of innovative new businesses that are crucial to growth and expansion. The act will also strengthen, promote, and develop an ecosystem of business and government and non-government institutions that foster an innovative entrepreneurial culture in the Philippines.

Some of the incentives supported by the law include: 1) full or partial subsidy on business registration, 2) endorsement to IPOPHL, 3) full or partial subsidy on the use of facilities, office space, and equipment/services provided by government or private enterprises/institutions, and 4) grants for research, development, training, and expansion projects.

To strengthen the innovation ecosystem in the country, this whole-of-government approach is indispensable.

With its implementation, Filipinnovation has harnessed the potential of more Filipino innovators and entrepreneurs, which can lead the country to a more competitive standing in the global economic arena, at par with leading innovation achievers.

Filipinnovation: whole-of-government approach to inclusive innovation

Filipinnovation is the whole-of-government approach (WGA) to inclusive innovation, which will ensure policy coherence, alignment of priorities, and effective coordination in service delivery. This approach recognizes the importance of an inclusive innovation ecosystem that delivers coordinated action in various areas.

Given the range of government agencies that have a hand in Filipinnovation and in funding grassroots innovation, the need to integrate policies and programs to propel innovation initiatives in the country should follow a whole-of-government approach. This has been proven effective when the country entered the circle of innovation achievers reflected in its 2019 GII ranking. Through Filipinnovation, silos are eliminated as government agencies no longer work in isolation. In this approach, the country avoids having different policies cut across and undermine each other. The Filipinnovation strategy optimizes the impact of government funding towards inclusive innovation and ensures the multiplier effect of its impact and resources. Thus, even with low funding for R&D, innovation in the country has flourished as evidenced in the GII 2019, where the Philippines produced more innovation outputs relative to the level of its innovation investment. Financing innovation using the Filipinnovation strategy has expanded the Philippine innovation ecosystem, made the Science for Change Program possible, and has increased the Philippines' innovation efficiency.

The next challenge is to practically sustain Filipinnovation momentum and translate it into tangible problem-solving and lasting positive change—built on the collective power of Filipino minds and ideas working together from every island of the archipelago.

Notes:

1 The Manila Times, 2015.

2 Bayanihan is the community spirit to lighten any work through cooperation and collaboration, usually associated with an image of a group of people who are physically moving a small house from one place to another.

3 Universities Funded under the Department of Science and Technology Grants-In-Aid Program (DOST-GIA) 2014-2019.

4 Global Competitiveness Report 2019.

5 Policy Advocacy Group (PCARRD), 2009.

6 Philippine Innovation Act, 2019.

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CHAPTER 9

FINANCING RESEARCH, DEVELOPMENT, AND INNOVATION: THE CASE OF THE CZECH REPUBLIC

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Effective innovation activities are a prerequisite for long-term and sustainable economic growth and competitiveness. During times of economic crisis, innovation is considered one of the possible ways of minimizing the negative impact of the crisis. Expenditure on research, development, and innovation (R&D&I) also helps the convergence of national as well as regional economies, and so co-creates the basis for economic growth. For innovation to be successful, it is important to have a balanced system of support for innovation activities, resting on an optimal ratio of public and private investment, all underlain by the effective interconnection of the business, public, and academic sectors. The above interaction of all actors supporting research, development, and innovation is based on a quality research base, sufficient financial resources, and maximum use of the research results.

The financing of innovation in the Czech Republic has undergone many changes. A key strategy approved by the government in 2019 was the Innovation Strategy of the Czech Republic 2019–2030. It aims to support research, development, and innovation in a country that will be driven by the ambition to become one of the innovation leaders of Europe by 2030—under the motto "The Czech Republic: The Country for the Future". The Innovation Strategy of the Czech Republic contains nine pillars, the implementation of which should help to maintain performance in the face of increasing global competition. The financing of research and development is only one of the pillars, which indicates the significant complexity of providing public R&D&I support at the national level.

This chapter assesses the process of support for research, development, and innovation in the Czech Republic. The first section contains the starting points for their financing, contextualized by the process of transformation of the Czech economy. The second section analyzes the government's different R&D&I financing instruments—dividing them into national and foreign instruments—and evaluates their benefits and shortcomings. The third section describes some of the changes in R&D&I support and the persisting challenges in the financing of research, development, and innovation.

Starting points of the support for research, development, and innovation

Economic transformation in the Czech Republic in the early 1990s was accompanied by a lack of free domestic capital, even for necessary investments in tangible assets. In the beginning, the Czech Republic set out on a specific path of so-called coupon privatization; however, this did not solve the problem of lack of capital. The absence of domestic capital for the innovation of production facilities and processes or human capital was compensated for by an inflow of foreign direct investment (FDI) that became one of the main growth factors of the Czech economy. The main goal of economic policymakers was to attract capital and foreign know-how into the country to connect domestic firms to foreign production chains and increase their overall competitiveness. Since 1993, FDI inflow has steadily grown, reaching 47% of annual GDP in 2017.[1]

Thanks to inward FDI, the number of private companies under foreign control grew, and dominant sectors, such as the automotive industry, were created. Another positive aspect of these inflows was the connection of Czech firms to global value chains, as well as the sharp growth of exports and foreign trade. In contrast, to reduce their costs—such as those for labor—foreign investors mainly transferred into the Czech Republic and other countries of the Eastern Bloc their production processes for mounting and assembly, e.g., the production of lower value-added goods. The setting of support for inward FDI did not motivate firms to invest in high-tech activities, nor did it promote the larger involvement of companies in research and development or a higher share of more qualified labor. The result is that the Czech Republic remains mainly an industrial economy with a low representation of knowledge-intensive services (KIS). In contrast, a significant portion of innovation is concentrated within knowledge-intensive services in advanced economies. Although the employment of the Czech population grew faster in the last decade in knowledge-intensive production sectors and services compared to the European Union-28 (EU28) (1.3% vs 0.9%), convergence is very slow, and the share of knowledge sectors in total employment in the Czech Republic lags the share in the EU28 (33% vs. 40%).

The initial advantage—in the form of cheap and highly qualified labor—gradually became a disadvantage because it did not place higher demands on innovation that would lead to producing goods with higher added value, and it did not secure a shift to the upper tiers of global value chains. The foreign parent companies also kept the main research centers in the countries of origin, which, to a certain extent, reduced the innovation activity in the Czech Republic. The result was also a lower patenting activity of domestic enterprises, because subsidiaries usually patent new technical solutions in the domicile of the parent company, regardless of where the knowledge was created. The insufficient emphasis on research and development and high-tech innovation could, in the long term, slow down the convergence of the Czech economy with the rest of developed Europe. Another great challenge is the low support for public R&D&I from domestic business sources that are almost exclusively used to finance research and development in the business sector. While support for the business sector from Czech public sources in 2018 reached 9.5% of the volume of funds spent by the business sector on research and development (R&D), business sources represented 5.0% of expenditure of the higher education sector on R&D and 7.3% of expenditure of the government sector. In contrast, in Germany, direct support for enterprises from domestic public sources in 2017 was only 3.2% of the business sector expenditure on R&D, while business sources provided nearly 13.4% of higher education sector expenditure and more than 10% of government sector expenditure.[2]

Various indicators are used to compare support for—and the position of—research, development, and innovation of the Czech Republic among other countries. The main innovation indices include the Global Innovation Index (GII) and the Summary Innovation Index (SII). The composite indices include various indicators of the innovation process, including R&D&I financing and its prospects and starting points. The aim is to provide a comprehensive picture of the innovation potential of countries.

In most surveys, the Czech Republic regularly ranks approximately in the middle of the evaluated countries, and its position has not changed much over the last 10 years. According to the SII,[3] the Czech Republic ranked 14th in 2018 in the EU28 ranking of moderate innovators, with its index rising by 3.5 percentage points to 89.9 between 2011 and 2018, while the European Union (EU) grew by 8.8 percentage points. In the GII 2019,[4] the Czech Republic ranked 26th among 129 countries in terms of innovation performance, moving up one place since 2010. The absolute value of the Czech score was 49.46 last year, compared to the highest-ranked score of Switzerland (67.24) and the lowest-ranked score of Yemen (14.49). In both indices, the strengths of the Czech Republic are its knowledge and technology outputs, employment in fast-growing innovative firms, a high share of medium- and high-tech products in total exports, and the in-house innovations of small and medium-sized enterprises. In contrast, the Czech Republic lags in the indicators of market sophistication, patent applications, and expenditure on venture capital.

In addition, the latest survey of innovative firms by the Czech Statistical Office in 2016 showed that lack of financial resources is considered a significant obstacle hindering innovation activities for a fifth of all firms that are mainly under domestic control.[5] The second most important barrier to innovation for companies is the difficulty encountered in obtaining public support for innovation (16.8%), and the third is the lack of qualified staff (14.1%). The results of the questionnaire survey among domestic companies support the hypothesis that problems persist in the financing of expenditure on research, development, and innovation.

Financing of research, development, and innovation in the Czech Republic

R&D expenditure is increasing. While in 2008 it comprised 1.2% of GDP, in 2018, it reached 1.9%. This dynamic increase has been driven mainly by the growing involvement of companies, which in 2018 financed 58% of R&D expenditure; in contrast, the share of funds coming from the state budget and the European funds has been decreasing over time—to 34% and 6% respectively in 2018. In the business sector, the decisive role is played by companies under foreign control. In 2018, their R&D expenditure exceeded a 66% share, and in recent years, they have gained a lead far ahead of domestic private companies. The trend in investment incentives shows that where a company under foreign control has implemented a project successfully in the manufacturing industry with a lower added value in the past, the likelihood of further follow-up investment in higher-value company functions, such as R&D, increases.

Research and development is carried out mainly in the business sector, to which 62% of R&D expenditure was directed in 2018, compared to 58% in 2008. In terms of sectoral economic activity, the largest share (54.6%) of R&D expenditure in 2018 went to the manufacturing sector. While its overall share has not changed substantially since 2008, it has undergone structural transformation. Increases were seen mainly in the automotive industry (from 14.9% in 2008 to 19.9% in 2018) and the electrical engineering industry (from 3.1% in 2008 to 7% in 2018). In contrast, the share in the production of computers, electronics, and optical apparatuses decreased from 5.6%

to 4.6%. R&D expenditure in the manufacturing sector was followed by the information and communications activities sector, whose share moved up in 2018 to 20.1% from 13.3% thanks to information technology (IT) activities.

Around 22% of total R&D expenditure was directed in 2018 into the higher education sector, compared to 19% in 2008. In contrast, a decrease in the share of R&D expenditure was recorded in the government sector, moving from 24% in 2008 to 16% in 2018. Three-quarters of the funds were spent in the workplaces of the Czech Academy of Sciences. In terms of scientific areas, funding was concentrated in the natural sciences (US$450 million or 68%), with a small percentage going to the humanities and medical sciences, which each accounted for around 1% each of the total expenditure. The rest was spent in the technical sectors. While R&D expenditure in the business sector has long been financed mainly by enterprises themselves (around 90%), R&D expenditure in the government and higher education sectors is financed largely from public sources, both Czech and foreign.

R&D&I financing in the Czech Republic from the state budget

The state budget funding for research and development has long been channeled into several main areas. Around half of all resources are distributed institutionally to secure the implementation of basic research, as set up under the Czech Academy of Sciences to support research at higher education institutions and other research organizations. Those organizations are usually subordinated to the various ministries and their policies and mainly carry out applied research and development. Competition for purpose-specific funding comes from researchers under grant projects for basic research and from beneficiaries of research organizations, enterprises, and other entities. The programs are focused predominantly on projects contributing to the concrete objectives of ministerial and inter-ministerial strategies, and on improving the systemic environment and functioning of research organizations. Last but not least, there are programs supporting industrial research—ultimately used for innovation in the business sector and for developing the competitiveness of the economy.

In 2018, the state budget provided 1.36 billion euros (EUR) to finance research, development, and innovation in the Czech Republic. The largest volume of institutional support is provided mainly by the Ministry of Education, Youth and Sports—in 2018, higher education institutions (HEIs) absorbed around EUR 261 million, while the Czech Academy of Sciences (CAS) absorbed EUR 152 million. The purpose-specific supports that have long prevailed over institutional support are provided mainly by the Grant Agency of the Czech Republic, used in particular by HEIs and CAS; the Technology Agency of the Czech Republic, whose support is intended for enterprises and HEIs; the Ministry of Industry and Trade; and the Ministry of Education, Youth and Sports, where most support is granted to HEIs. While institutional support aims at improving mainly higher education institutions, purpose-specific support is channeled into industry, the medical sciences, social sciences, humanities, and biosciences.

So, disregarding basic research, the purpose-specific support is intended to develop research activities contributing to the objectives of specific programs in the context of implementing the National Policy of Research, Development and Innovation. The programs can be divided into ministerial—such as health, culture, defense, and agriculture—and cross-cutting, specific programs—such as social sciences research, security, international cooperation, support for young scientists, and the development of key technologies. Apart from fulfilling the main objectives, most programs significantly help to develop cooperation between the research and business sectors. The success of that support is demonstrated in the deepening cooperation between scientists, who can focus on creating specific applied outputs, and entrepreneurs, who gain a source of knowledge and new ideas, in addition to technical help. Institutional support has secured the conceptual development of research organizations, by reducing the administrative burden on researchers and supporting the necessary R&D infrastructure.

Policymakers cannot do without quality evaluation. Recently, the evaluation culture has significantly improved thanks to the requirements for the evaluation of European programs. The evaluation tools then find a broader application in national support programs.

R&D&I support in the Czech Republic from European funding

Income from EU structural funds represents an important component of the financing of Czech research, development, and innovation. For the period from 2014 to 2020, the Czech Republic has been allocated funding for R&D from the European Regional Development Fund of around EUR 2.4 billion, provided through three operational programs: Operational Programmes on Research, Development and Education (OP RDE); Enterprise and Innovations for Competitiveness (OP EIC); and OP Prague—the Growth Pole of the Czech Republic. In 2018, public aid spent under OP EIC and OP RDE amounted to EUR 367 million (including state budget cofinancing), of which HEIs received 68%, CAS workplaces 21%, and enterprises 11%. The largest share of proposals and supported projects is implemented in three sectors: physical and analytical chemical sciences, computer science, and environmental biology. Charles University, Masaryk University, and the Biological Centre of the CAS are behind more than half of the supported projects and funding obtained from EU structural funds in the Czech Republic.

The evaluation of the results to date of OP EIC—the largest Czech program supporting R&D in the business sector and funded from EU funds—shows that the supported projects have had a positive impact on increasing the innovation performance of the assisted enterprises, mainly SMEs. The benefits include speeding up the innovation process, as enterprises have been able to innovate up to two years faster than if they had not received the aid. Projects were primarily intended to improve the technical infrastructure of firms for R&D. Positive evaluation was also given to cooperation between enterprises, HEIs, and research organizations. This cooperation often continued after completion of the project. The OP EIC support has helped to improve the qualifications of the labor force and has improved the ability to implement in-house research in the future.

In recent years, the supported innovation was mostly of an average level, with a lower impact on the development of high value-added production. The supported innovation predominantly concerned product innovation (90%), while process, marketing, and organizational innovations were implemented only as complementary processes. In the case of research organizations, interest in funding is inhibited by the high rate of cofinancing as well as by the limited amount of the grants from some programs. For research organizations, it is more attractive to draw support from other public expenditure programs that offer a higher intensity of support from public sources.

An important impact can also be observed in the financing of public research from EU funds. In the 2007-2013 programming period, the majority of the Operational Programme Research and Development for Innovation—a total allocation of EUR 2.4 billion—was earmarked for extensive investment in building a new public research infrastructure. With that, eight centers of excellence and 40 regional research centers were created, and thanks to that investment, the Czech Republic reached the level of the developed states in terms of the availability of a modern research infrastructure.

The radical improvement of the infrastructure for public research should increase the quality of public research and its innovation performance. The Czech Republic should also step up its participation in the EU framework program, Horizon Europe, which is a European funded instrument for supporting R&D, where applicants face global competition. However, it appears that the effects of the improved quality of the research infrastructure on both the quality of the research itself and on innovation need more time than one or two programming periods and require further measures to support international cooperation, human resources in research, cooperation with industry, and the concentration of research capabilities.

Changes in the conditions of R&D&I support and new challenges

Experience from recent years has shown that the system of research and development financing must be consistently evaluated and adapted if it is to lead to the convergence of the national economy with the most advanced economies of the world. The Czech experience could also be a valuable source of information and inspiration for other countries in similar stages of development.

Possible changes include enhancing the financing of research and development, focusing support on projects with a higher added value, and increasing research on the benefits for society. The Czech Republic has set explicit targets for R&D expenditure up to 2.5% of GDP by 2025 and 3.0% by 2030. Efforts should continue to remove the barriers to innovation progress, including low levels of investment in venture capital. Subsequently, other forms of financial instruments should be used, including guarantees and preferential loans. Apart from direct support, more media coverage should be given to the possibility of using indirect instruments, such as more effective forms of tax support for business R&D&I. Consideration should also be given to increasing the financial ceiling for subsidies in some instruments that require reaching a certain critical value of resources.

Valuable lessons can be learned from the development of investment incentives, which have become an important tool for R&D support in the Czech Republic. To increase added value, the Act on Investment Incentives has been amended, stating that at least 80% of employees of the incentive recipient must have average gross monthly earnings at least at the level of the average wage in the region where the project is implemented. At the same time, the incentive recipient must either employ at least 2% of the total number of employees as R&D staff or spend at least 1% of the project expenditure on cooperation with research institutions, while employing 10% tertiary-educated employees or spending 10% of the project expenditure on R&D.

To target the financing of research and development more effectively, it is necessary to evaluate the provided support credibly—both purpose-specific support, such as projects, and institutional support, such as long-term development of research organizations. Research organizations should be evaluated on the basis of their performance, excellence, and societal relevance. Assuming rising budget expenditures, the results of these assessments should be strongly reflected in the financing of organizations, with the aim of developing top-level research. In program support, pressure is increasing to evaluate all standard phases—from ex ante to impact, and to leverage evaluation results in new funding programs.

It is also crucial to support promising areas of research and innovation so that public resources are not fragmented without sufficient impact on the supported projects. To attract as much EU funding as possible, the country needs to adopt the Research and Innovation Strategy for Smart Specialisation (RIS3). The fundamental idea behind this concept is that the given country identifies—based on its strengths and the entrepreneurial discovery process—the key activities, areas, and technological domains in which it has the potential to reach a competitive advantage.[6] That strategy is gradually being put into practice in the Czech Republic and priority areas of support are being established,[7] including national domains of specialization that have the greatest potential to improve competitiveness, knowledge-based growth, and innovation capacity. Examples include transport for the 21st century, advanced mechanical engineering, life sciences, nanotechnologies, AI, and cybersecurity. RIS3 also aims to exploit the potential of the country to contribute to solutions for current social and technological challenges—including environmental challenges—while possibly contributing to the current strategic plans of the European Commission in this area (Green Deal).[8]

The R&D support from operational programs should focus on currently functioning innovation networks—with the potential to utilize existing capacities, rather than build new capacities. That measure would help to channel funding to scientists and not to further extension of infrastructure. Other objectives of the current policies include the better promotion of foreign projects for R&D support, especially among small- and medium-sized enterprises, and the provision of technical support in establishing foreign partnerships and submitting applications to European funding programs. A final aspect would be reducing the imbalance between funding that flows from enterprises to public entities and funding provided to enterprises from the state budget.

Conclusion

With the gradual convergence of the Czech economy with the advanced world economies, the competitive advantage of lower wages in the Czech Republic will gradually fade out. Domestic economic policy should, therefore, focus on supporting innovation and reducing the high burden of government regulation and the complicated system of subsidies and taxes. The Czech government is aware of these needs and seeks to increase expenditure on research, development, and innovation; to streamline the system of its use, including the evaluation of research organizations; and to motivate the business sector to cooperate more fully with public research and development. The key challenges of the government policy include both support for venture capital investment and the search for other forms of financial instruments, including tax support for research and development. The selection of promising areas of research and development must reflect national specificities as well as the overall direction of Europe.

Notes:

1 Czech National Bank, n.d.; Excluding financial and insurance activities.

2 Research, Development and Innovation Council, 2019.

3 European Commission, 2019a.

4 Cornell SC Johnson College of Business et al., 2019.

5 Czech Statistical Office, 2016.

6 Foray et al., 2012.

7 Department for Analysis and Coordination of Science, Research and Innovation, 2018.

8 European Commission, 2019b.

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CHAPTER 10

FINANCING INNOVATION IN BRAZIL

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Challenges for financing innovation and the role of the public sector

Technical progress has long been known as one of the main drivers of economic development. Innovation, however, does not happen automatically or driven only by market forces. One basic feature of innovation is that it creates strong positive externalities in the economy—the social benefits of innovation far outweigh the private ones, These benefits justify the role played by the states in this area. As an example, innovations in health care, although generating greater profits for the innovator, also create several social benefits, such as improved quality of life and increased life expectancy.

In addition to externalities, innovation is subject to a series of market failures, which, in the absence of public policies, can lead to lower investment levels in innovation than is socially desirable. In developing countries, such as Brazil, these market failures are even more frequent and more consequential than in developed ones.

First, the risk associated with innovation projects is greater than for traditional investment projects, which makes market interest rates for these projects higher. In Brazil, the economic risks directly associated with innovation are deepened by political, macroeconomic, and social uncertainties. Therefore, the costs of investing in innovation are even higher than in developed countries. In addition, although the interest rate has been falling in the last few years, in recent decades, Brazil has maintained higher interest rates than the rest of the world, which also negatively affects the willingness of the business leaders to invest and take the risk of innovative projects.

Second, a relevant source of market failures for innovation is the asymmetry of information between an investor and the inventor, who often has the best information about the probability of success of their innovation. Given that investors find it more difficult to differentiate good innovation projects from bad, they would tend to invest in those with less risk and to charge everyone a higher interest rate. In other words, asymmetry of information increases the cost of investing in innovation, especially in a country where the cost of capital is already high.

These market failures mean that the banking system tends to be less likely to finance innovation projects. In addition, banks often require hard-to-find guarantees for innovative new companies, who then must become dependent on other sources of public or private funding, such as own capital or venture capital funds.

Another aspect of investment in innovation is that it is dependent on highly trained and qualified personnel. This type of professional is not easily found in the market, especially in countries like Brazil. According to the Global Innovation Index, Brazil had less than 900 researchers per million inhabitants in 2019—a number much lower than in more developed countries.[1] For this reason, even in times of economic crisis, companies would be hesitant to fire researchers. This makes the adjustments costs for R&D investments higher than those of traditional investments.

All of these reasons justify each state's role in stimulating—directly or indirectly—investments in R&D, especially in developing countries. This action has taken place in several ways besides the investments made by governments through budget allocations in science and technology. Tax incentives for innovation are used in several countries to reduce the cost of capital associated with innovation.[2] Public policies in several countries have also stimulated venture capital funds, which are generally aimed at young companies in sectors with high technological dynamism. Worldwide, grants and subsidized credit for innovative companies are also common instruments amongst the public policies for innovation. In addition, in some countries, technology procurement is also widely used to stimulate the development of new technologies that are of interest to specific sectors of government, such as health or defense.

Considering the importance of financing innovation, the Business Mobilization for Innovation (MEI), created and coordinated by the National Confederation of Industry—Brazil (CNI), has innovation financing as one focus for its agenda. The MEI brings together Brazilian business leaders, with the aim of bringing innovation to the center of business strategies and increasing the effectiveness of innovation policies in the country.

In the next sections, we discuss support and financing mechanisms for innovation in Brazil, the main challenges, and how the country can overcome these challenges. To a large extent, the diagnosis and suggestions presented here are part of the MEI's innovation financing agenda.

Support for innovation in Brazil

During the last few decades, Brazil has built a relatively broad system of support for innovation. Policies implemented in the country range from direct support to scientific research—carried out mainly by universities and public research institutes—to tax incentives and subsidized credit for innovative companies.[3] In health, for instance, Brazil has built a wide system of public research laboratories, such as the Oswaldo Cruz Foundation (Fiocruz), the Adolfo Lutz Institute, and the Butantan Institute, among others. This system has made Brazil an important center for epidemiological research, which has been critical in tackling the COVID-19 crisis.

Until the late 1990s, most of these policies did not exist. One of the main milestones in the policy for supporting and financing innovation in Brazil was the creation of Sectoral Funds in 1999, which directed specific taxes collected from various sectors to finance R&D activities in those sectors. For example, the government collects a specific tax on oil royalties to finance technological development in the oil sector. Other sectors, such as health, biotechnology, mining, aeronautics, and others, are also taxed. The levy, collected by the Ministry of Science, Technology, Innovation and Communications, must be used to fund R&D projects in these sectors. In 2004, the country approved the Innovation Law, which allowed, for the first time, the Brazilian State to grant subsidies directly to innovative companies. In addition, the law allowed companies to contract research projects from universities and public research institutes, regulating, among other things, the intellectual property derived from these contracts.[4] In 2006, the Brazilian Congress approved the so-called *Lei do Bem* (Law of Good), which, along with incentives for production, instituted a simplified system of tax incentives for companies investing in R&D. In 2013, the Brazilian Innovation Agency (Finep) launched a broad subsidized credit program for innovation, operated jointly by Finep and the National Bank for Economic and Social Development (BNDES). Finally, in 2014, the Brazilian Company for Industrial Research and Innovation (Embrapii) was created. Embrapii is an innovation agency inspired by the successful model of the German Foundation Fraunhofer, in which technological projects of interest to companies and performed by accredited research institutions can receive public subsidies worth up to a third of their total costs. Although it has a relatively small budget, Embrapii is an innovative model in the group of institutions supporting R&D in the country. The National Service of Industrial Training (SENAI) Innovation Institutes have participated in this initiative from the very beginning: 8 of the 42 research institutes accredited by EMBRAPII are from SENAI.

Brazil also establishes investment obligations in R&D for companies operating in regulated sectors, particularly in the oil and electricity sectors. Although the companies invest these resources, the R&D programs are under the supervision of their respective regulatory agencies: the National Petroleum Agency (ANP) and the Brazilian Electricity Regulatory Agency (ANEEL).

Table 10.1 details the volume of resources available in the main public instruments for supporting innovation in the country.

In 2018, the innovation credit programs of BNDES and Finep disbursed around US$2 billion worth of new contracts. Subsidized credit resources for innovation in Brazil have grown significantly since 2010, when they were around US$1.8 billion, to a peak of US$4.6 billion in 2014. Much of this growth was due to Finep, which tripled its disbursements for innovation over the same period. In the same year, the total disbursements of BNDES reached US$108 billion, which means that innovation represented around 4% of the total credit provided by the bank. In fact, the volume destined for innovation never represented more than 4% or 5% of the total subsidized credit disbursed by BNDES every year. The largest portion of BNDES credit has been directed towards activities other than innovation, such as investments in infrastructure and the expansion of productive capacity in the automotive and food industries, among others.

As for results, there has been evidence of the positive impacts of subsidized credit on companies' investments in innovation.[5] Although few, these studies found an increase in investments in the R&D of companies benefiting from innovation credit programs, both from Finep and BNDES. In other words, the studies found no evidence of the *crowding out effect*— where public sector spending reduces or eliminates private sector spending—on companies' technological efforts. However, they have not considered the amount of credit received by firms in their estimations.

The Ministry of Economy estimates that tax incentives for research, development, and innovation reached US$5 billion in 2018. The greatest share is provided by the Informatics Law, created in the early 1990s to stimulate the sector. It establishes a reduction in the Industrial Production Tax (IPI) for companies that comply with local content requirements and that invest in R&D. This incentive represented around US$2.8 billion in tax

TABLE 10.1

Resources applied in the main programs and policies to support innovation in Brazil, 2018 figures unless otherwise specified (in US$ millions)

Program/Policy	Funding agency	Resources available (US$ millions PPP)
Subsidized credit	BNDES	889
	FINEP	1,200
	Total	2,089
Tax breaks for innovation	"Lei do Bem" (Law of Good)	1,052
	Informatics Law	2,837
	Other tax incentives	1,151
	Total	5,040
Mandatory R&D investments	ANEEL	432
	ANP	996
	Total	1,428
Government budget allocations for R&D (excluding general university funds)	Central government	6,786
	States	1,819
	Total	8,605

Sources: BNDES Annual Report (2018); FINEP Financial Report (2018); National Indicators for S&T/Ministry of S&T, Innovation and Communications; National Petroleum Agency (ANP); and Brazilian Electricity Regulatory Agency (ANEEL).
Note: The Purchase Power Parity—PPP conversion factor was used to convert to US dollars based on 2017 World Bank data.

breaks in 2018. The second most important fiscal incentive was established by the Lei do Bem, which provides a deduction in the income tax of companies that invest in R&D projects and represents a tax expense of about $1 billion in 2018.

In the case of the Lei do Bem, the literature shows that tax exemptions have stimulated private investments in innovation. The observed increase in R&D investments in companies that received tax incentives ranges from 7 to 11 percent in one study,[6] depending on the control variables used in the estimations, and more than 17% in another.[7] Positive effects on productivity and the employment of highly qualified personnel have also been identified.[8] Certainly, it is possible to improve the design of this incentive. An example of improvement would be to focus the incentive primarily on additional R&D investment and not on the total R&D performed by companies, as it is today. There are also unresolved oversight issues, which bring legal uncertainty to companies that use these incentives.

The incentive with the greatest tax exemption for innovation in the country, however, is the Informatics Law. Yet, there are several studies pointing out the reduced effects of this incentive in increasing companies' productivity or even their R&D investments.[9] It is important to note that, although the law provides for investment in R&D, it has several other objectives, including minimum levels of local content. Hence, one of the biggest bottlenecks of this law is the linking of incentives to local content requirements that are rigid, bureaucratic, and difficult to implement.

Regarding tax incentives, in 2018, the volume of exemptions in the Brazilian economy reached almost US$140 billion, or 3.97% of GDP. Of this amount, only 3.6% were exemptions for investments in science, technology, and innovation. Assessing the impact—both negative and positive—of all of these exemptions is essential to build more effective and evidence-based public policies and to select which ones have the best cost-benefit ratio for the Brazilian economy.

Finally, an important gap in financing innovation in Brazil is the quasi-absence of venture capital funds. In the country, these funds represent only 0.01% of GDP, according to the Brazilian Private Equity and Venture Capital Association, compared to between 0.3% and 0.4% in countries like the United States or Israel.[10] According to the Global Innovation Index, Brazil ranks 61st in venture capital deals, making this a weakness of the country. In fact, venture capital represents less than 10 percent of total investment funds—including both private equity and venture capital—in the country. Despite this, according to Anjos do Brasil—an association whose objective is to promote the growth of angel investments in the country—there are more than 7,000 angel investors in the country, who invested about US$400 million in 2016, which is still a small amount for the size of the Brazilian economy.

There are some public initiatives for venture capital investment funds as well, at both Finep and BNDES, but they are still incipient. For example, from the early 2000s—when FINEP started to invest in VC funds—to December 2018, Finep had made investments of only about US$230 million.

To help Brazilian entrepreneurs find the best public or private instruments to support their innovation projects, Entrepreneurial Mobilization of Innovation has created a tool called MEI Tools.[11] MEI Tools is a periodic publication that summarizes all the innovation support programs available in the country, at various levels, including initiatives from the private sector. One of these programs is the *Edital de Inovação para a Indústria* (Innovation Call for Industry), an initiative of SENAI and Social Service of Industry (SESI) aimed at financing the development of innovative solutions and increasing the productivity of Brazilian industrial firms. Since it was created in 2004, over 1,150 innovative projects have been supported by this initiative, and more than US$134 million has been invested. This initiative is the only support mechanism for innovative projects at a national level that has remained continuous over the past 16 years. In its 16th edition, the Innovation Call for Industry made available more than US$20 million across different categories of projects, including new calls that allocated US$6 million for solutions to problems generated by the coronavirus disease (COVID-19) pandemic.[12]

Trends in the federal budget for R&D

In the last few years, Brazil has faced a serious fiscal crisis, which has adversely impacted the public budget across many areas. Although necessary, the effort to contain public spending growth may have lasting impacts on the capacity of scientific and technological production in the Brazilian economy, causing unwanted effects on the country's growth.

Incidentally, the contingencies proposed by the federal government have roused the concern of research institutions and companies regarding the future of science and technology (S&T) in Brazil. In July 2019, the National Council for Scientific and Technological Development (CNPq) announced the suspension of an open call for graduate scholarships in the second semester. Three months earlier, CNPq had announced that thousands of researchers could go without their stipends starting in October because the budget available for the Institution would not be enough to reach the end of the year.

Within the federal R&D budget, the primary funding sources supporting research are the CNPq and the National Fund for Scientific and Technological Development (FNDCT). The CNPq provides scholarships for undergraduate students, graduate students, and researchers. The CNPq also provides grants for research projects in Brazilian universities and research institutions. The FNDCT is the main source of funds for supporting research projects in universities, research institutions, and companies.

The budget allocations for these two funds have been sharply reduced over recent years. The FNDCT, which had a budget of nearly US$1.3 billion in 2010, ended 2018 with a budget of less than US$400 million.[13] This represents a drop of more than 70% in the resources for research projects in Brazilian companies and research institutions. The same happened with the CNPq. In 2019, the approximate budget of US$300 million was half of the budget in 2013 (Figure 10.1).

This sharp drop in the federal budget for R&D means that the total volume of federal resources to support R&D in the country is currently lower than it was in the early 2000s, when several of the innovation support funds had not yet been created. The consequence is that there are virtually no public resources available to support the development of new technologies in companies or research institutions across the country, aside from credit.

Another substantial result of this shortage is brain drain. Several Brazilian researchers and scientists are looking for professional opportunities outside the country due to the lack of opportunities in Brazil. Evidence of the difficulties faced by Brazilian researchers is that the country is losing positions in all components of the Global Talent Competitiveness Index—mainly in attracting and retaining talent. The country ranked 33rd in the capacity to attract talent in 2014 and moved to 96th in 2020. In a country where the number of scientists and researchers is still low compared to other countries, this loss of qualified personnel could impact the country's ability to innovate and compete in the long run.

Challenges and opportunities for improvement

The high cost of capital and the risks associated with innovation limit companies' willingness to invest in R&D and innovation. To mitigate this impact, it is necessary to build a broad, effective, and well-structured framework of public policies for supporting R&D activities.

In this sense, a fundamental issue is how to guarantee the stability of the resources available for research in the country. R&D is a long-term effort subject to a series of uncertainties. Therefore, it is necessary to provide some predictability for the availability of funding sources to guarantee the continuity of these efforts and to produce significant results. The public sector has a fundamental role in assuring this predictability.

Brazil still has a long way to go to build stable policies capable of surviving government changes. While this is constantly being improved, more recent credit policies for innovation are an

FIGURE 10.1

Government budget allocations for the primary funds supporting S&T in Brazil: The National Fund for Scientific and Technological Development (FNDCT) and the National Council for Scientific and Technological Development (CNPq), 2000–2019

Source: Integrated System of Planning and Budget (Siop).
Notes: Available from: <https://bit.ly/2OwIOA8>. Accessed February 1, 2020. The PPP conversion factor was used to convert to US dollars based on World Bank data.

example of discontinuity. After accelerated growth between 2010 and 2014, credit policies have suffered a sharp reduction in recent years. The same happened to the resources allocated directly by the public sector for R&D. The sharp drop in S&T budgets observed in recent years puts the efforts made in the previous period at risk, given that the research infrastructure previously established requires constant maintenance and investments.

Tax incentives contribute to reducing the cost of capital and the risk of business investments in innovation activities. Although now more stable and predictable in the country, these incentives can still be improved to amplify their results. For this, it is essential to create permanent evaluation mechanisms that highlight necessary improvements. The continuity and expansion of the incentives provided by Lei do Bem is critical to guaranteeing the legal security of R&D investments in the country, even in a time of fiscal crisis.

Worldwide, credit has been increasingly used to support incremental innovation activities. The maintenance of financing lines for this type of innovation could contribute to a complete framework for financing innovation in Brazil.

However, it is also necessary to move forward in designing other mechanisms. Stimulating venture capital markets, for instance, is one way to facilitate the funding of disruptive technologies. Several legal and regulatory barriers to the complete development of the venture capital market in Brazil remain:

1) inadequate taxation, which does not take into account the complete portfolio of the investor;
2) the absence of tax incentives for venture capitalists;
3) lack of regulation for entrepreneurial capital;
4) the extensive time required to open and close a company and to change its organization; and
5) the investor's responsibility for the debts of the start-up.

The investor's responsibility in the new business was the subject of legislation for angel investors (Complementary Law n. 155) in 2016. However, in addition to other improvements, there is still a need to improve investment exit mechanisms, such as the development of secondary markets.

Another way to stimulate this market is to exempt from taxation the capital yields obtained by venture capital funds investing in start-ups. Finally, it is also possible to expand mechanisms for public co-investment in private venture capital funds, in order to share the risk and to stimulate technologies that meet the country's priorities.

The constant and open debate about the virtues and problems of the various mechanisms for funding innovation is critical. However, it is necessary that these mechanisms are considered as state policies and that the necessary improvements are based on effectiveness and evidence.

Notes:

1 Similarly, Brazil ranks 53rd for this data indicator in the GII, making it their lowest R&D-related GII indicator.

2 Kerr et al., 2015.

3 A broad analysis about innovation policies in Brazil over the last period can be found in De Negri et al., 2018 and in CNI, 2018.

4 In this regard, the Brazilian Innovation Law is similar to the Bay-Dole Act in the United States.

5 Rauen et al., 2018; Machado et al., 2017.

6 Kannebley et al., 2012.

7 Zucoloto et al., 2017.

8 Shimada et al., 2014; Zucoloto et al., 2017.

9 Salles Filho et al., 2012; Ribeiro et al., 2011; Kannebley et al., 2012.

10 According to the Organization for the Economic Cooperation and Development (OECD).

11 Available from http://www.portaldaindustria.com.br/cni/canais/mei/biblioteca/publicacoes/.

12 More information on the categories of projects supported by the 16th edition of the Innovation Call for Industry can be found at http://www.portaldaindustria.com.br/senai/canais/edital-de-inovacao-para-industria/

13 De Negri, 2019.

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CHAPTER 11

FINANCING INNOVATION IN INDIA: CHALLENGES AND OPPORTUNITIES

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India made significant progress in the last decade in building the country's innovation ecosystem. With around 50,000 start-ups, it is today the third-largest start-up economy, after the United States of America (U.S.) and the United Kingdom (U.K.). As per the Global Innovation Index (GII) in 2019, India was placed at the 52nd position, improving its ranking from the 57th position in 2018.[1] It is of interest to note that, according to StartupBlink, a Zurich-based global start-up ecosystem map and research center, India ranked 17th globally among 100 countries in 2019, based on the strength of its start-up ecosystem, having moved up 20 notches from the 37th rank in 2018.[2] The GII ranking is based on a set of 80 indicators classified into the Innovation Input Sub-Index, which has five innovation measures—Institutions, Human capital and research, Infrastructure, Market sophistication, and Business sophistication—and the Innovation Output Sub-Index, which is measured by Knowledge and technology outputs and Creative outputs. The Start-up Ecosystem ranking, on the other hand, focuses on innovation outputs and is derived from the number and quality of start-ups in a country and the business environment.

Performance of the Start-up Ecosystem of the top 100 countries was found to have a significant positive correlation with GII innovation rankings, as shown in Figure 11.1. A similar trend was noted in the innovation input to output performance in the GII 2019 report.[3] Higher investments in research and development (R&D) and innovation infrastructure tend to result in more robust start-up ecosystems.

India, marked in blue in Figure 11.1, seems to beat the trend. In spite of inadequate investment in public R&D and innovation infrastructure, the country is the 3rd largest start-up economy.

In StartupBlink's 2019 ranking of the most entrepreneurial cities, six Indian cities made it to the top 100. Bengaluru was ranked the top start-up city in India at the 11th position globally, while New Delhi and Mumbai followed in the 18th and 29th spots, respectively. Chennai, Hyderabad, and Pune also made it to the top 100. As per the GII Innovation cluster/ city ranking in 2019, Bengaluru was placed in the 65th position, followed by Delhi at 70th and Mumbai at 97th.

While the end goal of the two ranking exercises is similar, the approaches are different. The first is built around innovation, with investment in R&D and associated needs as the engine of growth and development, and the latter is built on entrepreneurship as the driver of wealth creation. Hence, it is natural that the outcomes would not match perfectly. Comparing the two reports, however, compels one to go beyond the conventional measures and take a closer look at the various means of innovation financing. The following sections discuss the role played by governmental agencies, venture capitalists (VCs), and other ecosystem enablers in promoting and funding innovation in India.

FIGURE 11.1

Innovation and start-up performance by country, 2019

▲ StartupBlink rankings, 2019
▶ GII rankings, 2019

Sources: Author's analysis based on data from GII 2019 and StartupBlink website; Cornell et al., 2019; StartupBlink, 2019.

Public expenditure in R&D

Investment in research and development is not only critical to the growth of the Indian economy, but to the security, health, and well-being of its people, as became apparent in the wake of the coronavirus disease (COVID-19) pandemic.

India's investment in R&D has decreased over the last decade from 0.85% of GDP in 2008–2009 to remain stagnant at around 0.7% for the last several years. This is significantly lower than the top five R&D spenders globally in 2017—4.3% for the Republic of Korea, 4.2% for Israel, 3.3% for Japan, and 3.2% for both Switzerland and Finland—and lower than the R&D investments of other BRIC countries, which include Brazil, Russia, India, and China.[4]

Gross domestic expenditure on research and development (GERD) in India increased to US$63.2 billion in purchasing power parity (PPP) terms in 2017–2018 from US$50.3 billion PPP in 2014–2015 and accounted for 2.9% share in world GERD during 2017–18. GERD in India is mainly driven by the government sector, of which 45.4% is the Central Government, 6.4% state governments, 6.8% higher education, and 41.4% industry—with 4.6% from public sector industry and 36.8% from private sector industry during 2017–18.[5] Figure 11.2 captures the share of industry investment in India's GERD over the last decade.

Twelve major scientific agencies accounted for 99.8% of the R&D expenditure incurred by the Central Government in 2017-18. Of this, 61.4% was spent on R&D in defense, atomic energy, and space, while the remainder was allocated as follows: 11.1% to the Indian Council of Agricultural Research (ICAR), 9.5% to the Council of Science & Industrial Research (CSIR), 7.3% to the Department of Science & Technology (DST), 3.7% to the Department of Biotechnology (DBT), 3.1% to the Indian Council of Medical Research (ICMR), and 3.7% to the Ministry of Earth Sciences, Ministry of Electronics and Information Technology, Ministry of Environment, Forest and Climate Change, and Ministry of New & Renewable Energy.

Several of these agencies undertake market-facing initiatives, developing technologies that are commercialized. The Technology Development Board (TDB) was set up within DST in 1995 to provide focused attention on commercialization of indigenous technologies. TDB is funded from the R&D tax collected by the government, until fiscal year 2016–2017, from industry on imports of technology, and provides financial assistance as soft debt or equity to small and medium-sized enterprises (SMEs) and start-ups for technology commercialization. TDB has also supported 11 venture capital funds with a total commitment of US$38 million, leveraging total funds aggregating to over US$350 million.

Low investment in R&D and translation capability and lack of investments of private players in innovation are major contributors to suboptimal innovation outcomes. India aspires to invest 2% of GDP in R&D by 2022. This would not only require a very substantial budget allocation for R&D investment by the government but also increased contribution in R&D from industry so that the percentage of industry contribution is raised to at least 60% from the current 41%. In most developing and developed countries, industry's contribution to GERD is over 50%. Whether this would be feasible in the post-COVID scenario is too early to say.

Promoting an innovation culture

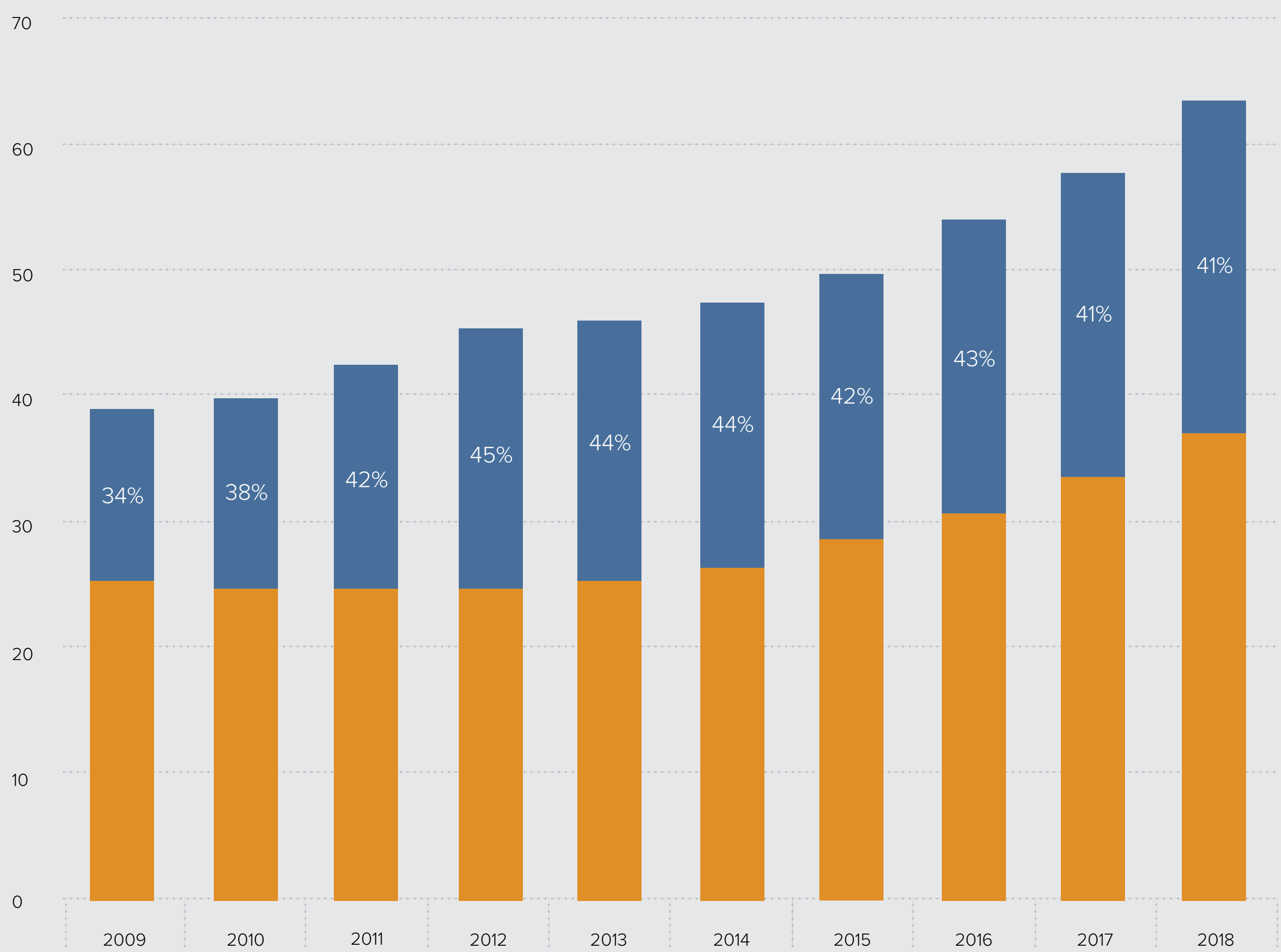
The National Science & Technology Entrepreneurship Development Board (NSTEDB) was established in 1982 by the Government of India under the aegis of the DST to promote knowledge-driven, technology-based companies. It was NSTEDB that spearheaded the science and technology parks and incubators movement in the country and established technology business incubators in academic institutions and as private non-profit companies. This was subsequently adopted by several other ministries and departments under the Central Government, including the Ministry of Electronics and Information Technology and the Ministry of Micro, Small and Medium Enterprises, as well as several state governments.

The Biotechnology Industry Research Assistance Council (BIRAC) was set up by DBT, Government of India in 2012 as an industry-academia interface agency to strengthen and empower the emerging life sciences sector and support relevant innovations. The Atal Innovation Mission (AIM) initiative by the National Institution for Transforming India, NITI Aayog (Hindi for Policy Commission) was set up in 2016 as the government's flagship initiative to promote a culture of innovation and entrepreneurship in the country for different sectors of the economy and across stakeholders—from school students to industry.

Today there are over 500 incubators in the country set up by these government agencies to nurture start-ups and build the innovation ecosystem. The agencies partner with these incubators to offer tailored grants, soft loans, and equity-linked investments to fund innovations right from the idea stage to commercialization. These government grants play a crucial role in sustaining start-ups during their establishment phase and at least partially absorbing the technology risk. The Biotechnology Ignition Grant (BIG) scheme of BIRAC, for example, provides up to US$67,000 to life sciences and healthcare start-ups to establish the proof of concept for their ideas. BIG has supported over 400 start-ups and innovators in the last five years and encouraged thousands of researchers and individuals to pursue an entrepreneurial dream. Successful BIG grantees typically go on to raise follow-on grant or equity funding from BIRAC and other agencies, and this has proven to be one of the most impactful idea stage grants for the life science sector. NSTEDB's National Initiative for Developing and Harnessing Innovation program, PRomoting and Accelerating Young and ASpiring innovators & start-ups (NIDHI-PRAYAS), addresses the funding gap between idea to prototype. It has been hugely successful in supporting a large number of pre- and early-incubation ideas at incubators with fab labs and prototyping workshops.

FIGURE 11.2

Industry's share in GERD



▲ GERD in US$ billion
▶ Year

■ Industry investment, US$ billion
■ Public investment, US$ billion
% Industry Investment, % of GERD

Sources: Author's analysis based on GERD data from Research and Development Statistics at a Glance, 2019–20; DST, 2020; The World Bank, 2020.

The other grant instrument that has become popular with funding agencies is challenge grants, including Grand Challenges, that fund innovative solutions aimed at specific problems or challenges. Grand Challenges India, funded jointly by the Bill & Melinda Gates Foundation and DBT, and implemented by BIRAC, has spawned a large number of entrepreneurs working on healthcare solutions for the poor. NSTEDB has co-created and co-funded several large-scale innovative challenge programs in partnership with industry bodies and corporates. Some of the flagship programs that have generated tens of thousands of ideas include the Global Innovation Technology Alliance (GITA) in partnership with the Confederation of Indian Industries (CII), Power of Ideas with the Economic Times, and the India Innovation Growth Program in partnership with Lockheed Martin and Tata Trust. AIM funds Grand Challenges to scale and deploy solutions in partnership with several line ministries. State governments have started conducting challenge grants to seek solutions from start-ups, innovators, and individuals to solve local problems.

These funding initiatives have been catalytic in developing a robust pool of technology-driven entrepreneurs and innovators across various domains in the country. While only the most innovative and impactful ideas emerge and receive funding through the tiered selection process of these competitions, a culture of ideation and entrepreneurial aspiration is built during the process that percolates well beyond the recognized clusters of innovation.

Boosting investments through enabling policies

A reason for the low levels of innovation in a developing economy is the lack of incentives for private players to invest in innovation. Many fear that the benefits of their innovations will be shared by free riders who have not invested in the product innovation and development process. With state regulations and a robust intellectual property regime in place, these concerns have been addressed.

Concerted efforts of multiple government departments, notably the Department for Promotion of Industry & Internal Trade (DPIIT) under the Ministry of Commerce and Industry, Government of India, NITI Aayog, DST, and DBT have been instrumental in framing the policies and regulations for start-up investments. These are largely around innovation funding, tax rebate on R&D, innovation infrastructure and incubation, tax incentives to promote entrepreneurs, waivers of patent filing fees, and initiatives around ease of doing business. The government is also putting in place a wide range of policy reforms around public procurement rules for start-ups and micro, small, and medium-sized enterprises (MSMEs). It is time that the government evolves as a sophisticated consumer of innovation, including directly buying from start-ups.

One of the enabling policy interventions that is expected to boost funding of social entrepreneurs is built around unlocking the Corporate Social Responsibility (CSR) fund for innovation financing. In India, it is mandatory for a particular class of profitable companies to contribute 2% of their annual profits for social activities, through a dedicated procedure prescribed by the CSR rules and regulations. The section on CSR in the Indian Companies Act 2013 was amended in 2019 to include contributions to incubators and research projects in publicly funded universities, Indian Institutes of Technology (IITs), and national laboratories eligible for CSR funding.

The Government of India launched a US$1.5 billion fund of funds for start-ups in 2016. The Small Industries Development Bank of India (SIDBI), as the Fund Manager, was entrusted with allocating contributions to various venture capital funds (alternative investment funds). The process, however, has been slow, and so far only approximately US$100 million has been disbursed. Government needs to hasten the deployment of the fund.

The other significant thrust is on focused investments in innovation infrastructure, including setting up regional tech transfer offices, biotech and medical technology parks, research parks in engineering college campuses, and centers of excellence in specific areas for technology development and commercialization.

AIM launched an innovation mapping exercise in 2018 and created the India Innovation Index as a tool to analyze and enhance the status of innovation at the state level, ranking the states on various input and output innovation parameters.[6] This index offers an opportunity for states to analyze their absolute performance as well as relative performance to their peers at a similar level of income. This would enable local governments to frame policies that would boost regional efforts, thus contributing to building a nationwide innovation ecosystem.

Private capital for funding growth

India has started to witness rapid scale-up stories, large investment rounds driven by global venture capital firms, creation of unicorns in user-driven innovations, and a growing user community responding to and adopting innovations. Indian start-ups received a total of US$58 billion over the last five years from 2014–2019 across 5,011 deals.[7] In 2019, the total funding raised across 766 deals was US$12.7 billion. The major share of investments was understandably in late-stage start-ups dominated by global VCs.

There were over 280 domestic investors in the country in 2017, around 150 of them being angel investors, 95 VCs, 15–20 corporations, 5–10 accelerators, and over 220 foreign investors.[8] While Bengaluru, Delhi, and Mumbai are the clear winners as start-up destinations, 21 other cities have emerged as start-up hubs. The ecosystem is maturing with successful Indian entrepreneurs investing in start-ups. There is, however, a trend of start-ups moving to more mature global hubs in search of larger investments, markets, and mentoring. The policy environment, if made more transparent, predictable, and enforceable, could help attract more capital—including more domestic capital—into innovation activities in the country.

Leapfrogging with ecosystem enablers

Following the growth in the innovation ecosystem, the country is witnessing the emergence of a set of new age infrastructures, the "innovation commons". These innovation commons are developed and evangelized with time, energy, and intellectual resources from groups of volunteers who take it on themselves to build these platforms as digital or cyber-physical highways for everyone to access—and then build their innovations on top of these layers. A case in point is India Stack, a set of application programming interfaces (APIs) that allows governments, businesses, start-ups, and developers to utilize a unique digital infrastructure to solve India's grand challenge of digital and financial inclusion, through a movement towards "presence-less, paperless, and cashless service delivery".[9] India Stack, which includes the open API infrastructure of the Unified Payment Interface (UPI) platform that is used by banks for digital payments, has been developed by volunteers from iSPIRT, a think tank with the mission to make India a "product nation". Another platform, called the National Health Stack, is being developed to serve as the digital backbone for transforming the country's health systems.

This can only happen when the innovation system has a critical mass of expert ecosystem enablers wanting to give back to the society and rally to build solutions that could not possibly be accomplished by one institution or one company. This also cannot happen without academic excellence and the culture of innovation taking root and producing a critical mass of young and effective minds wanting to solve the hard problems. India seems to have reached the take-off point and, with the right policies in place, can get into the league of the top ten most innovative countries in the next five years. While we plan to leapfrog, one has to remember that the cumulative investment by these enablers into the innovation commons will be significant and should somehow be captured in the calculations on innovation financing.

An opportunity to rebuild the innovation ecosystem

The government has set a target of increasing the investment in R&D to 2% of GDP by 2022. Whether this would be feasible in the post-COVID scenario is too early to say. While one would expect the expenditure targets to get revised in the short term, R&D spending in specific domains like biopharmaceuticals, vaccines, biosecurity, One Health, digital health, and data science are expected to increase significantly both in the public and private sectors. Investments have to be made in areas where there are gaps in research capability and capacity. A lot more emphasis would also be expected on developing manufacturing capabilities of priority drugs and diagnostics across the value chain. This is not to imply that the existing strategies for funding innovations around the Sustainable Development Goals (SDGs) or developing deep science-based innovation capabilities will not be pursued. It will be imperative to fund all of the above in order to be an innovation-led economy.

The pandemic has clearly demonstrated the existence of a wide network of vibrant and agile innovation communities in the country. Start-ups and individuals were found to rise to the occasion to pivot and build COVID-relevant solutions. It is heartening to notice a surge in the number of ecosystem enabler groups from different streams of academia, industry, industry associations, and other networks collaborating to jointly develop platforms to combat the COVID-19 pandemic. There is also a significant rise in the number of strategic investments by Indian corporations into start-ups. The government needs to actively foster and finance these collaborations so that the ecosystem does not go back to its old normal of viewing others as competitors rather than collaborators once the pandemic recedes.

Notes:

1 Cornell et al., 2019.

2 StartupBlink, 2019.

3 Cornell et al., 2019.

4 EAC-PM, 2019.

5 DST, 2020.

6 NITI Aayog, 2019.

7 Data Labs by Inc42, 2019.

8 NASSCOM, 2017.

9 iSPIRT, 2015.

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CHAPTER 12

ISRAEL'S CHALLENGING TRANSFORMATION FROM START-UP NATION TO SCALE-UP NATION

Yaron Daniely, aMoon Venture Fund

Few people in the fields of business and technology today are unaware of Israel's reputation as a world leader in innovation and entrepreneurship. The 2009 New York Times Best Seller *Start-up Nation* put Israel on the map as a force to be reckoned with for the disproportionate number of start-ups churned out by a country that is barely the size of New Jersey. Israel consistently appears at the top of international rankings and reports, such as the World Intellectual Property Organization (WIPO) Global Innovation Index (GII) and the World Economic Forum (WEF) Global Competitiveness Report.

With more start-ups per capita than any other country,[1] Israel is second only to Silicon Valley in its level of innovation, with a ratio of 1 start-up per 1,400 people. This tiny nation, whose name doesn't even fit within its borders on most world maps, is also home to the highest number of engineers per capita and boasts the world's second-highest research and development (R&D) expenditure rate.[2] Indeed, this places Israel first across several indicators in the 2019 Global Innovation Index, in terms of researchers per million population, gross R&D expenditure as a percent of gross domestic product (GDP), and research talent in business enterprises.

Israel enjoys an unusual richness of risk capital, ranking second in the world for venture capital (VC) availability.[3] Initially spurred and continuously supported by public resources, this prevalence of risk capital has received a boost from the recent establishment of hundreds of local R&D centers by multinational corporations (MNCs), such as Facebook, Google, Amazon, and others that seek to benefit from the profusion of technological innovation that Israeli entrepreneurs are generating. As one of the first countries in the world to allow the creation of university technology transfer organizations over 60 years ago,[4] Israel continues to make strides in academia-spurred products and services,[5] with two of its largest recent exits—Mobileye's acquisition by Intel and Mazor's acquisition by Medtronic—originating in university technologies.

As Warren Buffet put it, "If you're going to the Middle East to look for oil, you can skip Israel. If you're looking for brains, look no further. Israel has shown that it has a disproportionate amount of brains and energy."[6]

I and many other Israelis relish these figures and are proud of the innovative ecosystem our country has fostered, against all imaginable odds. Yet, often overlooked given this glowing data is a less fortunate fact: while we have excelled at launching game-changing start-ups and life-changing technologies, we have struggled to produce well-known multinational corporations. As far as large industry-leading global companies go, Israel has few. Those that have risen to the top of their fields, including Teva Pharmaceuticals and Check Point Software Technologies, locally employ less than 10,000 people put together. And with the recent challenges that Teva has encountered, Check Point is the only Israeli tech company to appear on Forbes' Global 2000 list, which ranks the world's 2,000 largest publicly traded companies.[7] In contrast, Israel is the third most-represented country on NASDAQ in terms of the number of companies listed.[8]

For a highly innovative country that is rich with venture capital and entrepreneurial culture, this lack of industrial maturation has become a mystery to many. Is it a result of a purposeful strategic focus on early-stage innovation? Or perhaps the inevitable and uninvited outcome of an unbalanced public policy? As it continues to be a role model for aspiring innovation economies around the world, Israel must solve this conundrum to leverage its innovation ecosystem into a sustainable scaled economy for the benefit of its people.

The challenge

The runaway success of many local start-ups has created what is known in Israel as an "exit culture" in which entrepreneurs begin their work not with the goal of building a global, publicly traded, industry-leading company, but a company that will be purchased as soon as possible by a much larger international company. Young Israelis—and their parents—no longer seek careers as doctors, lawyers, or academics, but more than any other profession, as "start-upists".[9]

Make no mistake: acquisitions of Israeli start-ups—such as Waze, Mobileye, Click, and countless others by companies like Intel, Google, and Salesforce—have added tremendous value to Israel's economy and global prestige. The financial value of Israeli high-tech exits over the past decade amounted to over US$70 billion,[10] which is equivalent to nearly 20% of the country's annual GDP. Advocates for this exit culture argue that the money flowing into Israel from these billion-dollar transactions serves as a growth engine for launching new early-stage companies, and for attracting multinational corporations to open or expand their R&D centers in Israel.

Yet there is an often-overlooked downside to this approach. In the long run, a private sector consisting entirely of small, technologically advanced companies chasing an exit is damaging for the Israeli economy because it exports the country's most valuable know-how and hinders the development of large local companies. This, in effect, suppresses the number of jobs available to Israelis within Israel and reduces the long-term tax payments necessary to fund the country's pressing security, health, education, and infrastructure needs,[11] which are only going to increase. Even more importantly, it benefits the few—the serial entrepreneurs with strong technological backgrounds and unique know-how—while leaving behind the vast majority of the population, who are largely precluded from direct engagement, development, and social mobility opportunities which these exits generate.

Some say that Israel's small population of just nine million people is to blame, and the domestic market simply isn't large enough to accommodate the growth and sustainability of industry-leading publicly traded companies. Some might add that geopolitical challenges make it hard for Israeli start-ups to grow into mature, independent companies and operate globally.

While these are significant hurdles to industry growth, they do not fully explain the general failure of Israel's private sector to scale and expand globally while keeping a robust innovation ecosystem. Half of the top-ranked innovative economies in the GII 2019 report have population sizes similar to, or smaller than, Israel. Yet, all of them—Switzerland, Sweden, Finland, Denmark, and Singapore—have produced numerous global corporations operating in a wide range of industry verticals, including pharmaceuticals, food, financial services, and mobility.

Geopolitics is not a good reason either—Israel has extensive trade and economic ties outside the Middle East, with warming ties to previously closed markets, even within the Middle East.

So what explains Israel's imbalanced industrial ecosystem? Why are other innovative economies successful at cultivating an entrepreneurial system while at the same time allowing scaled businesses to emerge? To what extent does financing play a role in the problem—and potentially its solution?

The "Catch-22" of multinational corporations

Riding the wave of technological innovation produced in this tiny country, over 500 multinational corporations have set up innovation centers in Israel to take advantage of the unparalleled local talent pool.[12] While this is to be celebrated and embraced, it is also part of the problem. While there is immense talent locally, it is immensely limited: the 2019 High-Tech Human Capital Report issued by Start-up Nation Central and the Israel Innovation Authority reported that high-tech workers represented 9.2% of the Israeli workforce in 2019.[13] The report further stated that MNCs employ a higher percentage of tech employees compared to local companies, and the average compensation per position by employers in MNCs is about 40% higher than by domestic companies. The unavoidable outcome is that these MNCs are winning the battle over this precious human resource.

When an Israeli student graduates with a degree in engineering or computer science and is given the choice of joining a growth-stage Israeli company or a brand-name MNC willing to pay a much higher starting salary, which offer do you think the graduate will take?

On the face of it, MNC R&D centers focus on generating new technologies and spurring innovation that delivers certain gains to the Israeli economy. But that's not the full story; this dominant presence and control of valuable Israeli talent and technology benefits, first and foremost, the MNCs themselves while delivering marginal benefits to Israeli innovation and industry growth. The tax payments that are derived from the local operations of these MNCs are only a fraction of the benefit that strong Israeli corporations would have generated if they were to emerge.

The role of financing

According to the GII 2019, Israel is surpassed only by Canada and the United States of America (U.S.) in terms of the availability of investment capital for new companies and start-ups. Yet this relative abundance of risk capital is misleading. Much of this funding is directed at the establishment and early phases of start-ups, and not to supporting the growth and maturation of these companies into global commercial organizations with a strong local footprint.

For such an advanced innovation ecosystem, Israel lacks multibillion-dollar funds that invest at the stage where a company can grow from selling one product overseas to becoming a large company employing thousands of Israeli workers. Even Israeli pension funds, for example, are more likely to invest in overseas real estate markets than they are to invest in a growth-stage Israeli company. This dearth of funding for growth-stage companies helps explain why entrepreneurs are so easily snatched up by MNCs, why so many promising start-ups fail to thrive, and why entrepreneurs choose to sell rather than scale their companies.

One of Israel's most well-known entrepreneurship initiatives involves the Israel Innovation Authority's Incubators Program—18 government-funded incubators with the mandate of awarding millions of dollars to promising start-ups.[14] These incubators are run by private investors who compete for the opportunity to manage the incubator over many years and access the rich flow of early-stage innovation in Israel while relying heavily on government funding. It is a promising and well-meaning effort, but the long-term impact of the program has been mixed. The initiative has fostered a few modest exits of early-stage companies, but few companies were able to take off successfully and secure additional funding beyond the short period allowed within the incubator. Many of these companies live and die in the incubator, and more than a few are closed despite showing significant technological promise.

Early-stage companies that are fortunate enough to receive funding from private resources may not benefit from those investments in the long term. For example, in 2018, nearly half of all funding going to Israeli start-ups was facilitated in part by corporate venture arms, also known as strategic investors.[15] While it is exciting and theoretically beneficial for young start-ups to evolve with that strategic support, it also limits their independence and the likelihood of growing to become strong market players before they are absorbed by the strategic investor—which often happens too soon and at a significant valuation discount. Even if the investment came from a non-corporate venture capital fund, of which Israel has many, the business model of virtually all venture funds requires near-term cash distribution to earn their investors a meaningful return on investment—which means another mad rush toward an exit.

The tendency of investors to push for acquisitions contributes to a myopic situation where a brilliant entrepreneur is less motivated to build a multibillion-dollar company in Israel. Instead, they can court Siemens or Facebook early in the company's life cycle, increase their chances of a huge exit, and call it a day.

The weakness of the Israeli stock market is another important limiting factor in this equation.[16] As long as the Tel Aviv Stock Exchange remains relatively illiquid and major domestic investors lack the tools to properly evaluate and invest in technology companies, public listings of tech companies in Israel will continue to be perceived as a last-ditch attempt to raise minimal capital—which backfires when valuation and lack of liquidity entomb the company. The valuation arbitrage of two similar companies traded on NASDAQ and TASE represents a major barrier to the growth of Israeli companies and industries.

During his tenure, the former chairman of the Israel Securities Exchange said it best: "There's a certain feeling that it's not worth doing business in Israel, and we have to change it."[17]

Solutions and policy recommendations

There are some positive signs that Israel's public and private sectors are becoming more aware of this predicament and are making moves toward improving the conditions for business growth. For example, in 2018, we saw—for the first time in Israel—a decrease in exits and an increase in investments.[18] This may be a promising sign that Israeli entrepreneurs are becoming less eager to sell their companies and more eager to grow. Yet, assuming much of these investments came from corporate or private venture groups, the push towards near-term exists will continue, and the exits will come sooner rather than later. Below are some suggested approaches to tackling the growth challenge, as well as some recommendations that may be broadly applicable for policymakers involved in directing financial resources within national economies.

Numerous economies around the world are attempting to enhance the innovation activities in their respective countries through the evaluation of new models and allocation of resources to specific initiatives. Based on the observations described above, it may be important to foster an environment in which innovators are not immediately drawn to the comforts of a job at an MNC or a quick exit. Public-private partnerships can, and should, lead efforts to provide financial security and support to enable budding entrepreneurs to take big risks and stick with them. Additional measures could include models for encouraging young companies to collaborate more closely with each other and even merge to create more stable and scalable businesses.

It is important to capture the significant benefits of having MNCs within a national economy. Incentives to lure MNCs are common; Israel and other countries have awarded them hefty tax incentives while offering MNCs access to unmatched talent and technologies.[19] In exchange for those tax benefits and access to precious human capital, local governments should encourage MNCs to support innovation within and for the benefit of the local ecosystem. Rather than merely "absorbing" innovation, these programs would see MNCs investing in external, independent innovation hubs that leverage resources and expertise brought by the MNC to build strong and scalable enterprises, without a commitment to be absorbed into the MNC or to serve its exclusive proprietary needs. A rising tide lifts all boats—with a more vibrant and independent innovation platform supported by MNCs, the ecosystem as a whole stands to benefit.

Regulators should also work to create attractive opportunities for experienced domestic and foreign growth players to engage with the innovation ecosystem. In a country where there are so many innovators, the fact that there are so few growth funds has been—and continues to be—a major roadblock. We need to think of structures that incentivize the introduction of more growth players to join the likes of aMoon, which is remarkably the only local growth fund in the health-tech space—a field in which Israel is a world leader.

For those skeptical about the importance and potential influence of public sector intervention in such matters, it may be useful to know that the robust Israeli venture capital industry we know today was actually created by a government-funded program. In 1993, the Israeli government launched the YOZMA group,[20] which used public funds to leverage financing from foreign corporations and institutions. This powerful and unprecedented initiative included equity guarantees for foreign investors, programs that linked Israeli firms with foreign business angels, and the listing of Israeli venture firms on foreign stock exchanges. YOZMA invested in Israeli start-ups and established numerous public-private funds. By the year 2000, it accomplished an amazing feat: the Israeli VC industry had reached the point where private sector investments eclipsed public sector investments—and the local VC industry has since taken off without looking back. The success of YOZMA could serve as a model for new government programs across the globe and should be entertained not only for early-stage, high-risk capital but for growth capital as well.

Finally, a robust stock exchange and its exposure to innovation is an important goal. The Tel Aviv Stock Exchange needs to become savvier, more liquid, and more robust. In some countries, if a company wants to grow, it can employ multiple mechanisms to raise public funds that aren't fully evolved in other countries, including Israel. Part of the problem is the scarcity of institutional investors playing major roles in the growth sector. Institutional investors shouldn't be the first in line to risk public capital on a field they don't fully understand, but it is up to regulators to catalyze their participation and make them more educated and comfortable with the specific challenges and value propositions of growth-stage companies. Even a small fraction of institutionally managed capital can dramatically shift the opportunity landscape.

Notes:

1 Yerman, 2019.

2 Deloitte, 2020.

3 WEF, 2018.

4 Leichman, 2018.

5 Yablonko, 2019.

6 Friedman, 2010.

7 Murphy et al., 2019.

8 Williams, 2018.

9 Shamah, 2013.

10 Solomon, 2019.

11 Halbfinger et al., 2020.

12 Mizroch, 2019.

13 Israel Innovation Authority, 2019.

14 Israel Innovation Authority, 2019.

15 Ravet, 2019.

16 Reuters, 2019.

17 Elis, 2015.

18 Solomon, 2018.

19 Solomon, 2016; EY, 2019.

20 OECD, 2003.

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CHAPTER 13

EQUITY GROUP—FINANCING INNOVATION IN KENYA

James Mwangi, Equity Group Holdings Plc

Equity Group Holdings is a Pan-African financial services group based in Nairobi, Kenya with Bank subsidiary operations in Kenya, Rwanda, Uganda, Tanzania, South Sudan, and the Democratic Republic of the Congo which now enjoys the position of the largest financial services and banking group in Eastern and Central Africa by market capitalization. The Group's operations include a fintech company, Finserve Africa; as well as a networked health care provider, Equity Afia. The Group's corporate foundation, Equity Group Foundation (EGF), has delivered humanitarian programs in Education and Leadership, Food and Agriculture, Social Protections and Safety Nets, Health, Clean Energy and the Environment, and Enterprise Development and Financial Inclusion to millions in the region.

Equity Group's Creating Shared Value (CSV), strategy provides triple bottom line socio-economic returns to society, the environment, and social development policies. Our programs and services are underpinned by technology, innovation, and synergy as a central means to launch, nurture, and scale up Africa's next generation of successful leaders and entrepreneurs delivered to all communities in which Equity has operations.

Equity Group finances innovation in Kenya directly and indirectly through debt financing, entrepreneurship education, retained earnings, and government financing. The African Guarantee Fund has noted that capital support is an integral part of actuating innovation in Kenya. Equity Group's vision for the future of innovation financing is to close the small and medium-sized enterprises (SME) financing gap in Africa, raise private and public gross domestic expenditure on research and development (GERD) as African economies shift from being primarily commodity-driven to innovation-driven economies, finance integration of African SMEs into global value chains to accelerate adoption of 4th Industrial Revolution technologies, and catalyze the development of industry clusters. Kenya has a vibrant and diversified private sector driven economy that embraces a start-up entrepreneurship culture and innovations such as mobile money. Key challenges such as weak intellectual property rights (IPRs) are overshadowed by the immense opportunities of innovations to tap into Africa's large and youthful population, rising middle class, rapid urbanization, and rapid leapfrogging in the adoption of mobile and Internet technologies. Developing countries can learn from Kenya's mobile money innovation ecosystem, the financing of innovations through financial inclusion, and adoption of free market policies that enable SMES to thrive.

Equity Group's biggest challenges and solutions for financing innovation in Kenya

The financing of innovation faces the challenge of low financial and entrepreneurial literacy among micro, small, and medium-sized enterprises (MSMEs). This trickles down into higher business failure rates and loan defaults as well as hinders the breadth and depth of financial products and services that MSMEs consume. Likewise, the informal setup of most MSMEs hinders the use of financial statements and records to compute credit scores for their businesses. The informal sector in Kenya is the largest employer and also a key driver of the economy. Many entrepreneurs and innovators lack collateral to give as securities for their loans. In addition, Kenya also has weak protection of innovators' intellectual property rights such as patents and trademarks. This has led to a lack of legal guidance on the use of IPRs as collateral for loans, which could be a big hindrance to debt financing of innovations. Finally, in the critical sector of agriculture in Africa, the biggest risk to financing agriculture innovations remains not credit but the unpredictable dangers of changes in weather.

Banking and financial services providers finance innovations through efficient capital allocation to businesses with the highest probability of 1) executing the most promising product, process, business model, and marketing innovations, 2) commercializing new technologies, and 3) shaping research and development by financing innovations.[1] To help address many of Africa's key challenges to innovation financing, Equity Group has launched a suite of products that support the innovation ecosystem.

Equity Group's primary conduit for financing innovation is debt financing to SMEs across all sectors of the economy. Deposits mobilized from households and firms are the key source of intermediate funds, with surpluses that amounted to US$4.82 billion in December 2019. The financing of SME ideas and aspirations comprised 59% of Equity Group's US$3.66 billion loan book, while large enterprises made up 13%. The Group maintains a deliberate strategy of aligning products for SMEs across the entire enterprise life cycle from micro start-ups to small, medium, and large enterprises—and eventually to multinationals. This has earned the Group a reputation as the leading incubator and funder of entrepreneurs in Kenya. Financing for SMEs who are integrated into the global value chains (GVCs) which drive export competitiveness in Kenya stood at 27% of the entire loan book being denominated in foreign currencies. This financing was mainly funded by foreign currency borrowings from development finance institutions (DFIs), such as the International Finance Corporation (IFC), European Investment Bank (EIB), KfW Group, and African Development Bank (AfDB), and stood at US$567 million in December 2019, while remittances from Africans in the diaspora grossed US$1.42 billion.

Entrepreneurs solve the most challenging socioeconomic problems of our times by offering creative and innovative solutions that can be piloted or scaled up. The United Nations Economic Commission for Europe has noted that innovative micro, small, and medium enterprises (MSMEs) profitably convert new ideas, technologies, inventions, and industry knowledge into new products, services, markets, processes, and organizations.[2] Low entrepreneurial skills have been linked to not only higher loan default risk and low innovation but also low survival rates of businesses. In 2018, the United States of America (U.S.) Small Business Administration (SBA) Office of Advocacy reported that only 50% of start-up businesses survive the five-year mark, and only 30% live to ten years.

Equity Group Foundation (EGF) nurtures entrepreneurs and innovators in Kenya to stimulate innovation and economic growth by training MSMEs on the entrepreneurship education curriculum provided by the International Labour Organization's (ILO) Start and Improve Your Business (SIYB) program. Since 2011, EGF has trained more than 52,000 MSMEs throughout the country, averaging over two new jobs created per trainee. EGF launched the Financial Knowledge for Africa (FiKA) program in partnership with MasterCard Foundation to deliver financial literacy training covering budgeting, savings, debt management, and financial services to over 2 million women and youths. The Financial Literacy and Entrepreneurship Education comprised 13% (US$53.5 Million) of Equity Group Foundation's US$411.6 million in cumulative social investment programs as of December 2019.

In the key sector of agriculture, Equity Group also helps MSMEs access financing through collateral substitute innovations, such as group social cohesion guarantees, the use of stock of goods for sale or quantity of agricultural produce, and cash flow based lending. It assists farmers in circumventing weather risk by financing the adoption of irrigation agriculture technologies such as greenhouses, drip or sprinkler irrigation, and farm inputs like high-yielding, drought-resistant cash and food crop varieties. The bank leverages a value chain model for agricultural financing by roping in partners on both the input and output side. Equity Insurance Agency has also developed innovative products with insurers, such as crop weather insurance and index-linked livestock insurance, to help farmers manage climate-related shocks.

Vision for the future of innovation financing

Equity Group seeks to replicate the success of championing financial inclusion innovations and MSME financing for innovation by reaching 100 million individuals and enterprises in 15 sub-Saharan African countries by 2024.

Equity is itself a serial innovator and a role model for SMEs. In the 1990s, Equity developed a savings-led, low-margin, high-volume business model that democratized access to finance and financial services for the majority of Kenyans. This model won the 2007 Global Vision Award as "initiator of concepts of the future that will change the world economy". In 2010, the Computer Society of Kenya declared Equity the Best in Mobile Technology Application. In 2012, African Banker Magazine declared Equity the Most Innovative Bank in Africa. Equity has consistently won the Best Bank in Agency Banking, Mobile Banking, and Internet Banking awards by Think Business. In the 2018 Banker East Africa awards, Equity Bank was named the Best Digital Offering in East Africa and Most Innovative Bank in Kenya. Equity is the only bank in Kenya that owns a Mobile Virtual Network Operator, Equitel, to provide itself with holistic mobile money and telecom infrastructure services. It is a front runner in open banking since the launch of the Jenga API suite, which allows software developers and SMEs to integrate themselves into the Group's ecosystem through a sandbox. Equity is a market leader in diaspora remittance processing due to integrations with financial technology (fintech) companies such as Wave, World Remit, and PayPal. These innovations are funded through retained earnings as the Group's dividends policy demands retention of 60% of profits after tax. Retained earnings as of December 2019 stood at US$897.15 million.

The role of governments in innovation financing is globally acknowledged. It includes supporting scientific research, formulating laws, building innovation institutes and public universities, creating budgetary incentives, enabling technology transfers, and protecting intellectual property rights. The Government of Kenya funds research and innovation by public universities through entities such as the Universities Funding Board and the National Research Fund. In addition, they fund research institutes, such as the Kenya Medical Research Institute, the Kenya Agricultural Research Institute, and the Kenya Industrial Research and Development Institute, which provide fiscal incentives to innovators and SMEs. This works alongside funding regulators like the Kenya Industrial Property Institute. Equity Group is a responsible corporate citizen that supports government financing of innovations by augmenting the government's fiscal deficit to the tune of US$1.72 billion in a treasury securities portfolio and corporate tax payments program that stood at US$89 million as at December 2019.

Measurable impact of innovation financing

Since 1994, when Equity turned around from an insolvent building society, the Group has been experiencing tenfold growth across all its parameters for success every five years (Table 13.1). The number of customers grew from 12,000 in 1994 to 13.9 million in September 2019, principally due to innovations to democratize access to finance. Today, the Bank enjoys a market share of over 50% of bank accounts in Kenya. This contributed heavily towards driving Kenya from merely 4% of the adult population banking in 1994 to a financial inclusion penetration rate of 58.7% in 2006 and an 89% rate by 2019.[3]

The savings-led model innovatively created a savings culture among clients to grow the Bank's deposits from US$1.15 million in 1994 to US$4.82 billion in December 2019. As a result, the Bank's cost of funds is well below the industry average at an enviable 2.9% in December 2019, which is largely comprised of checking and savings accounts. The loan book grew from US$350,000 in 1994 to US$3.66 billion in December 2019 with financing of MSMEs constituting 59% and large enterprises comprising 13%. Financing innovations of SMEs involved in international trade exports composed 36% of the loan book in foreign currency, amounting to US$1.32 billion in December 2019. Equity was feted as Africa's SME Bank of the Year in both 2018 and 2019 by the SME Finance Forum of the G20 Global Partnership for Financial Inclusion (GPFI).

Total assets grew from US$1.22 million in 1994 to US$6.73 billion in December 2019, representing 6.88% of Kenya's GDP of US$98.37 billion. The GDP growth rate for Kenya stood at 2.63% in 1994 but averaged 5.45% between 2005 and 2019 with the highest growth rate recorded in the fourth quarter of 2010 at 11.6%.[4] Shareholder funds grew from negative in 1994 to reach US$1.08 billion. Equity Bank has the highest market capitalization in East and Central Africa and on the Nairobi Securities Exchange, with market capitalization reaching US$2.04 billion in January 2020. Investors put a high premium on Equity Bank's value-driven innovations of about US$300 million above the market capitalization of the second-ranked bank. Equity Group's global rating of B2 by Moody's is at the same level as the sovereign rating of Kenya.

The Bank was ranked globally by Banker Magazine at the 844th position on total assets size, 15th on return on total assets, 75th on soundness (capital assets ratio), and 32nd on profits on capital.

Equity Group's investments in mobile money innovations have led the Bank to acquire over 20% of Kenya's mobile money market share since the 2015 launch of Equitel MVNO (mobile virtual network operator)—a telecom and banking sector convergence solution. Digitization and innovation in the Bank have changed the concept of banking from "somewhere you

TABLE 13.1

Equity Bank performance trend analysis—10X growth every 5 years at peak

Value in US$	1991	1996	2001	2006	2011	2016	2019
Funding	290K	3.02M	16M	163M	1.59B	3.37B	4.82B
Loans	86K	1.69M	8M	109M	1.13B	2.66B	3.66B
Total assets	240K	2.13M	19M	200M	1.96B	4.74B	6.73B
Profit before tax	(40K)	106K	550K	110M	128M	249M	315M
Shareholder funds	(180K)	225K	2.38M	22M	342M	820M	1.12B
Number of customers	9K	26K	105K	1.01M	7.15M	11.1M	14.14M

Source: Equity Group Holdings Plc Internal Records.
Note: K (thousands), M (millions), and B (billions).

go" to "something you do", as customers have adopted banking as a lifestyle. In December 2019, 97% of Equity's transactions occurred via mobile self-service channels, agency points, and merchant banking, as opposed to fixed cost branches and ATMs. The Bank's innovations via artificial intelligence and machine-learning scoring technologies have enabled 93% of the loans to be disbursed efficiently via mobile channels (Figure 13.1). The Bank has more than 40,000 agents in Kenya serving as bridges to cash as the economy shifts towards a cashless society. Integrations with global card associations and innovations in mobile point-of-sale (mPOS), along with acquisitions of last mile retail merchants, has seen the Bank gain 60% of the merchant banking share in Kenya. Integrations with global fintech companies have seen the Bank become a market leader with almost 50% market share of Kenyan diaspora remittances, reaching US$1.42 billion in December 2019 across Equity Group. The Financial Times and IFC declared Equity the most sustainable bank in Africa in 2009, and the Computer Society of Kenya honored Equity as the best in mobile technology in 2010. African Banker Magazine awarded Equity the most innovative bank in Africa in 2011 and the Banker declared Equity the most innovative bank and the best mobile banking service in 2016. Think Business has consistently ranked Equity as the best in agency banking every year, since 2015.

Lessons learned and policy recommendations

Across more than two decades of experience and expertise, Equity Bank knows that there is still very high unmet demand for financing innovation in developing countries such as Kenya. Deepening access to finance for MSMEs is thus critical if entrepreneurs and innovators are to lead in wealth and job creation. There is a need for capacity-building training for MSMEs and innovators to not only commercialize and monetize their innovations but also to better manage their businesses for longevity. The impartation of entrepreneurship skills and best of breed business practices can help many MSMEs live well beyond their fifth birthday.

Leveraging private sector GERD from retained earnings of companies is key to the adoption of new technologies. This is also key in companies building a culture of serial innovation, serial intrapreneurship, and serial mergers and acquisitions that underlie serial monopoly strategies of leading companies globally. The role of government in improving business conditions for MSMEs and deliberately investing in the global competitiveness of their countries is likewise important.

SME finance policies, modeled on the lines of the G20 Global Partnership for Financial Inclusion (GPFI) guidelines, can help many countries create reforms geared towards the funding of SME innovations.[5] The reforms needed comprise the regulation and supervision of SMEs' access to financial products and competition—as well as financial infrastructure, such as credit reference bureaus, and government interventions, such as credit guarantees and government procurement. Kenya has three credit reference bureaus which have helped to lower overall over-indebtedness by reducing adverse selection and information asymmetries, such as moral hazard. Credit risk guarantees help banks finance innovations by MSMEs in the high-risk informal sector or as climate shocks to agriculture. Government procurement provides access to markets for MSME innovations. Policies geared towards improving business conditions, as well as improving the global competitiveness of countries, are key to spurring a vibrant entrepreneurship and innovation ecosystem that banks can finance.
The adoption of National Entrepreneurship Policies and Strategies, as well as National Financial Education policies, are key to the provision of entrepreneurs' and innovators' capacity-building capabilities as a public good for emergence of an MSME ecosystem at the core of any "start-up nation".[6] Entrepreneurship policies normally cover regulations, entrepreneurship education, skills development, technology transfer, innovations, and access to finance by innovators through debt, venture capital, and government grants—in addition to promoting awareness and peer-to-peer networking. Financial literacy training is seen as a key life skill for individuals and MSME innovators to develop the financial capability to understand and consume financial products, thus driving financial inclusion.

Government use of tax or debt funding to finance GERD by universities and public research institutes—spurring development of industry clusters, regulating adoption of new technologies such as fifth-generation wireless technology (5G), protecting IPRs, financing innovative start-ups through early-stage venture capital, or providing a market by buying new technologies and innovations—is central to whether or not a country will emerge as a champion in the digital economy.

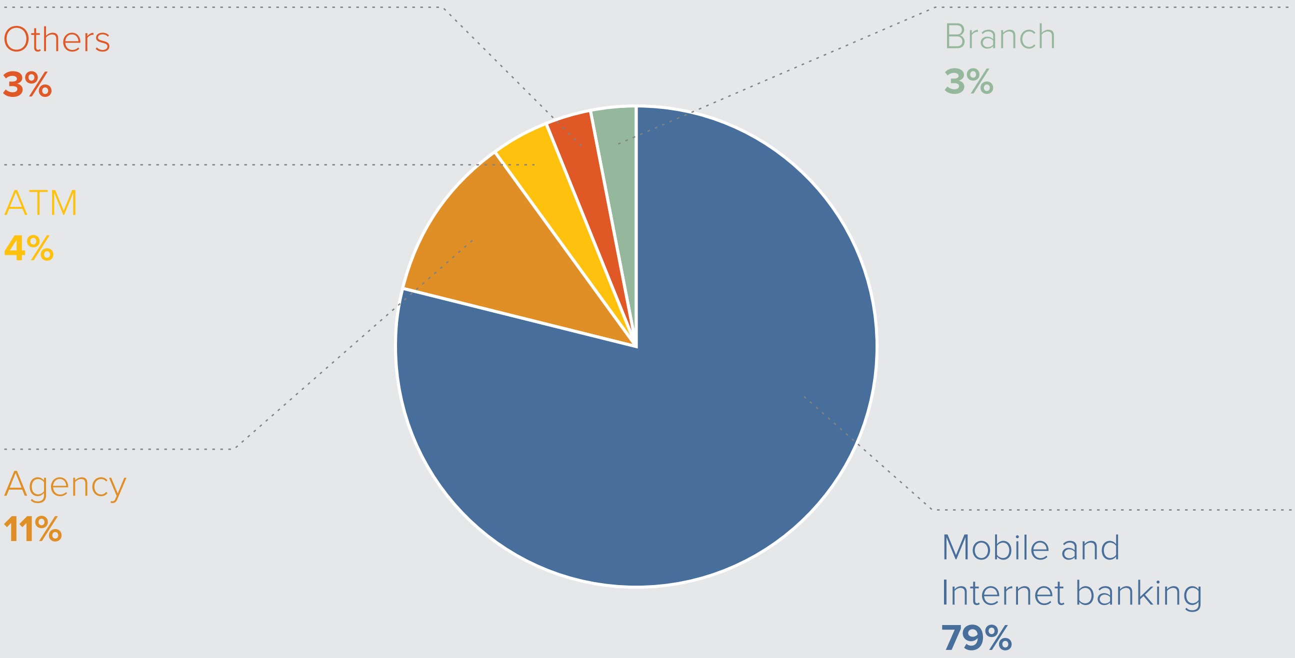
Finally, fiscal policies, such as targeted lower corporate income tax incentives, can help quicken the pace of adoption, experimentation, and consumption of innovative technologies if linked to the use of retained earnings to increase private sector GERD. For instance, in Germany, private sector GERD as a percentage of GDP stood at 2.1% with annual spend in 2015 reaching 62.4 billion euros.[7]

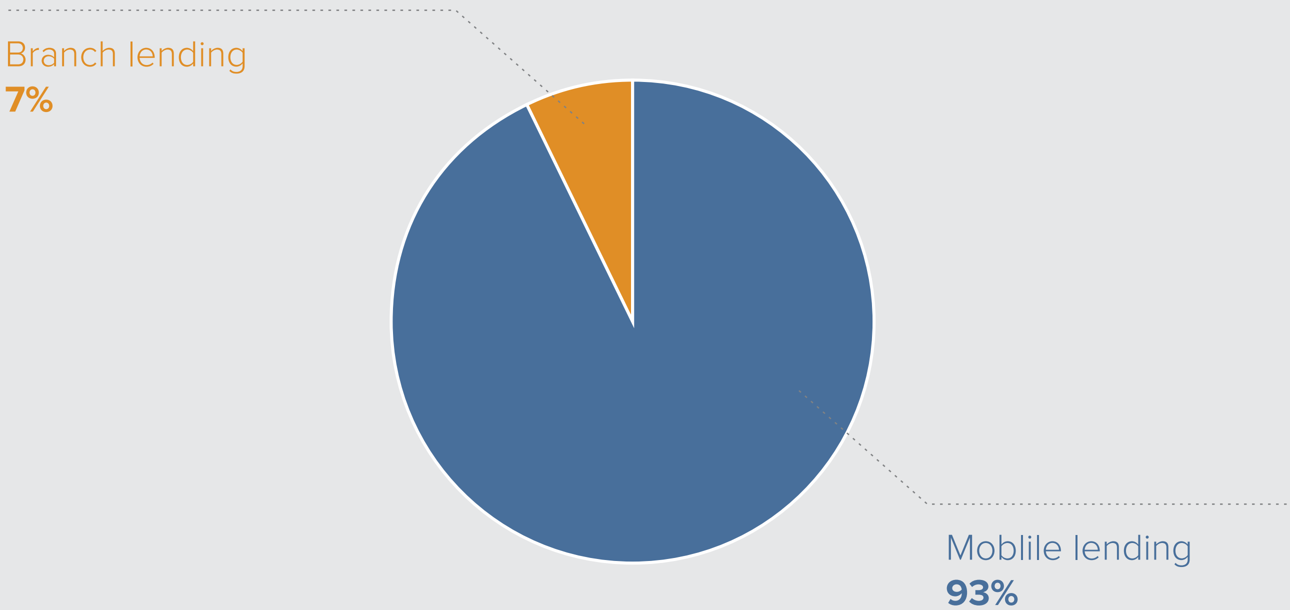
Opportunities for financing Africa's innovative future

Kenya's financing for innovation largely hinges on the vibrant and diversified private sector-driven economy, which is endowed with a well-educated and entrepreneurial workforce and a relatively high level of business and industry sophistication. Kenya has a start-up nation culture with over 7.41 million MSMEs in 2016 that Equity Bank targets to finance their innovative ideas, dreams, and aspirations.[8] The bank envisages playing a key role in bridging the finance gap and providing access to SMEs. This can be achieved by increasing financing to enable Kenya's GERD of 0.98% of GDP to catch up with world leaders, such as Israel at 4.8% or South Korea at 4.5%.[9] Funding the agrarian revolution in Africa as a food and agricultural bank is also key, as agriculture employs 80% of Africa's labor force.

FIGURE 13.1

Fintech innovation and digitization





Source: Equity Group Holdings investor presentation, full year 2019.

Likewise, Equity Bank is acutely aware of the need for Kenya and other African countries to shift from an overdependence on primary commodity exports growth to manufacturing efficiency, innovations, intellectual property, and business sophistication-led growth. It is thus also important to finance industrialists that can make Africa the manufacturing hub and "factory" of the world. The pursuit of exports and promotion leveraging gives Equity Bank the low wage competitive advantage and is key to the continent's global competitiveness and employment of youths, who comprise over 60% of the population. Related, Equity Bank is also keen on ensuring that it plays a critical role in funding the gap within Kenya's industry cluster development. In recent years, Kenya has excelled in information and communication technologies (ICT) business incubators with hubs like Nailab, iHub, and iLab cropping up to offer ICT innovators with a one-stop shop for facilities, mentorship, and funding for the whole innovation funnel cycle. This will only blossom exponentially with the full launch of the Konza Technopolis technology hub by the Kenyan government, dubbed "Silicon Savannah", and the creation of new fintech companies through the Nairobi International Financial Centre.

To help achieve this transition, mobile and Internet computing technologies are also expected to revolutionize innovation in Kenya by enabling the leapfrogging of pathways to development. Kenya's mobile phone subscriptions reached 49.5 million (96% of the population) in 2018, with many accessing the Internet through mobile channels. Equity Bank is a market elder in mobile money innovation and is also financing the whole innovation value chain for mobile money payments—both for its own ecosystem as well as those of telecommunication and fintech companies. Fourth Industrial Revolution (4IR) technologies, such as cloud and quantum computing, AI, machine learning, and the Internet of Things (IoT), are expected to herald a plethora of innovations that Equity Bank will be financing. Financing innovation towards the achievement of the UN Sustainable Development Goals (SDGs) is another gap that Equity Bank will be helping to bridge.

Finally, Equity Investment Bank is expected to grow as Kenya and other African economies shift from low-income to lower middle-, upper middle-, and, eventually, high-income economies. This will see the bank launch private equity and venture capital funds to offer equity investments for innovators and MSMEs. Financing and leveraging intellectual property as collateral is expected to significantly evolve as the economies become increasingly digital. The Group's fintech arm, Finserve, is expected to set up a fintech fund to invest in innovative ICTs for the development start-up sector providing digital solutions to Africa's most pressing problems.

To this end, Equity ultimately sees its role as financing the emergence of homegrown, African multinational corporations, innovators, and entrepreneurs. Equity seeks to mobilize a factor of production for wealth and job creation, as a cure to the African paradox of poverty amidst abundant resources, thus enabling Africa to finance its way to an innovative future.

Notes:

1 Kerr et al., 2015.

2 United Nations Economic Commission for Europe, 2009.

3 Central Bank of Kenya et al., 2019.

4 Trading Economics, 2010.

5 International Finance Corporation, 2011.

6 UNCTAD, 2012; OECD, 2015.

7 DAAD, 2017.

8 Kenya National Bureau of Statistics, 2017.

9 AUDA-NEPAD, 2019.

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CHAPTER 14

ABU DHABI: INNOVATION AT THE HEART OF A MODERN, DIVERSIFIED, AND SUSTAINABLE ECONOMY

Tariq Bin Hendi, Abu Dhabi Investment Office

"In 50 years, when we might have the last barrel of oil, the question is: when it is shipped abroad, will we be sad? If we are investing today in the right sectors, I can tell you we will celebrate at that moment."

—His Highness Sheikh Mohamed bin Zayed Al Nahyan, Crown Prince of Abu Dhabi and Deputy Supreme Commander of the UAE Armed Forces

The United Arab Emirates (UAE) is a federal republic of seven emirates—or states—of which Abu Dhabi is the capital and home to most of the country's oil reserves. The country has experienced transformational growth since the discovery of oil and gas in the second half of the 20th century. The revenue from natural resources has driven economic progress and funded ambitious government projects while maintaining a low taxation environment that attracts investors and talent from around the world.

The task facing Abu Dhabi—and commodity-exporting nations in general—has been responsibly managing this finite resource to build a sustainable economy for the next generation. Abu Dhabi's response has been an ambitious program of economy-building projects, using natural wealth as the foundation for long-term, sustainable development and steadily preparing its economy for a post-oil future. This has been allied with measured policies designed to ensure economic stability without hampering growth, including augmenting government revenues through the introduction of a value-added tax (VAT) in 2018 and the planned introduction of road tolls in 2020. The net result has been a highly stable, exceptionally resilient, and increasingly diversified economy, to the point where non-oil sectors now comprise most of the emirate's GDP.[1]

Over the past decade, innovation and knowledge-intensive industries have increasingly taken center stage in Abu Dhabi's economic vision. Those efforts are also now delivering results. As Abu Dhabi considers how to build further on its achievements, its approach to leveraging oil and gas revenues to accelerate other sectors offers a valuable case study for other resource-based economies.

Building solid foundations for sustainable growth

In the past 50 years, Abu Dhabi has relentlessly reinvested its natural wealth into the broader economy, and the vision for making those investments has grown more complex over time. Businesses, sovereign wealth funds, and government investment agencies have directed revenue into developing non-oil businesses to speed the pace of growth and diversification.

One of the key stewards of the emirate's wealth has been the Abu Dhabi Investment Authority (ADIA), established in 1976 to invest funds with a focus on long-term value creation. Another key milestone was the creation of Mubadala in 2002, which has innovated and invested around the world to diversify the emirate's economy and create lasting value for future generations.

Today, while oil resources remain plentiful in the emirate, the non-oil sector now comprises around 60% of Abu Dhabi's GDP, up from approximately half at the start of the decade.[2] Sectors including construction, financial services, aviation, tourism, logistics, trading, manufacturing, and media now all play a much larger role in the emirate's economy than in the past.

Sources of income have been further diversified by 2018's introduction of a VAT in Abu Dhabi, and across the wider UAE and much of the Gulf Cooperation Council (GCC), at a rate of 5%, one of the lowest levels in the world. The country's tax receipts in the first year of the VAT's operation were 25 billion United Arab Emirates dirham (AED), or 5.5% of total revenues, a significant amount that augmented government finances without detriment to the UAE's reputation as a low-tax environment.[3] There is zero tax payable on company profits, and the promise of income tax-free salaries for employees is a considerable advantage when attracting and recruiting talent.

Most recently, the knowledge economy has been prioritized for development. As stated in the UAE Ministry of Economy *Annual Economic Report 2019*, in the five years from 2014 to 2018, the country's information and communications sector grew by a total of 27.2% and at an average annual rate of 5.4%; the education sector grew 28.2% in total and 5.6% annually; the professional, scientific, and technical activities sector grew 9.5% in total and 1.9% annually; and the manufacturing sector grew at an average annual rate of 4.2%.[4]

The digital economy now contributes 4.3% to GDP, with that figure predicted to rise substantially.[5] For instance, around 40% of the population uses government digital services more than once a week, while consumers have also embraced e-commerce.

The growth and diversification of the economy have been carefully nurtured over the years and enhanced by a business-friendly environment and favorable tax regime, easy access to capital and international markets, and financial and political stability.

Abu Dhabi offers investors an advanced level of infrastructure—by sea, air, and road—as well as an inexpensive energy supply and communications technology. With more than 200 islands, the Yas Marina Circuit F1 track, and Louvre Abu Dhabi, among many other attractions, its lifestyle appeals to expats, while world-class universities offer collaborations for research and development (R&D). Abu Dhabi is also a haven of economic stability and financial strength within the Middle East and North Africa (MENA) region, offering investors confidence with a predictable policy framework underpinned by a clear strategy for national growth.

The businesses that benefit come in all sizes. Global companies routinely choose Abu Dhabi as a regional base for the Middle East and nearby regions. At the same time, micro, small, and medium-sized enterprises (MSMEs) make up 98% of all companies and contribute 29% of Abu Dhabi's GDP and 43% of its employment, according to the Abu Dhabi Chamber of Commerce and Industry.[6]

Family-owned companies are also a defining feature of the commercial landscape, often trading across multiple industries. Having grown in step with Abu Dhabi itself, some family businesses generate significant income as the local agent for international brands, such as global retailers, food service, or car manufacturers. They are also active in areas such as construction and property, publishing and media, and manufacturing. The best of these family businesses are highly competitive, with world-class management and operational experience, and are now aiming to develop as agile and innovative organizations fit for a digital future.[7] Targeted business support by the Abu Dhabi government will help them to achieve a sustainable and creative path for future growth.

In addition to local businesses, Abu Dhabi has accelerated the growth of international and expatriate-owned companies by establishing special economic zones—including five "free zones"—targeting specific sectors ranging from media through to shipping and manufacturing. For small and medium-sized enterprises (SMEs), free zones simplify the business set-up process and enable 100% foreign ownership of the business.[8] These free zones are innovation ready, promoting the growth of industry clusters where similar businesses can thrive as part of like-minded communities. The free zone concept has proven successful in encouraging knowledge-economy start-ups. Standout examples include Abu Dhabi's twofour54 ecosystem, which has earned a reputation as a regional center for media businesses, and Masdar City, which has established Abu Dhabi as a major regional hub for the green economy and a test bed for renewable energy and technology companies.

Planning for the long term

Today, Abu Dhabi benefits from an economy that encompasses a healthy combination of local companies and international partners, major corporations and SMEs, and a dynamic start-up culture that attracts foreign and local entrepreneurs. The latter is particularly important for sustainable long-term growth, and Abu Dhabi has worked in recent years to ensure innovators have everything they need to succeed.

While words such as "start-up" and "entrepreneur" are frequently used as proxies for "innovation", the reality is that many new businesses compete in an existing space rather than explore new possibilities. A traditional approach has been the "agency" model, based on bringing ideas from abroad and tailoring them to the local market. Abu Dhabi is now building on these foundations, as part of its wider economic diversification plans, and creating an environment where new ideas and business models can flourish.

The next challenge is to expand a successful business ecosystem into a world-leading innovation ecosystem. In the past decade, innovation has moved to the center of the country's long-term vision, recognized as a key ingredient that will accelerate transformation and leapfrog economic development. Innovation is at the core of clearly defined strategic programs, including the Abu Dhabi Economic Vision 2030 and the Abu Dhabi government's Ghadan 21 accelerator program.

Announced in 2007, the Abu Dhabi Economic Vision 2030 created a roadmap for the emirate's economic future by defining four priority areas to direct public policy: economic development, social and human resources development, infrastructure development and environmental sustainability, and optimization of government operations.

This vision has been instrumental to informing planning. For example, the Economic Vision 2030 outlines the importance of addressing skill gaps and encouraging collaboration between higher education institutions to support the research and development ecosystem. The vision has also helped prioritize infrastructure projects, including airports, ports, road construction, electricity supply, and telecommunications networks that are now allowing Abu Dhabi to be at the forefront of harnessing technological innovations.[9]

Ideation to implementation to innovation

Building on initiatives like the Abu Dhabi Economic Vision 2030, the UAE National Innovation Strategy was launched in 2014 with the aim of making the nation one of the world's most innovative within seven years. The UAE has made good progress in this regard, steadily rising up the Global Innovation Index (GII) rankings in recent years to currently stand at 36th globally and 1st in the Arab world.[10]

The UAE National Innovation Strategy has four tracks: implementing supportive institutions and laws, applying an integrated system of modern tools, encouraging the private sector to innovate, and preparing individuals to obtain highly innovative skills. Understanding that innovation is a cornerstone of both economic and social development, the four tracks work together to establish a national culture of ideas, entrepreneurship, and partnership between the public and private sectors.

Within Abu Dhabi, the Ghadan 21 accelerator program—"ghadan" being an Arabic word for tomorrow—is doubling down on efforts to achieve these objectives by investing in business, innovation, and people.[11] Launched in 2019, it is a three-year holistic package worth a total of AED 50 billion (US$13.6 billion) designed to boost Abu Dhabi's knowledge-based economy. One year into the program and more than 50 initiatives are underway—many aimed at attracting and supporting innovative start-ups and small businesses and spurring innovation through research and development.

Highlights from Ghadan 21's first-year report card in February 2020 included establishing the Abu Dhabi Investment Office's AED 535 million (US$145 million) Ventures Fund to 1) invest in both early- and later-stage tech ventures, 2) be a limited partner in established global funds looking to access the MENA region, and 3) partner with global accelerators focused on helping innovative start-ups.

Another flagship Ghadan 21 initiative, Hub71, based at Abu Dhabi Global Market (ADGM), has assessed and welcomed more than 50 start-ups to its coworking space operated by WeWork. Hub71 is a global technology ecosystem that encompasses capital providers, business enablers, and strategic partners under one roof. It does this with support from strategic partners such as Mubadala, SoftBank Vision Fund, Microsoft, and ADGM. Abu Dhabi also entered into the largest-ever government partnership with private enterprise, XPRIZE Foundation, investing AED 300 million (US$81 million) in a crowdsourcing innovation platform through a series of XPRIZE Abu Dhabi global competitions.

Mitigating risk and supporting growth

Many decades of effective policymaking, sound investment, and long-term planning have laid strong and stable foundations for economic growth. This is evident by the resilience shown to the economic turbulence of early 2020 and the government's ability to respond decisively with an ambitious package of stimulus measures under the Ghadan 21 Accelerator Programme. This included assisting with the availability of loans to local companies as part of a new partnership between the Department of Finance and three of the emirate's major banks—ADCB, ADIB, and FAB—providing SMEs with more financing options. The message was clear: ambitious entrepreneurs with great ideas will be supported in Abu Dhabi through all economic cycles.

The Abu Dhabi government has for many years placed great emphasis on supporting innovative entrepreneurs, recognizing both their contribution to the economy and the reality that governments are uniquely able to de-risk the critical early phases of a new enterprise. Deeply embedded within this mission and vision is the Abu Dhabi Investment Office (ADIO).

ADIO supports companies that have innovation at the core, helping them to win and succeed in Abu Dhabi. Its incentive programs and dedicated investor care team helps companies access everything the emirate has to offer. For start-ups, ADIO understands that speed is everything, especially for innovation-focused companies trying to stay ahead of the competition. As such, it can make decisions and deploy capital quickly. Armed with a significant funding pool, ADIO offers bespoke packages of cash and non-cash support, incorporating both advisory services and incentives, delivering the right building blocks that each individual investor needs to succeed.

Abu Dhabi's innovation ecosystem works in unison to create an environment where big thinking can thrive. For specialized financial technology (fintech) entrepreneurs, ADGM's RegLab is proving a highly effective source of innovation. It offers a controlled environment where start-ups at the cutting edge of fintech can safely test innovative solutions.

Multiple initiatives running in parallel are enabling Abu Dhabi to move quickly, de-risk innovation, and achieve results.

Maintaining a clear focus on priority areas

While innovation applies across all sectors, the best results are achieved through targeted programs solving specific challenges that are locally relevant, yet also globally significant.

For example, one focus area for ADIO is agricultural technology or “AgTech”. ADIO is directing AED 1 billion (US$272 million) worth of incentives into AgTech innovations to deliver economically and environmentally sustainable food production in desert and arid environments. In April 2020, ADIO invested AED 367 million (US$100 million) in four AgTech pioneers establishing new R&D and production facilities in the emirate as part of its goal to turn sand into farmland, solve complex global agriculture challenges, and expand the profile of local food producers. Making such a significant investment at a time of so much global uncertainty embodies Abu Dhabi’s commitment to put innovation at the heart of long-term economic planning.

ADIO is also supporting innovation in areas where Abu Dhabi has a comparative advantage, like its plentiful energy sources, such as oil and gas or sunlight for solar generation. The emirate’s established industries provide a ready customer base for innovative tech solutions.

For Abu Dhabi’s national oil company, ADNOC, technology is a key enabler for delivering smart growth as part of its 2030 Strategy.[12] More broadly, industry leaders have coined the phrase “Oil and Gas 4.0” to describe the scale and pace of change to operations, closely aligned with the concept of the Fourth Industrial Revolution.[13] Disruption and opportunity cut across sectors including artificial intelligence (AI), cybersecurity, and blockchain—three standout areas for investment for ADIO—as well as automation and robotics.

AED 10 billion (US$2.72 billion) is earmarked in 2020 for infrastructure spending through public-private partnerships, presenting a huge opportunity for the private sector. More generally, the Abu Dhabi Local Content Program, created by the Abu Dhabi Department of Economic Development, is also making it easier for the private sector to participate in government tenders.

This clear focus on a limited number of priority sectors applies across Abu Dhabi’s full range of innovation support, with strong synergies between ADIO and other agencies supporting R&D and start-ups. For example, Hub71 has launched the Abu Dhabi Climate Initiative with government partners to fast-track research and development in water and climate technology, including establishing a dedicated accelerator program, Climate Lab. XPRIZE Abu Dhabi aims to find solutions to critical global challenges, including climate change, water scarcity, and AI.

Abu Dhabi is enabling innovation on all fronts—and in all business cycles—using the strength of its economy and its comparative advantages to create opportunities for established companies and start-ups with equal vigor.

Bringing private sector finance into the funding mix

Abu Dhabi is distinguished in its ability to direct government investment into innovation. However, recognizing the risk of relying exclusively on public funds, Abu Dhabi is resolute in balancing government and private sector investment in innovation to ensure long-term economic sustainability.

ADIO’s role is to empower private investment and innovation, acting as an enabler and catalyst using a tool kit of cash and non-cash incentives to remove potential obstacles to innovation. ADIO’s Ventures Fund, as discussed earlier, is increasing the available funding pools in Abu Dhabi by expanding the venture capital (VC) universe, among other objectives.

The ability of early-stage companies to access financing has been an obstacle to entrepreneurship in the MENA region, with traditional banks, institutional investors, and family offices working hard to close the gap. The emirate is now seeing the growth of alternative financing sources, including VCs, which have been fundamental to Silicon Valley’s success but have been less prominent in the MENA region’s investment landscape.

This approach maintains a healthy balance between attracting international investment into Abu Dhabi and supporting the growth of local businesses. For locally-based partners, particularly family businesses, ADIO works to reduce the financial risk inherent in pivoting away from an agency model, discussed earlier, and towards one where businesses are empowered to originate new ideas, and/or to disrupt and tailor ideas from abroad. This will allow the best Abu Dhabi-owned companies to expand into sectors where there is scope to grow into internationally significant operators.

Beyond funding innovation, Abu Dhabi is building a pathway to raise future capital with stock exchange listings. Two of the region’s largest listed companies, First Abu Dhabi Bank (FAB) and telecom provider Etisalat, are listed on the Abu Dhabi Securities Exchange (ADX). The number of listed companies in the UAE, either in Abu Dhabi or on the Dubai stock exchanges, continues to grow, rising from 130 in 2017 to 137 in 2018.[14] Authorities in the UAE are looking at ways for SMEs to use an initial public offering (IPO) to raise funds—a very welcome strategy as “unicorns” emerge from the local innovation ecosystem and rise into global players.[15]

Learning from the Abu Dhabi experience

Abu Dhabi is blessed with natural wealth, but this places a deep responsibility on the current generation. The lesson learned from the past is that such good fortune must be reinvested for tomorrow—carefully and with consideration—so that economic opportunity expands beyond the limits of a commodity boom.

While many economists will debate the benefits and risks of government intervention in the economy, Abu Dhabi's unique circumstances have demonstrated the value of robust central planning to maximize community benefit and emphasize long-term growth.

Its journey so far demonstrates the value of clear strategic thinking, diversifying a resource-based economy step-by-step. Family-owned companies have successfully leveraged the strong economy to build revenues, while free zones have welcomed international investment where needed, integrating high-value activities into the economy. Abu Dhabi has consistently set ambitious economic goals, identified and funded the inputs that will contribute to achieving those goals, and then raised the bar even higher.

Today, Abu Dhabi boasts a highly diversified economy—the fruits of strategically invested oil and gas revenue—that is less dependent on revenue from natural resources with each passing year.

The Abu Dhabi Economic Vision 2030 is inching towards its fulfillment date. The emirate's leadership is considering the strategic vision that will follow—looking ahead not only to the next decade but also to the next 50 years and the trends that will shape the future of its people, with certainty that the drive towards an economy based on knowledge, ideas, and innovation will only accelerate.

Notes:

1 Statistics Centre - Abu Dhabi (SCAD), 2020.

2 Statistics Centre - Abu Dhabi (SCAD), 2020; Statistics Centre - Abu Dhabi (SCAD), 2010.

3 UAE Ministry of Economy, 2018.

4 UAE Ministry of Finance, 2019.

5 UAE Ministry of Economy, 2019.

6 Abu Dhabi Chamber of Commerce and Industry, 2019.

7 PwC, 2019.

8 UAE Government, 2020.

9 Abu Dhabi Executive Council, 2007.

10 Abbas, 2019a.

11 Government of Abu Dhabi, 2020.

12 Abu Dhabi National Oil Company (ADNOC), 2020.

13 The National in partnership with Abu Dhabi National Oil Company (ADNOC), 2020.

14 UAE Ministry of Economy, 2019.

15 Abbas, 2019b.

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CHAPTER 15

INTELLECTUAL PROPERTY AS AN ASSET FOR FINANCING INNOVATION

Pippa Hall, United Kingdom Intellectual Property Office

This chapter argues that intellectual property (IP) assets have long been recognized as assets. In the United Kingdom (U.K.), evidence suggests that there are fewer than 5000 IP valuation reports commissioned per annum, and the market is somewhat underdeveloped versus what might be considered optimal. This chapter provides research findings from projects the U.K. Intellectual Property Office has conducted, as well as more recent joint work with the British Business Bank.

Using evidence drawn from sources including U.K. government research into the question of IP asset valuation and current strategic discussions, the chapter suggests that, through engagement with IP owners and the banking industry, it should be possible to bring more clarity to the subject of IP asset valuation so that investors and innovators can benefit from asset value as collateral for innovation. This will benefit the wider economy through further innovation where firms are able to collateralize their intellectual property.

IP as an asset for financing innovation

The theme of innovation finance is of direct relevance to ongoing efforts by policymakers to improve the ease with which firms can unlock the investments they make in intellectual property through financial markets. The focus of government intervention is to make it easier to maximize the return on IP through better knowledge, information flows, access to finance, insurance, and trading mechanisms. This will incentivize the creation of new ideas, increase the share that is commercialized, and thus contribute to innovative activity, which enhances economic growth.

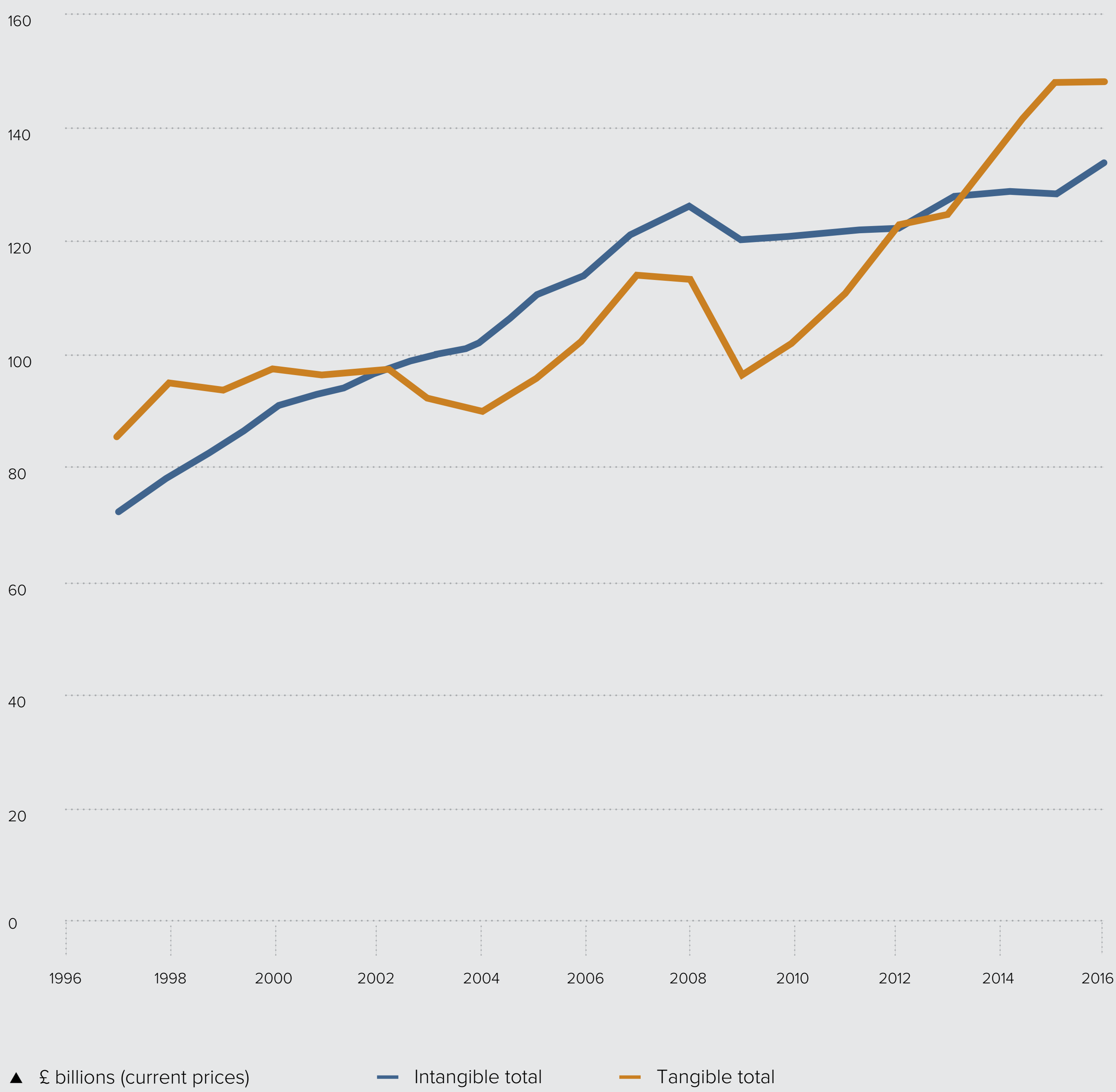
Too often, IP-rich firms find it difficult to collateralize their investments to unlock future growth funding, especially when compared with those firms holding more conventional assets. There is a mismatch between the potential value created by companies with strong intellectual property portfolios and the investment opportunities afforded by investors. This is a problem highlighted as far back as the 2006 Gowers review, for which we have undertaken research to improve the evidence base, and more recently, in our joint work with the British Business Bank and the wider financial sector.

Whilst there are no easy solutions within this complex set of interactions between businesses and financial institutions, we have been able to make clear what the problems are, describe the methods of valuation, and improve our understanding and use of IP assets as a fundamental driver of economic growth. This chapter describes some of the macro context for why this work matters, lays out some of the problems and challenges which need to be overcome, and finally points to some of the solutions which have been suggested in the U.K. and elsewhere; this includes the U.K. experience of how policymakers may work with the financial services sector to enable businesses to leverage their investment in IP.

For the U.K., the growth in investment in intangibles, such as those protected by intellectual property, has been substantial. Between 1997 and 2016, investments in intangibles increased by 87% from £71.91 billion British pounds to £134.29 billion (Figure 15.1).[1] In 2016, almost half of the assets U.K. firms

FIGURE 15.1

U.K. market sector intangible and tangible investment, 1997-2016



Source: U.K. Office of National Statistics (ONS), 2019.

invested in were intangible knowledge assets, rather than tangible assets. However, it is not only the volume amounts which are striking, but also their growing importance to the economy. This pattern of the growth of intangible investment has also been studied by other developed economies.

The value of IP assets and the fact that these assets are often "hidden in plain sight" is the principal point of concern in the U.K. Intellectual Property Office (IPO) 2017 *Hidden Value* report. This report describes the potential of intangible value:

> More than 80% of enterprise value attributed by the stock market is not underpinned by tangible assets and is based around intangible assets. The implied importance of IP for U.K. companies appears to be borne out by successive research reports. In 2011 the U.K. market sector invested £137.5 billion in knowledge assets compared to £89.8 billion in tangible assets; of this, just under half of knowledge based investment (£65.6 billion) is thought to have actual or potential protection through the use of formal intellectual property rights.[2]

Through its work on IP and the economy, the European Union (EU) European Observatory on Infringements of Intellectual Property Rights has produced several reports estimating the value of IP on specific industrial sectors as a means of characterizing the threats posed to that value through fraud. In a recent report, the Observatory found 1) that Europe's intellectual property rights (IPR)-intensive industries generated 29.2% (63 million) of all jobs in the EU during the period 2014 to 2016, 2) that 38.9% of all employment in the EU (83.3 million) can be attributed, directly or indirectly, to IPR-intensive industries, and 3) that 45% of the total economic activity in terms of gross domestic product (GDP) in the EU is attributable to IPR-intensive industries worth EUR 6.6 trillion.[3] The U.K.'s recent report *Using Intellectual Property to Access Growth Funding* acknowledges both the importance of IP asset valuation and the need to improve its delivery, pointing to an "unvirtuous" circle of disinvestment: whereas lenders are unwilling to risk investment, essentially driving costs up, innovators struggle to succeed the first time—a common occurrence amongst innovators, start-ups, and entrepreneurs—and then find it difficult to access additional funds elsewhere.[4]

Our understanding of IP—its desired functions and its unintended consequences—has evolved over the years. In the past, as IP assets were concretized through registration, and a bureaucracy was established to administrate this task, perhaps the most important mutation trademarks underwent in the U.K. was to transform from a means of protecting against fraud into an asset property. Historian Lionel Bently cites the 1875 Trade Mark Registration Act's reference to the "proprietor" of the "title" of a trademark as part of the "rhetoric of property" which facilitated this change.[5]

Ownership of IP assets has also increased (Figure 15.2). Between 2002 and 2019, total IPR applications to the U.K. IPO doubled from 75,436 to 152,322. Trademark applications increased 162% from 36,013 to 107,527; design applications increased 169% from 9,512 to 25,545; while patent applications decreased by 36% from 29,911 to 19,250.

Where once they were perceived as purely defensive instruments, grants and registrations for patents, trademarks, and designs are now regarded as assets. The benefits of these assets are frequently stressed by IP rights administrators. For example, in the 2017 World IP Report, WIPO estimates that one-third of the value of goods is derived from "intangibles such as technology and branding".[6] Notwithstanding these important and widely accepted findings, there remains a problem in transferring the business and legal community's enthusiasm for registration into hard cash. This was succinctly described in a recent edition of the WIPO's online magazine:

> Intellectual Property (IP) is now the most valuable asset class on the planet, and yet establishing IP value and exploiting the economic potential of IP assets remain much of a mystery to businesses, financiers and investors.[7]

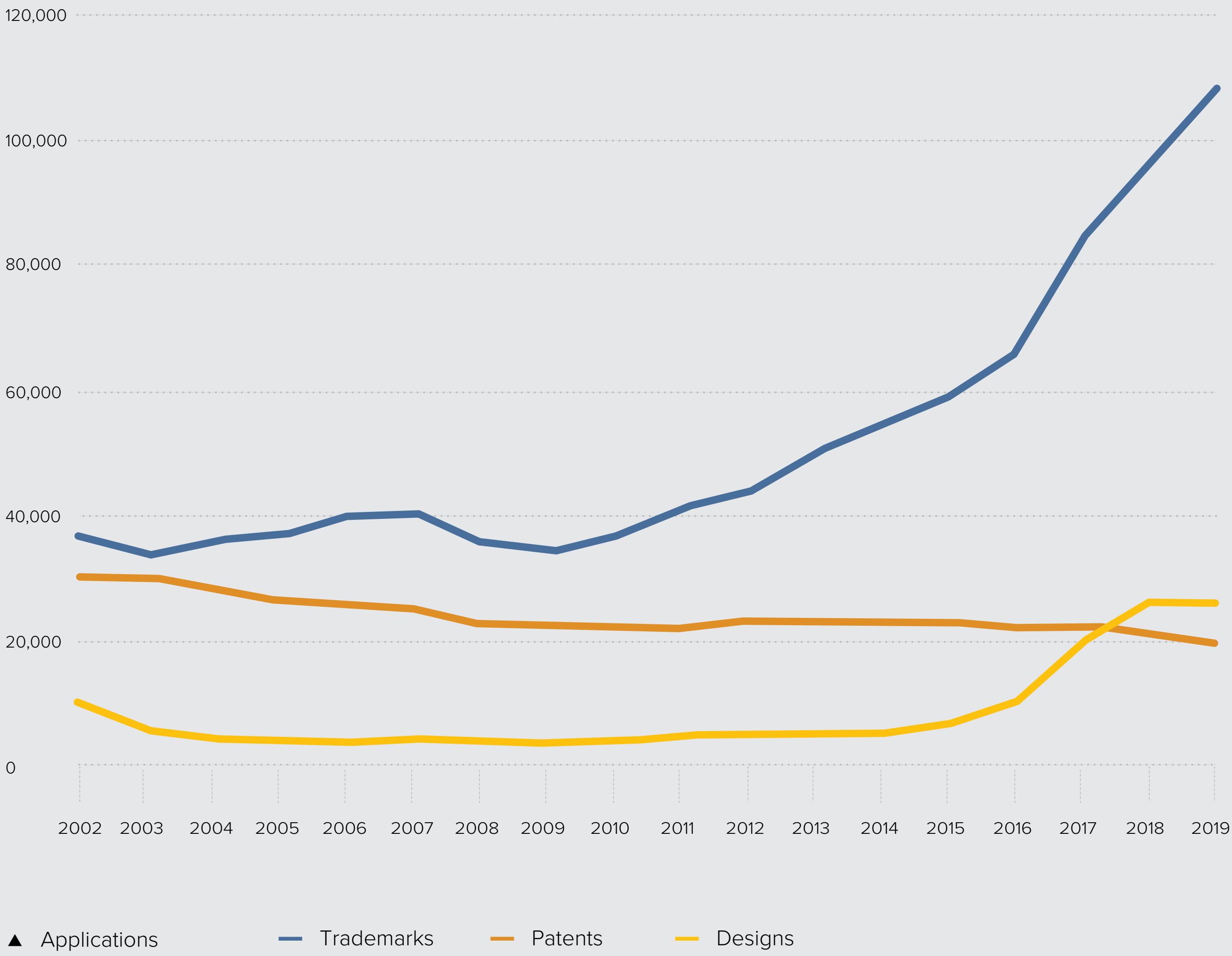
IP valuation is consistently raised as a barrier to businesses being able to use their IP as collateral for debt funding. This has been confirmed by research conducted by U.K. IPO and the British Business Bank in 2017 and 2018:

> IP and other intangible assets can be difficult to value, especially if they are innovative and therefore untested. Moreover, the value of such assets is often context-specific in that they may only be valuable within the firm where they are enveloped due to the way that they interact with other firm assets and thus may not be as valuable outside of that firm. Unsurprisingly, a 2010 survey showed that only 3% to 4% of SMEs had ever tried to assess the value of their IP.[8]
>
> In any case, there is no single market-wide or agreed methodology for valuing IP. Without a consensus approach, it is difficult to independently verify the value attributed to a piece of IP, which is further exacerbated by the lack of transaction data. The complexity of IP valuation also means that specialist expertise is needed. Indeed, it is estimated that only about 600 people work in this field in the U.K. This scarcity creates a cost for determining the value of IP and, in the absence of a scalable process, limits growth.[9]

In the U.K., the *Hidden Value* report estimates that between 3,000 and 4,000 specific IP valuations occur annually. These are conducted by around 600 practitioners with specialist skills regarding the valuation of IP assets. The numbers are low; they characterize the mismatch between the IP community's belief in the value of IP and the financial sector's lack of certainty concerning how the valuation of innovation—codified by IP—should be conducted. The extent of this problem is demonstrated by the report's uncertainty concerning the actual value of the IP assessed in the U.K. today. The figure is described as "not less than £50 million annually and is likely to be considerably higher—perhaps closer to, but not as high as £1 billion".[10] The Hidden Value report is one of the most significant contributions to the understanding of the IP landscape conducted by the IPO in recent years. It opens up the prospect of further research into the objectification of IP assets through

FIGURE 15.2

Total IPR applications to the U.K. IPO



Source: Intellectual Property Office.

consistent, standardized, and methodologically sound practices. It characterizes a tremendous gap in the market, and it identifies a problem: the potential asset value of innovative companies' IP may be undervalued. Furthermore, it provides evidence for those involved in the financing of start-ups and innovative IP-dependent industries that the value of existing IP can be understood and quantified. It also makes it clear that the failure to address this problem will not make it go away. Innovators and investors will continue to require objective evidence concerning the value of IP, both as potential and actual assets. Here, the U.K. IPO research, in partnership with IP *valuers*—those who appraise the value of IP, will provide valuable evidence.

Evidence from IP administrators in the U.K. chimes with the views of our international partners. The U.K. IPO's report *Banking on IP* was published in 2013, and it identifies the mismatch between the potential value created by companies with strong intellectual property portfolios and the investment opportunities afforded by investors:

> Whilst there are improvements needed to the practicalities (but not the rules) of registration, the basic step that is missing is a clear inventory of the IP and intangibles, without which a lender can never be certain that the assets which should be present are in fact to hand.
>
> One of the most unhelpful aspects of the IP financing debate is the tendency to conflate the terms 'technology' and 'IP'. There are millions of intangible business assets whose value is either not being leveraged at all, or only being leveraged inadvertently. Whilst it is that technology and knowledge-based companies will own important IP, there are many thousands of U.K. businesses with IP (registered and unregistered) who would not think of themselves as being in the technology space, including many of the U.K.'s globally recognised creative brands and manufacturers.[11]

Subsequent reports, notably *Trends at U.K. Intellectual Property Office 1995-2017* and *Hidden Value: A Study of the U.K. IP Valuation Market*, describe U.K. businesses' sophisticated registration habits to deliver increasing volumes of IP registration with international and national registrations systems. The reports also comment on a recurring problem: namely the failure to transfer the implied value of IP registrations into investment. As evidence, the *Hidden Value* report estimates that less than 5,000 IP valuation reports are commissioned in the U.K. per annum.

> Compared with tangible asset-related practices, IP valuation volumes appear to fall below what might be expected, given the substantial investment directed towards intangible asset creation. Where valuation activity serves an established need, the actual volume of activity will be most strongly influenced by factors outside the IP valuation market. Whilst additional available volumes are difficult to quantify, opportunity-led IP valuations appear to have the best prospects for growth in the near term. Market failings are most likely to lie in undue influence from the vertical relationships between intermediaries and valuers (though these also provide end users with a valuable signposting service) and in weak searching behaviour.[12]

Before concluding that an injustice is being done to the development of IP assets by the financial sector, it is worth considering what market conditions exist that might explain this situation. Perhaps the financial sector's reluctance to routinely lend capital on the strength of collateral in the form of patents, trademarks, designs, and copyright resides in their nature. These are intangible assets and, in an industry whose folk memory now includes both tulips and subprime mortgages, a reluctance to invest in the potential identified by Rothstein in his 2018 discussion of J.K. Rowling's artistic work can be understood.[13] There are two kinds of assets associated with IP: 1) the potential value of untested products such as inventions, trademarks, designs, and artistic works that have not yet reached the market, and 2) well-established products which have been trading successfully for centuries. Valuers and investors need to assess risk; untested potential may not be realized, and proven success may be difficult to replicate. For investors working in the aftermath of the Great Recession, it is worth asking whether the words "intangible" and "non-existent" might be interchangeable. Indeed, although the Bank of England and the HM Treasury websites are surprisingly IP-free, insurance brokers at Lloyd's offer policies designed to protect clients from unforeseen IP disputes. In other words, far from being neutral, the financial sector identifies specific problems created by modern, high-volume IP registration systems—ones that might inhibit growth and add to the costs of innovative companies through accidental infringement.[14]

There is, however, growing evidence that incentives to invest in IP-rich companies are strengthening. The simplistic dichotomy regarding the nature of intangibles characterized above belies the fact that all valuations are, in one way or another, vulnerable to an unexpected change of circumstances. Moreover, it is the entrepreneurial, fleet-footed businesses that seem most likely to prosper in our rapidly changing technical and economic environments. IP represents a global growth area, and those who are prepared to invest will profit. The U.K. Government's FinTech Sector Strategy initiative stresses the importance of emerging technologies to the U.K.'s financial sector. IP has a crucial role in the valuation, development, and deployment of this strategy. Indeed, if we adopt Bently's approach to the transformation of trademark registrations into forms of property, or assets, so that we seek the "rhetoric of valuation", it seems clear from the FinTech report that, underpinning the innovations and product developments of creative companies in the financial sector, we find IP. Patents, trademarks, design registrations, and copyright material will guarantee the value created by successful innovators in financial industries—just like everywhere else.

As well as outlining the regulatory framework, standards, and methodologies for assessing the value of IP assets, *Hidden Value* highlights the IPO's IP Financial Toolkit (now called IP for Investment) and IP Audit programs, which provide financial assistance to companies already engaged with one of the IPO's business support schemes. The report acknowledges that the "reach" of the IP Audit is, to some extent, limited to companies already aware of the importance of IP asset valuation. However, it does suggest that there is justification for broadening the scale of these interventions. It also acknowledges that changes in U.K. accounting regulations alter the way intangible assets are recognized on balance sheets following mergers or acquisitions and that steps are being taken to introduce qualifications for IP valuers. Two action points emerging from the report stand out. As well as connecting the IP and banking regulatory bodies to facilitate structural improvement, the IPO is exploring the possibility of providing support for SMEs directly with respect to IP asset valuation.

In recent roundtable discussions between the British Business Bank, HM Treasury, and the IPO, explanations for any ambivalence from the financial sector towards the credibility of IP asset valuation stemmed from regulatory frameworks within the banking sector, legal enforceability issues regarding the objectivity of valuation, and the liquidity of IP intensive companies. The principle is accepted, but the devil is in the details.

A key challenge identified in the IPO's roundtable discussions was the lack of awareness—amongst both businesses seeking finance and enterprises in the financial services sector trying to provide it—of IP's role as a valuable, albeit intangible, asset and how it may be used to generate cash flow. This means that because IP assets may not be identified or effectively deployed in business strategies, opportunities to secure their full commercial value may be missed. For financiers, it means that IP assets may not be fully appreciated in mainstream lending decisions. To explore these issues, the IPO has committed to research. More information about the practice and impact of IP asset valuations will strengthen the impact of our messages. Two initial research projects have been identified. One is a partnership between the IPO and leading U.K. banks to analyze business loan portfolios to measure the stability of companies with strong IP portfolios. The second partners the IPO with IP valuers themselves, so that we can track the progress of IP intensive companies and analyze the development of their intangible value through time.

The U.K. is not alone in its interest in IP asset valuation as a means of encouraging investment. In the United States (U.S.), Canada, Singapore, China, and the EU, similar approaches are being tested. One way to characterize our approach is to suggest that the instrument of IP asset valuation does not merely increase IP owners' leverage on lenders; it also develops understanding that will benefit all sectors. Sectors are created through specialisms reinforced over time; entrepreneurs don't see sectors—they only see connections and opportunities. Innovative, independent companies in the U.K. are bridging the gap between financial and intellectual assets by developing their own expertise in valuation and its realization. Since 2000, the UK-based commercialization company, IP Group, has focused on linking university-originated research with investors through carefully considered IP asset valuation and development. Innovative, entrepreneurial approaches to the issue of valuing IP assets can successfully transform valuation into investment. Approaches like this exemplify the fluidity and creativity of top-class businesses in the U.K. Whilst IP and finance might traditionally be regarded as rather conservative or "uncreative" realms, in the context of IP asset valuation, a spirit of invention is required to marry the powerful beneficial forces of finance and IP.

Assessing the value of IP assets and disseminating the benefits of doing this are complex tasks. It will take time to build trusted partnerships in a sector where confidentially, extensive regulation, objectivity, and security are paramount. However, by adding to our data sets at national and global levels, robust IP asset valuation can be delivered. IP administrators must engage banking and financial specialists in the regulation of IP asset valuation so that it becomes a widespread, standardized practice. To achieve this, a global and holistic approach to valuing IP must be developed. This will reduce the risk of these assets being overvalued by the financial sector.

Notes:

1 U.K. Office of National Statistics, 2019.

2 IPO, 2017.

3 EPO/EUIPO, 2019.

4 British Business Bank et al., 2018.

5 Bently, 2008.

6 WIPO, 2017.

7 Ogier, 2016.

8 IPO, 2017.

9 British Business Bank et al., 2018.

10 IPO, 2017.

11 IPO, 2013.

12 IPO, 2017.

13 Rothstein, 2018.

14 Rothstein, 2018.

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CHAPTER 16

OPPORTUNITIES TO REAP FINANCING THROUGH IP FOR INNOVATION

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The past two to three decades have been frequently called the “pro-patent” or “pro-IP” era. This period has been characterized by steadily increasing patent and intellectual property (IP) filings with major IP offices throughout the world as well as widening ways of using IP in business contexts. In a transition towards knowledge-based economies, this development follows the observation that the value of firms is increasingly determined by intangible assets, such as know-how, brands, or technological skills. According to a study by Ocean Tomo, 84% of the value of firms represented in the S&P500 stock index in 2015 could be accounted for by intangible assets, while only 16% of the value was determined by tangible assets such as physical property. In 1973, the corresponding shares were 17% and 83%, respectively, hence almost reversed.[1]

It comes, therefore, as no surprise that public policymakers have 1) put considerable efforts in place to make businesses aware of the importance of protecting their intangible assets against unauthorized use and/or unlawful copying by competitors, and have 2) advocated the use of intellectual property rights (IPRs) as a major means to achieve the respective protection—as IP rights have been created specifically for that purpose. To the extent that such awareness raising has reached businesses—which is a question in its own right—one can frequently observe that many firms have started to understand IPRs as a form of insurance a company should have. While such a view can be sufficient for a considerable share of firms, the “insurance-only” stance may, however, obscure perspectives of using IPRs in different and more proactive ways, such as for financing and revenue-generating purposes.

This chapter tries to promote a different view on IP—namely, as a tool that supports the financing of a firm as well as a tool to directly generate money that can fund and finance further innovative activities.[2] Against this backdrop, the chapter addresses major opportunities with respect to the financing of innovations and IP, but also some notable challenges. At the end, it will discuss recommendations for businesses as well as policymakers in government.

The role(s) of IP in securing financing and funding of a firm

Corporate finance, as a specific area of finance, is concerned with financing the decisions of businesses with the goal of maximizing company (share) value. Financing decisions hereby are meant, amongst others, to define “a mix that maximizes the value of projects taken” with the mix covering debt and equity.[3] According to Divestopedia, “...in short, any operation or aspect that involves the finances of an organization is part of corporate finance.”[4]

Discussions in corporate finance, therefore, focus on different sources of funding—be it debt, such as loans, or equity, such as investors buying stocks of a company. Arguably, grants for research and development (R&D) also have a financing functioning. Along these three dimensions, IPRs can have an important supportive function to leverage finance and to fund innovative activities.

IP and equity

In the case of equity, it is well known that IP can be particularly important for raising investments and investor interest.[5] IPRs, and in particular patents, are especially significant for start-ups that aim to attract venture capital (VC).

To understand and experience this significance in practice, beyond mere statistics and marketing of patent attorneys, one only needs to turn to the many now popular business reality television shows where start-ups present their business ideas to a jury of potential investors. The magazine Forbes, for example, states in one of its pieces of advice given to entrepreneurs: "VC firms put their money where there's IP. Look no further than Shark Tank [the United States of America (U.S.) version of such a business reality TV show, aired by ABC]. Have you ever watched an episode where the Sharks fail to grill the entrepreneurs on whether they have the appropriate IP protection?"[6] An example given in the context of the Shark Tank show is that of entrepreneur Tara Brown.[7] By asking the investors for funding to develop the IP of her firm further, she was able to increase sales for a novel non-heat hair roller from US$70,000 before the show aired to more than US$30 million within three months after the show.

Apart from such anecdotal evidence, one also has to underline the many academic papers that evidence the positive relationship between IP protection and VC. A good example here is the meta-analysis of Hall, who looked at 26 such studies.[8] From all these studies, the conclusion of the author is that "…it is clear that venture capitalists prefer to fund firms that have patent applications underway". The author also concludes that different studies offer different explanations for this positive relationship because "…some emphasize the relationship of patents to the underlying quality of the firm's inventions, while others see the patents as pure signals. Still, others emphasize the contribution of the patent grant to appropriability."[9]

The reasons for the significance of IP for investors are, therefore, manifold. First, start-ups—which usually lack larger sales records—can prove that their ideas have value. Their patented inventions must pass the patentability criteria during patent examination. Second, patents also provide for some assurance that the inventions behind a start-up may not be easily copied by other firms. Third, should the start-up go bust, the patents remain and can be sold or licensed to other entities, i.e., losses of the investors can be limited. And fourth, the patents may be "just a signal" to catch the attention of investors, to make the start-up more easily spottable in the market.

The suitability of different IP rights to support finance very much depends on industries. For some industries, such as life sciences or other high-tech industries, patents are of such importance that they can be considered a currency for business formation, growth, and sustenance. In other industries, patents play less of a role, but other forms of IP might be significant—for example, trademarks that protect brands. Furthermore, entire business models can be built on top of IP rights. Franchising, as a form of IP commercialization, can be mentioned in this context.

IPR in debt financing

IPRs may also play a role in debt financing. Patents and other forms of IP rights can be used as collateral for loans.[10] While the rationales for having IP rights back up loans may be similar to those used to back up equity investments, IP used for debt finance is far less common than IP-backed equity counterparts. That said, it may still be a surprisingly vivid market. There are estimates that "…venture lenders, including leader Silicon Valley bank and specialized nonbank lenders, supply roughly US$5 billion to start-ups annually", and—in the context of debt finance—that "…patent assets and their exchange can play a meaningful friction-reducing role in innovation financing."[11] On the other hand, there are study authors who state that "…only anecdotal evidence exists that ventures use patents as collateral to access debt financing."[12] One can interpret these findings in two ways. First, there may indeed be opportunities for using IP in debt finance. Second, there may also be challenges ahead, and this is why the market for such finance exists but is small. We will discuss such challenges later in the chapter. Definitely, though, there is a lack of research and data on the use of IP-backed collateral for debt financing of firms.

The challenges have prompted some governments to intervene and foster the markets for IP-backed debt finance. China, for example, operates government programs that promote the use of IP rights as collateral by providing interest subsidies, specific funds for banks, as well as valuation guidelines and tools to lower the lending risk. Between 2018 and September 2019, it is reported that in the Guangdong province alone, the total amount of patent-collateralized loans may be worth 30 billion yuan (more than US$4 billion), and that "thousands" of companies have benefitted from the schemes.[13] A scheme in Singapore to support IP-collateralization that was launched in 2014 was, however, discontinued in 2018.[14] Other examples include the Republic of Korea, where the Korean Development Bank (KDB) is said to have advanced US$100 million to "…80 IP rich companies in the form of collateralized loans" and the IP Financing Scheme (IPFS) program of Malaysia, which "…is a RM200 million IP-financing program offered through Malaysian Debt Ventures Bhd" to support the use of IP as collateral.[15] One issue with these government programs is that properly detailed evaluations of their outcomes do not seem to exist, at least publicly, that discuss in detail the successes and challenges of the schemes.

IP in the context of R&D grants

An often-overlooked financing function of IP rights may exist in the context of (government-provided) R&D grants. Here, we see two main strands with subtle differences in how IPRs are handled.

In the first strand, many government R&D subsidy programs require that patents and other forms of IP are filed/registered as a result of (successful) R&D projects. Governments want to foster research that results in the successful commercialization of products and services in the market, for which having IP rights is a requirement. However, policymakers and firms should take a very careful look at how the grant schemes are designed. The big fallacy is to believe that an applied-for IP right is equal to a commercialized R&D result. In fact, considerable follow-up research and development to reach, and move beyond, prototype stage may still be needed after a patent has been, for example, filed for an invention.

In the Czech Republic, a system of performance-based research funding in place in the early 2010 years provided points for any patents and utility models that were filed in the course of research projects.[16] Funding was made available to major actors of the Czech innovation system as a function of points obtained. This has led to a proliferation of utility model (UM) filings, which are non-examined patent-like IP rights. In essence, by using utility models, which are not substantively examined for whether the claims brought forward are worthy of IP protection, Czech innovators had the possibility to "print money" by registering as many utility models as possible. The national system by which R&D funding was allocated did not care whether the registered UMs and the inventions behind them had any reasonable commercial prospects. The system, therefore, led to increased costs for the Czech innovation system but not to more innovations entering the market. The system has since been reformed. The major lesson learned for research funders is that performance metrics for IP outputs must include an assessment of the potential commercial value and market outlook.[17]

In the second strand, another often-overlooked financing function of IP rights can be seen in the growing popularity of grants for research consortia, and in particular, transnational research consortia. The European Union (EU) has been at the forefront of the respective development. It has enacted different framework programs for R&D—now in its newest iteration called Horizon-Europe—that require parties from different countries to team up and work on common research projects.[18] Participating in programs like Horizon means additional sources of funding and finance of R&D, on top of other benefits, such as knowledge and technology transfer among consortium partners and the establishment of networks.

The specialty of IP in consortia-based R&D funding lies in the contracts that govern the consortia—the consortia agreements. Here, participants, in their different contributing roles to a project, must know what type of existing know-how and IP is allowed to be used by and shared with the different partners (so-called background IP). Similarly, there must be an agreement as to how jointly developed research results, including, for example, patents, are to be shared among partners (so-called foreground IP). This means that there are quite a few demands laid upon the IP knowledge and IP management skills of consortia partners. Such IP management requires not only registration and filing of IP, but also strategic thinking and negotiating skills for the consortia contracts. However, the potential benefits—such as network formation, access to know-how by the partners, and learning—may outweigh the efforts.

Exchanges and marketplaces for IP—a source for innovation finance?

Soaring IP activities amid challenging issues for IP marketplaces

If IP can be used for both equity and debt finance, the question may then arise whether IP can be used to leverage financing opportunities through exchanges and marketplaces, the same way that stock and/or bond exchanges can be used for capital finance by firms. After all, the usage of the word "assets" and "property" suggests that IP shares a number of characteristics with financial securities. As already mentioned, there is an ever-increasing supply of IP, which would suggest liquidity. Even if the ownership of IP is not transferred, there is clear evidence that (mostly bi-lateral) licensing is a significant activity to raise money for many companies, and this significance has been increasing over time.[19]

There is a short and a long answer to this question: the short answer is there may be respective opportunities. The long answer is that the issue at hand is rather complex and requires differentiated thinking. At the onset, in a very well-written essay discussing IP—and more precisely, patent— marketplaces, study authors Hagiu and Yoffie note:[20]

> "The patent market consists mainly of bilateral transactions, either sales or cross-licenses, between large companies. Such deals are privately negotiated and might involve hundreds or thousands of patents...outside of these bilateral deals, patent buyers and sellers frequently have a hard time finding each other. There is no eBay, Amazon, New York Stock Exchange, or Kelley's Blue Book equivalent for patents, and when buyers and sellers do find each other, they usually negotiate under enormous uncertainty: prices of similar patents vary widely from transaction to transaction and the terms of the transactions (including prices) are often secret and confidential."

Hagiu & Yaffie seem to focus their analysis on the sheer size of the markets. Indeed, there are no IP marketplaces that have the size and volume of a New York Stock Exchange or that of the mentioned large Internet platforms for trading physical goods. But there are numerous smaller initiatives to establish IP marketplaces, with some at least seemingly succeeding in niche markets, while others disappear after a short time. The latter phenomenon seems particularly common for marketplaces that rely solely on electronic trade.

A study by the consulting firm Technopolis for the European Agency for SMEs (EASME) and the European Commission sought to answer specific questions that might explain the seeming paradox.[21] For example, why do so many initiatives fail with respect to the establishment of IP marketplaces, and none reach truly large sizes despite the soaring use of IP and the significance of IP trade and licensing? What can then be learned to establish better-suited mechanisms that aid in collaborations to commercialize IP for promoting innovation?

Looking at the relevant literature and data, as well as executing a thorough interview program with IP finance and tech transfer experts, it emerged that one major difficulty for developing IP markets further is that not all patent/IP licensing is the same. The most crucial distinction seems to be that there are two different market segments—"stick licensing" and "carrot licensing":[22]

- "Stick licensing" refers to the situation where a technology is already used by a company, and the holder of the underlying IP rights (a different company) wants the technology-using firm to obtain a license. This kind of licensing relies heavily on litigation—or the threat of litigation—against alleged IP infringers. It is, therefore, also termed as enforcement or assertion licensing. In discussions on patent/IP monetization markets or brokered IP/patent markets, it is usually this type of licensing and market segment that is referred to.

- "Carrot licensing" describes a different situation "…where parties are interested in a certain technology or knowledge and thus actively pursue a license.… This corresponds in many instances not only to the licensing of patents, but also know-how, i.e., technology licensing."[23] In carrot licensing, therefore, a technology transfer takes place.

The distinction is important as both types of licensing have different characteristics and potential public support needs—even if the boundaries between the two markets are also to an extent fluid.[24]

The "stick licensing" markets

In the case of stick licensing, one significant lever for policymakers is enforcement—the better the enforcement options, the more this IP licensing market segment will thrive. This segment of IP transfer, licensing, or IP monetization is the domain of mostly private patent brokers, which are usually small firms that specialize in monetizing IP portfolios. At any time, there may be a high two-digit to low three-digit number of such brokers operating worldwide. The strong reliance on the possibility to litigate is evidenced in the marketing of a number of these firms. They may offer outright support to firms in following up on patent infringements and brokering licensing deals. Some of the firms successfully operate marketplaces of their own, where the listings resemble listings of tradable financial securities. One can find "bid" and "ask" prices for IP portfolios, for example.

A revealing and important piece of information on such exchanges is the availability of evidence of use (EoU) for listed IP packages. EoUs are being compiled to demonstrate that some market players may already be using patented technologies but fail to pay royalties to owners of the respective patents. Hence, if there is a good EoU, the related IP portfolios become financially attractive. Whoever owns them gets the right to sue said market players for patent infringement and obtain royalty payments—mostly through settlement out of court, as litigation in the courts can be a lengthy, expensive, and risky option for both defendants and plaintiffs.

Another feature of stick licensing is that it is mostly (larger) portfolios of IP rights for a technology that are the subject of interest. The reason is because it is much easier to challenge a single patent—for example, in terms of its validity—which is an important defense for alleged patent infringing parties. Also notable in the stick market is that technology transfer is taking place to a lesser extent, if at all. This reflects the observation that patent infringers have been able to put the technology to use without exchanging with the patent owners, although this is unlawful. Hence, patents listed in stick markets may resemble to an extent the physical goods markets: it is more about the patents (as "commodities") being traded and, to a lesser extent, about the technology, which includes both the patents and the know-how to put the patents to use.

As a bottom line, stick licensing markets may provide an opportunity for firms to obtain finance via the services and marketplaces of patent/IP brokers, if they have IP of reasonable quality and portfolio sizes that may already be partially infringed on or used by other parties. For many public policymakers, however, driving the market through increased litigation possibilities may not be very appealing—amidst a fiery debate about whether increased litigation actually spurs innovation or not, in a market where enforcement-related IP licensing agreements that are settled out of court make very few details public with respect to the terms of the agreements, and in battles between parties where there may be no clear black-and-white.

The "carrot licensing" markets

Once government policymakers are aware of the existence of different IP trade and licensing segments and realize that certain actions on their part may have effects that are difficult to advertise to their constituents, they may be tempted to focus specifically on the carrot licensing market segments. After all, this sees benevolently collaborating partners with little to no dispute, at least initially, harmonically trying to cover complementary needs which will result in the (co-)development of new innovations. Would it not be good to have marketplaces specifically for that purpose—to allow sellers and buyers of the respective IP to find each other more easily, given that unsuccessful "matchmaking" has been identified as a major barrier to technology transfer?[25]

The respective challenges for policymakers to support carrot licensing may turn out to be even higher than for the stick licensing markets.[26] One major issue is that in carrot licensing markets, where there is a technological gap to be covered for a company, an existing patent is highly unlikely to be a turnkey solution for the gap. There is a need to adapt the technology to the respective use case. This will usually require further development of the initial patent. It entails that both parties—the hopeful licensor and the licensee—must develop together a common understanding of the problems to be solved and what the patented technology can and cannot contribute to the solution. It also entails putting to use the know-how of the inventor regarding the invention—know-how that is hard to fully embody in the few pages that make up a patent specification. The Technopolis study has illustrated that such "adaptation" may go as far as the licensor being able to help develop a business use case for his/her licensee. Negotiation experience, cultural differences between the parties, and common R&D become a topic, amongst others. Hence, in carrot licensing, one can usually observe a shift from the pure transfer of IP to the transfer of technology and knowledge accompanied by co-development efforts. Trade or exchange takes place in earlier phases of the development of innovation compared to stick licensing. The situation is further aggravated by the fact that the timing must be right: the potential licensee must have a technology need exactly at the time a corresponding technology is made available and patented.

Against this backdrop, it becomes clear that setting up marketplaces that treat IP as a tradable uniform commodity akin to iron ore will face particular difficulties in the context of carrot licensing. The more successful of these marketplaces will operate in highly personnel-intensive manners, with an (electronic) exchange being at best an auxiliary tool. Their mode of operation will more closely resemble that of consulting firms, where able experts support the "buyers" and "sellers" of the IP/technology to align their mutual understanding, co-develop the innovations further, create use cases, etc. For firms that seek to find licensing partners—and hence further financing—by placing their patents simply on an electronic exchange, this is bad news. Chances are high that the posted patent will just stay there, listed forever. Significantly more effort is needed to commercialize the patent. For policymakers, the Technopolis study delivers the message that there is no silver bullet for improving the IP markets by establishing a purely electronic IP marketplace with public funds.[27] Rather, a bundle of measures is necessary, and, even then, persistence, as well as realistic expectations, may be needed to see the efforts come to fruition.

Common issues in all forms of IP-supported finance

Generally, neither the stick nor the carrot licensing markets can be described as highly liquid, with successful carrot licensing agreements being less commonplace than their enforcement-related counterparts. One problem or barrier to all types of IP finance activities—be it debt or equity finance—is valuation.[28] Intellectual property differs from real property in that the value of IP is very context specific. By definition, a patent, for example, protects a unique invention. Hence, patents cannot be a uniform commodity, such as iron ore. Moreover, the value of the same IP may be different for different companies. One IP portfolio may be very valuable for a company in a certain technology or market position, while, for another firm, the same IP portfolio may be worthless. One particular piece of IP by itself may be worthless, but as part of a portfolio of rights may be extremely valuable. Eventually, one must conclude that there is no such thing as a uniformly-accepted standard method for valuing IP.

Given the sparsity of information on already struck deals, it is no surprise that intermediaries, such as brokers, licensors, and licensees, find it difficult to price a license. Taken together, these factors also explain why purely electronic IP marketplaces may find it so hard to succeed: operators must cater to heterogeneous rather than homogenous goods. There is hence a strong need for human interaction and intermediation for valuing the IP. This also applies to stick licensing, even if the respective requirements in carrot licensing are arguably higher.

The valuation, liquidity, and enforceability challenges described are also major challenges for using IP as collateral in debt finance. On top of these three barriers, there are also barriers unique to IP-based debt financing. One such barrier is banking regulations.[29] Standards like Basel-III set a very strict framework of requirements on how much capital a bank needs to set aside to match the risks associated with certain types of collateral. IP may not meet these criteria. Eventually, one also has to see that while venture funders take a look at the company and its future prospects as a whole, debt funders are restricted to solely assessing the collateral, i.e., the IP.[30] This may be one important factor for why equity-based IP finance is currently more successful than the still nascent IP-backed debt finance.

Conclusions and recommendations

The following are the major conclusions of this chapter:

- There are indeed numerous opportunities to use IP for financing innovation for many firms, if they understand IP rights not only as an insurance policy but also as an active tool for finance purposes.
- However, it is evident that some types of uses of IP finance are more challenging to implement than others.
- Some types of uses of IP for finance—such as IP in consortia agreements in collaborative settings—constitute particularly untapped potential.
- Good know-how of the workings of the IP system in general, the potential value different types of intellectual assets and IP in a company might have, as well as excellent IP management skills are key for success.

A respective set of recommendations for both policymakers and firms, therefore, should build on improving a differentiated know-how and information base around IP-based finance. Against this backdrop, the following recommendations for policymakers and firms seem sensible.

Fostering the use of IP audits by firms

Firms should use offerings that provide for an assessment of all of their IP assets, while governments should implement respective schemes for first-time IP audits and improve existing schemes for firms.

Many countries have, with various degrees of success, implemented publicly supported "first" audits of the IP situation of a firm. Running under different names such as "IP Audits Plus" (United Kingdom), "IP Prediagnosis" (France), or "discover.IP" (Austria), these schemes attempt to analyze the whole IP situation of a firm and identify where potentially valuable intellectual assets and IP may be found. Firms should be made aware of and use such offerings. Policymakers should look at implementing respective schemes, if they have not done so, and improving the existing ones. A key success factor is the availability of well-trained service-providing staff that can bridge technical, legal, and management/business know-how and that is able to develop, with the consulted firm, a joint strategic understanding of the IP of the firm. Complementary measures should be considered, such as individual IP coaching after the initial audit has taken place, to ensure proper implementation of recommendations, or the use of self-assessment tools (e.g., prior to an audit) such as the ipAwarenessAssessment web tool of the United States Patent and Trademark Office (USPTO) or the IP Healthcheck questionnaire of the United Kingdom (U.K.) IP Office.

Improving the know-how of firms in relation to the usage of IP in collaborative settings

Firms in sectors where (R&D) collaborations are a topic need to be well-versed in the management of IP rights in collaborative settings, and governments should ensure adequate awareness raising in this regard.

With the growing prevalence of R&D consortia funding, open innovation approaches, and even “straightforward” licensing, firms must improve their know-how regarding how to manage their IP in such setups. In many countries, policymakers have yet to improve respective support efforts. While there seems to be a lot of material available with respect to the “basics” of IP, such as how to file a patent or trademark, the use of IP in collaborations is more sparsely covered. There is a need for a comprehensive support package that may cover things like negotiation tips, information collection on licensing terms, or support in the provision of what firms should look for when drafting a licensing agreement. Some countries have successfully developed model licensing contracts, for example, the United Kingdom’s Lamberts Toolkit, Austria’s Intellectual Property Agreement Guide (IPAG), Ireland’s Knowledge Transfer Ireland (KTI) model agreements, and Germany’s BMWi model agreements for R&D collaborations. Most of these attempts have their roots in university-industry technology transfer licensing. There may be a need for adaptation to business-to-business (B2B) settings. Also, it might be good to have an international exchange—sharing experience with respective solutions—followed by implementation of successful models in countries that have not yet worked on offerings.

Improving the know-how of intermediaries

Among business finance intermediaries, non-IP specialists need basic IP know-how too.

Apart from addressing firms directly, there is also a need to improve the IP know-how of important stakeholders and business intermediaries in the finance sector. This includes educating banks—for example, with training programs for how to value IP. Other important target groups are investor associations, R&D and innovation supporting agencies, cluster organizations, etc.

Taking a careful stance to foster IP markets

Policymakers need to consider differentiated approaches if they aim to design and implement measures to improve the IP finance markets.

Experience has shown that a number of seemingly straightforward solutions to the challenges of IP finance and licensing markets should be taken with a grain of salt:

- The first solution concerns the establishment of electronic IP marketplaces. Given the non-commodity character of IP as described and the valuation issues, it is highly likely that simple electronic marketplaces will not deliver on expectations. More successful private marketplaces are very personnel-intensive undertakings, akin to consulting firms.

- Another solution concerns the use of “simple” IP filing indicators as a major requirement to obtain (R&D) funding. The example in the article shows that ill-designed systems may primarily produce costs and hardly any positive effects. Policymakers wanting to advance technology transfer from university to industry should not count patents and IP alone but should pay more attention to the commercial outlook or context of the applied-for patents and IP.

Creating context-specific approaches

Businesses in industries where IP is used will likely face challenges that are specific to their firm, market environment, and industry. A proper response is a tailored corporate IP strategy, tied closely to the overall business strategy and catering to financial goals. Generally speaking, there must be an understanding that different types of IP finance market segments and instruments need to be treated differently. Therefore, a key success factor is, as a final conclusion and recommendation to policymakers, differentiated and context-specific approaches.

Notes:

1 Ocean Tomo, 2019.

2 The article is trying to focus here on the use of IP to fund/finance innovation. This needs a bit more clarification. The patent system, for example, by its very design is meant to foster innovation. It provides monopoly-like rights for a time-limited period, so that inventors can recuperate R&D costs. Such R&D would not have been undertaken by inventors absent patent protection, because competitors would simply copy the R&D results without themselves investing in R&D. In this analysis, we discard this specific incentivizing/financing function and look at instances where patents and other IP are used to generate monetary income streams that can, in addition to said incentivizing function, help fund innovative activities. However, money is fungible. It is difficult to link, in many instances, specific income streams directly to specific innovative activities. In this article, it is therefore assumed that at least part of the monetary income generated with the help of IP is also used for developing innovations.

3 Damodaran, n.d.

4 Divestopedia, 2015.

5 Haeussler et al., 2009.

6 Juetten, 2015.

7 Ciccatelli, 2017.

8 Most of these studies relate to developed countries, e.g., the U.S., Canada, Israel, or Germany. But VCs sometimes decide to fund companies also in less developed countries (if they have a good enough business model) and also help, as will be discussed further below, in funding further the continued costs for applying and using appropriate IP protection.

9 Hall, 2019.

10 British Business Bank – UKIPO, 2018.

11 Hochberg et al., 2018.

12 Fischer et al., 2014.

13 Shenggao, 2019.

14 British Business Bank – UKIPO, 2018.

15 Duff et al., 2019.

16 Good et al., 2015.

17 Radauer et al., 2011.

18 The rationale—a peculiarity of the European system—is rooted in the principle of subsidiarity. The principle states that the EU should, as a supranational organization, only be active in endeavors that cannot not be (well) handled at purely national level. Transnational R&D is such a case in point. National R&D supporting agencies will usually not spend their taxpayers´ money to subsidize research by parties abroad. The EU Framework Programme (FP)/Horizon programmes can be seen in this context as an early adoption of the open innovation concept that has been increasingly gaining popularity and advocates manifold types of inter-organizational collaborations to spur the development of innovations.

19 Zuniga et al., 2009; Radauer et al., 2013.

20 Hagiu et al., 2013.

21 Radauer et al., 2019.

22 Reinhardt, 2008.

23 Radauer et al., 2019.

24 Radauer et al., 2019.

25 Zuniga et al., 2009; Radauer et al., 2013.

26 Radauer et al., 2019.

27 See also Radauer et al., 2016; As far as the electronic marketplaces are concerned, this study conducted in Germany worked out a number of success factors for any who want to set up such a platform. While the study looked at the wider area of platforms that support "open innovation" collaboration, the success factors are basically similar if one were to establish an IP platform for "carrot licensing".

28 British Business Bank—UKIPO, 2018.

29 British Business Bank—UKIPO, 2018.

30 OECD, 2015.

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APPENDICES

APPENDIX I

THE GLOBAL INNOVATION INDEX (GII) CONCEPTUAL FRAMEWORK

The rationale for the Global Innovation Index

The Global Innovation Index (GII) project was launched by Professor Dutta in 2007 during his tenure at INSEAD. The goal was to find and determine metrics and methods that could better capture the richness of innovation in society, going beyond the traditional measures of innovation such as the number of research articles and the level of research and development (R&D) expenditures.[1]

There were several motivations for setting this goal. First, innovation is important for driving economic progress and competitiveness—both for developed and developing economies. Many governments are putting innovation at the center of their growth strategies. Second, the definition of innovation has broadened—it is no longer restricted to R&D laboratories and published scientific papers. Innovation could be and is more general and horizontal in nature, including social, business model, and technical innovation. Last, but foremost, recognizing and celebrating innovation in emerging markets is critical for inspiring people—especially the next generation of entrepreneurs and innovators.

Now in its 13th edition, the GII helps to create an environment in which innovation factors are under continual evaluation. It provides a key tool for decision-makers and a rich database of detailed metrics for refining innovation policies.

The GII is not meant to be the ultimate and definitive ranking of economies with respect to innovation. Measuring innovation outputs and its impact remains difficult, hence great emphasis is placed on measuring the climate and infrastructure for innovation and on assessing related outcomes.

Although the end results take the shape of several rankings, the GII is more concerned with improving the "journey" to better measurement, understanding innovation, and in identifying targeted policies, good practices, and other levers that foster innovation. The rich data metrics, at index, sub-index, or indicator level, can be used to monitor performance over time and to benchmark developments against economies within the same region or income group classification.

Drawing on the expertise of the GII's Knowledge Partners and its prominent Advisory Board, the GII model is continually updated to reflect the improved availability of statistics and our understanding of innovation. This year the model continues to evolve, although its mature state now requires only minor updates (Appendix IV).

An inclusive perspective on innovation

The GII adopts a broad notion of innovation, originally elaborated in the *Oslo Manual* developed by the European Communities and the Organisation for Economic Co-operation and Development (OECD). In its fourth edition, the Oslo Manual 2018 introduces a more general definition of innovation:[2]

An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process).

This update of the Oslo Manual also introduces a series of definitions associated to innovation in business activities and for different types of innovation firms.[3] In this context, innovation translates as improvements made to outcomes in the form of either new goods or services or any combination of these. While the GII focuses on a more general definition of innovation, it is important to highlight how these definitions capture the evolution of the way innovation has been perceived and understood over the last two decades.[4]

Economists and policymakers previously focused on R&D-based technological product innovation, largely produced in-house and mostly in manufacturing industries. Innovation of this nature was executed by a highly educated labor force in R&D-intensive companies. The process leading to such innovation was conceptualized as closed, internal, and localized. Technological breakthroughs were necessarily "radical" and took place at the "global knowledge frontier". This characterization implied the existence of leading and lagging economies, with low- or middle-income economies only playing "catch up".

Today innovation capability is increasingly seen as the ability to exploit new technological combinations; it embraces the notion of incremental innovation and "innovation without research". Non-R&D innovative expenditure is an important component of reaping the rewards of technological innovation. Interest in understanding how innovation evolves in low- and middle-income economies is increasing, along with an awareness that incremental forms of innovation can impact development. Furthermore, the process of innovation itself has changed significantly. Investment in innovation-related activity has consistently intensified at the firm, economy, and global levels, adding both new innovation actors from outside high-income economies and non-profit actors. The structure of knowledge production activity is more complex and geographically dispersed than ever.

A key challenge is to find metrics that capture innovation as it actually happens in the world today.[5] Direct official measures that quantify innovation outputs remain extremely scarce.[6] For example, there are no official statistics on the amount of innovative activity—defined as the number of new products, processes, or other innovations—for any given innovation actor, let alone for any given country (see the GII 2013, Chapter 1, Annex 1, Box 1). Most measurements also struggle to appropriately capture the innovation outputs of a wider spectrum of innovation actors, such as the services sector or public entities. This includes innovation surveys, which have contributed greatly to the measurement of innovation activities, but that fail to provide a good and reliable sense of cross-economy innovation output performance, and that are often not applicable to developing economies where innovation is often informal.[7]

The GII aims to move beyond the mere measurement of such simple innovation metrics. To do so will require the integration of new variables, with a trade-off between the quality of the variable on the one hand and achieving good economy coverage on the other. A key priority is to improve the measurement of innovation in the field of knowledge-intensive services, user and public sector innovation, including policy support to innovative entrepreneurship and venture capital, innovation linkages (in particular international ones), and innovation outputs and impacts more generally.[8]

The timeliest possible indicators are used for the GII: 29.9% of data obtained are from 2019, 41.5% are from 2018, 10.7% are from 2017, 3.6% are from 2016, 1.6% from 2015, and the small remainder of 3.1% from earlier years.[9]

The GII conceptual framework

The GII is an evolving project that builds on its previous editions, while incorporating newly available data, and is inspired by the latest research on the measurement of innovation. This year the GII model includes 131 countries/economies, which represent 93.5% of the world's population and 97.4% of the world's GDP in purchasing power parity current international dollars. The GII relies on two sub-indices—the Innovation Input Sub-Index and the Innovation Output Sub-Index—each built around pillars. Three measures are calculated (Figure I.1):[10]

Innovation Input Sub-Index: Five input pillars capture elements of the national economy that enable innovative activities.

Innovation Output Sub-Index: Innovation outputs are the result of innovative activities within the economy. Although the Output Sub-Index includes only two pillars, it has the same weight in calculating the overall GII scores as the Input Sub-Index.

The overall GII score is the average of the Input and Output Sub-Indices.

Each pillar is divided into three sub-pillars, each of which is composed of individual indicators, a total of 80 this year. The GII pays special attention to presenting a scoreboard for each economy that includes strengths and weaknesses and makes the data series accessible (Appendix II); providing data sources and definitions (Appendix III); and detailed technical notes and adjustments to the GII framework, including a detailed analysis of the factors influencing year-on-year changes (Appendix IV). In addition, since 2011 the GII has undergone an independent statistical audit performed by the Joint Research Centre of the European Union (Appendix V).

The Innovation Input Sub-Index

The first sub-index of the GII, the Innovation Input Sub-Index, has five enabler pillars: Institutions, Human capital and research, Infrastructure, Market sophistication, and Business sophistication. Enabler pillars define aspects of the environment conducive to innovation within an economy.

Pillar 1: Institutions

Nurturing an institutional framework that attracts business and fosters growth by providing good governance and the correct levels of protection and incentives is essential to innovation. The Institutions pillar captures the institutional framework of an economy.

The Political environment sub-pillar includes two indices: the first is the political, legal, operational or security risk index that replaces the political stability and safety indicator, reflecting more on the likelihood and severity of political, legal, operational or security risks impacting business operations; the second reflects the quality of public and civil services, policy formulation, and implementation.

The Regulatory environment sub-pillar draws on two indices aimed at capturing perceptions on the ability of the government to formulate and implement cohesive policies that promote the development of the private sector and at evaluating the extent to which the rule of law prevails (in aspects such as contract enforcement, property rights, the police, and the courts). The third indicator evaluates the cost of redundancy dismissal as the sum, in salary weeks, of the cost of advance

FIGURE A-I.1

Framework of the Global Innovation Index 2020

Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2020.

notice requirements added to severance payments due when terminating a redundant worker.

The Business environment sub-pillar expands on two aspects that directly affect private entrepreneurial endeavors by using the World Bank indices on the ease of starting a business and the ease of resolving insolvency (based on the recovery rate recorded as the cents on the dollar recouped by creditors through reorganization, liquidation, or debt enforcement/ foreclosure proceedings).

Pillar 2: Human capital and research

The level and standard of education and research activity in an economy are prime determinants of the innovation capacity of a nation. This pillar tries to gauge the human capital of economies.

The first sub-pillar includes a mix of indicators aimed at capturing achievements at the elementary and secondary education levels. Education expenditure and school life expectancy are good proxies for coverage. Government funding per pupil, secondary, gives a sense of the level of priority given to secondary education by the state (excluding funding from abroad). The quality of education is measured through the results to the OECD Programme for International Student Assessment (PISA), which examines 15-year-old students' performances in reading, mathematics, and science, as well as the pupil-teacher ratio.

Higher education is crucial for economies to move up the value chain beyond simple production processes and products. The sub-pillar on tertiary education aims at capturing coverage (tertiary enrolment); priority is given to the sectors traditionally associated with innovation (with a series on the percentage of tertiary graduates in science, engineering, manufacturing, and construction); and the inbound and mobility of tertiary students, which plays a crucial role in the exchange of ideas and skills necessary for innovation.

The last sub-pillar, on R&D, measures the level and quality of R&D activities, with indicators on researchers (full-time equivalence), gross expenditure, the R&D expenditures of top global R&D spenders, and the quality of scientific and research institutions as measured by the average score of the top three universities in the QS World University Ranking of 2019. The R&D expenditures of the top three firms in a given economy looks at the average expenditure of these three firms that are part of the top 2,500 R&D spenders worldwide. The QS university rankings indicator gives the average scores of the economy's top three universities that belong to the top 700 universities worldwide. These indicators are not aimed at assessing the average level of all institutions within an economy.

Pillar 3: Infrastructure

The third pillar includes three sub-pillars: Information and communication technologies (ICTs), General infrastructure, and Ecological sustainability.

Good and ecologically friendly communication, transport, and energy infrastructures facilitate the production and exchange of ideas, services, and goods and feed into the innovation system through increased productivity and efficiency, lower transaction costs, better access to markets, and sustainable growth.

The ICTs sub-pillar includes four indices, each on ICT access, use, online service by governments, and online participation of citizens.

The sub-pillar on general infrastructure includes the average of electricity output in GWh per capita; a composite indicator on logistics performance; and gross capital formation, which consists of outlays on additions to the fixed assets and net inventories of the economy, including land improvements (fences, ditches, drains); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings.

The sub-pillar on ecological sustainability includes three indicators: GDP per unit of energy use (a measure of efficiency in the use of energy), the Environmental Performance Index of Yale and Columbia Universities, and the number of certificates of conformity with standard ISO 14001 on environmental management systems issued.

Pillar 4: Market sophistication

The availability of credit and an environment that supports investment, access to the international market, competition, and market scale are all critical for businesses to prosper and for innovation to occur. The Market sophistication pillar has three sub-pillars structured around market conditions and the total level of transactions.

The Credit sub-pillar includes a measure on the ease of getting credit aimed at measuring the degree to which collateral and bankruptcy laws facilitate lending by protecting the rights of borrowers and lenders, as well as the rules and practices affecting the coverage, scope, and accessibility of credit information. Transactions are given by the total value of domestic credit and, to make the model more applicable to emerging markets, by the gross loan portfolio of microfinance institutions.

The Investment sub-pillar includes the ease of protecting minority investors index as well as two indicators on the level of transactions. The Investment sub-pillar includes the ease of protecting minority investors index as well as two indicators on the level of transactions. These two indicators look at whether market size is matched by market dynamism and provide a hard data metric on venture capital deals.

The last sub-pillar tackles trade, competition, and market scale. The market conditions for trade are given in the first indicator measuring the average tariff rate weighted by import shares. The second indicator is a survey question that reflects the intensity of competition in local markets. Efforts made at finding hard data on competition remain unsuccessful so far.

Domestic market scale, as measured by an economy's GDP, was incorporated in 2016, so the last sub-pillar takes into consideration the impact that the size of an economy has on its capacity to introduce and test innovations in the marketplace.

Pillar 5: Business sophistication

The last enabler pillar tries to capture the level of business sophistication to assess how conducive firms are to innovation activity. The Human capital and research pillar (pillar 2) made the case that the accumulation of human capital through education, particularly higher education and the prioritization of R&D activities, is an indispensable condition for innovation to occur. That logic is taken one step further here with the assertion that businesses foster their productivity, competitiveness, and innovation potential with the employment of highly qualified professionals and technicians.

The first sub-pillar includes four quantitative indicators on knowledge workers: employment in knowledge-intensive services; the availability of formal training at the firm level; R&D performed by business enterprise (GERD) as a percentage of GDP (i.e., GERD over GDP); and the percentage of total gross expenditure of R&D that is financed by business enterprise. In addition, the sub-pillar includes an indicator related to the percentage of females employed with advanced degrees. This indicator, in addition to providing a glimpse into the gender labor distributions of nations, offers more information about the degree of sophistication of the local human capital currently employed.

Innovation linkages and public/private/academic partnerships are essential to innovation. In emerging markets, pockets of wealth have developed around industrial or technological clusters and networks, in sharp contrast to the poverty that may prevail in the rest of the territory. The Innovation linkages sub-pillar draws on both qualitative and quantitative data regarding business/university collaboration on R&D, the prevalence of well-developed and deep clusters, the gross R&D expenditure financed by abroad as a percentage of GDP, and the number of deals on joint ventures and strategic alliances. In addition, the total number of Patent Cooperation Treaty (PCT) and national office published patent family applications filed by residents in at least two offices proxies for international linkages. The GII team has been evaluating various hard data-based indicators to measure innovation linkages in an economy. Measuring innovation linkages adequately remains challenging, if not to say, impossible based on existing innovation metrics.

In broad terms, pillar 4 on market sophistication makes the case that well-functioning markets contribute to the innovation environment through competitive pressure, efficiency gains, and economies of transaction and by allowing supply to meet demand. Markets that are open to foreign trade and investment have the additional effect of exposing domestic firms to best practices around the globe, which is critical to innovation through knowledge absorption and diffusion, which are considered in pillars 5 and 6. The rationale behind sub-pillars 5.3 on knowledge absorption (an enabler) and 6.3 on knowledge diffusion (a result)—two sub-pillars designed to mirror each other as much as possible—is precisely that together they will reveal how good economies are at absorbing and diffusing knowledge.

Sub-pillar 5.3 includes five metrics that are linked to sectors with high-tech content or are key to innovation: intellectual property payments as a percentage of total trade (three-year average); high-tech imports as a percentage of total imports; imports of communication, computer and information services as a percentage of total trade; and net inflows of foreign direct investment (FDI) as a percentage of GDP (three-year average). To strengthen the sub-pillar, the percentage of research talent in business was added in 2016 to provide a measurement of professionals engaged in the conception or creation of new knowledge, products, processes, methods, and systems, including business management.

The Innovation Output Sub-Index

Innovation outputs are the results of innovative activities within an economy. Although the Output Sub-Index includes only two pillars, it has the same weight in calculating the overall GII scores as the Input Sub-Index. There are two output pillars: Knowledge and technology outputs and Creative outputs.

Pillar 6: Knowledge and technology outputs

This pillar covers all those variables that are traditionally thought to be the fruits of inventions and/or innovations. The first sub-pillar refers to the creation of knowledge. It includes five indicators that are the result of inventive and innovative activities: patent applications filed by residents both at the national patent office and at the international level through the PCT; utility model applications filed by residents at the national office; scientific and technical published articles in peer-reviewed journals; and an economy's number of articles (H) that have received at least H citations.

The second sub-pillar, on knowledge impact, includes statistics representing the impact of innovation activities at the micro- and macro-economic level or related proxies: increases in labor productivity (three-year average), the entry density of new firms, spending on computer software, the number of certificates of conformity with standard ISO 9001 on quality management systems issued, and the measure of high- and medium-high-tech industrial output over total manufactures output.

The third sub-pillar, on knowledge diffusion, mirrors the knowledge absorption sub-pillar of pillar 5, except for indicators 5.3.2 (no longer net imports) and 5.3.5 (on research talent). It includes four statistics all linked to sectors with high-tech content or that are key to innovation: intellectual property receipts as a percentage of total trade (three-year average); high-tech net exports as a percentage of total trade; exports of ICT services as a percentage of total trade; and net outflows of FDI as a percentage of GDP (three-year average).

Pillar 7: Creative outputs

The role of creativity for innovation is still largely underappreciated in innovation measurement and policy debates. Since its inception, the GII has always emphasized measuring creativity as part of its Innovation Output Sub-Index. The last pillar, on creative outputs, has three sub-pillars.

The first sub-pillar on intangible assets includes statistics on trademark applications by residents at the national office and, this year, introduces an indicator showing which economies have the most valuable brands. This novel indicator sums the values of all the top 5,000 most valuable brands of each economy and then scales this brand value by GDP. In this pillar, industrial designs included in applications at a regional or national office replaces one survey question on organizational models—a new area that is linked to process innovations in the literature.

The second sub-pillar on creative goods and services includes proxies to get at creativity and the creative outputs of an economy. In 2014, to include broader sectoral coverage, a global entertainment and media output composite was added. In addition, that same year the indicator on audio-visual and related services exports was renamed "Cultural and creative services exports". It expanded to include information services, advertising, market research and public opinion polling, and other, personal cultural and recreational services (as a percentage of total trade). This year this last segment is replaced by heritage and recreational services. These two indicators complement the remainder of the sub-pillar, which measures national feature films produced in a given economy (per capita count); printing and other media output (as a percentage of total manufactures output),and creative goods exports (as a percentage of total trade), all of which are aimed at providing an overall sense of the international reach of creative activities in an economy.

The third sub-pillar on online creativity includes four indicators: generic and economy/country-code top-level domains, average yearly edits to Wikipedia; all scaled by population aged 15 through 69 years old and mobile app creation which is scaled by GDP (bn PPP US$). In 2019, the indicator on mobile app creation was improved to capture more precisely the downloads of apps by origin of the headquarters of the developer/firm. This improvement offered more insight into how innovation, production, and trade of digitized creative products and services are evolving in an innovation-based economy.

Notes:

1 For a detailed introduction to the Global Innovation Index, see the GII 2011.

2 Eurostat and OECD, 2018.

3 The manual uses the term "innovation activities" to refer to processes while the term "innovation" is limited to outcomes. Business innovation is defined as a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm. Business processes include all core activities by the firm to produce products as well as all auxiliary or supporting activities. A product innovation is a new or improved good or service that differs significantly from the firm's previous goods or services and that has been introduced on the market. A business process innovation is a new or improved business process for one or more business functions that differs significantly from the firm's previous business processes and that has been brought into use in the firm.

The innovation status of a firm is defined based on its engagement in innovation activities and its introduction of one or more innovations over the observation period of a data collection exercise. There are three categories of innovative and innovation-active firms: innovative, non-innovative, and innovation-active firms.

4 OECD, 2010; INSEAD, 2011; and WIPO, 2011.

5 INSEAD, 2011; OECD Scoreboard, 2013; WIPO, 2011

6 INSEAD, 2011; OECD, 2011; WIPO, 2011.

7 Elahi et al., 2016.

8 See OECD Blue Sky Forum on Science and Innovation Indicators retrieved from http://www.oecd.org/innovation/blue-sky.htm

9 For completeness, 0.7% of data points are from 2014, 0.6% from 2013, 0.5% from 2012, 0.5% from 2011, 0.5% from 2010 and a few exceptions from 2009 (0.2%). In addition, the GII is calculated based on 9,468 data points (compared to 10,480 with complete series), implying that 9.7% of data points are missing. The Data Tables (Appendix II) include the reference year for each data point and mark missing data as not available (n/a).

10 In 2019, the GII introduced an alternative to study the connection between innovation inputs and outputs, replacing the Efficiency Ratio (Chapter 1, Figure 1.10 and relevant segment).

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APPENDIX II

ECONOMY PROFILES & DATA TABLES

Economy profiles

The following tables provide detailed profiles for each of the 131 economies in the Global Innovation Index 2020. They are constructed around three sections.

1 The top section provides the overall Global Innovation Index (GII) rank for each economy.

2 The next section provides eight key metrics at the beginning of each profile that are intended to put the economy into context. They present the Innovation Output Sub-Index rank, Innovation Input Sub-Index rank, the income group to which the economy belongs, its geographical region,[1] population in millions,[2] GDP in billion US$ PPP, and GDP per capita in US$ PPP.[3] The last metric provides the GII 2019 rank for the economy.

Because of economies dropping or entering the GII, and because of adjustments made to the GII framework every year and other technical factors not directly related to actual performance (missing data, updates of data, etc.), the GII rankings are not directly comparable from one year to the next. Please refer to Appendix IV for details.

All scores at the sub-index, pillar, sub-pillar, and indicator level are normalized in the 0–100 range. The Innovation Input Sub-Index score is calculated as the simple average of the scores in the first five pillars, while the Innovation Output Sub-Index is calculated as the simple average of the scores in the last two pillars. Each sub-index rank is then computed on the basis of these scores for each economy.

3 Pillars are identified by an illustrative icon, sub-pillars by two-digit numbers, and indicators by three-digit numbers. For example, indicator *1.3.1, ease of starting a business,* appears under sub-pillar *1.3, Business environment,* which in turn appears under pillar, *Institutions.* Throughout the report the pillars are identified by their respective icons or names and the sub-pillars and indicators by their respective numbers.

The 2020 GII includes 80 indicators and three types of data. Composite (or index) indicators are identified with an asterisk (*), survey questions from the World Economic Forum's Executive Opinion Survey are identified with a dagger (†), and the remaining indicators are all hard data series.

For hard data, the original value is provided (except for indicators in sub-pillar 7.3, for which the raw data were provided under the condition that only the normalized scores be published). Normalized scores in the 0–100 range are provided for everything else (index and survey data, sub-pillars, pillars, and indices).

When data are either not available or out of date, "n/a" is used with a cutoff year of 2010, with few exceptions (see Appendix IV for more details). The year of each data point is indicated in the Data Tables in Appendix II online at https://globalinnovationindex.org. To the right of the indicator title, a clock symbol indicates that the economy's data for that indicator are older than the base year. More details, including the year of the data in question, are available in the Data tables in Appendix II online at https://globalinnovationindex.org.

For further details, see Appendix III, Sources and Definitions, and Appendix IV, Adjustments to the Global Innovation Index Framework, Year-on-Year Comparability of Results, and Technical Notes.

4 To the far right of each column, strengths of the economy in question are indicated by a solid circle (●), weaknesses by a hollow circle (○). Strengths within the economy's income group are indicated with a solid diamond (◆), weaknesses by a hollow diamond (◇). The only exceptions to the income group strengths and weaknesses are the top 25 high-income economies, where these strengths and weaknesses are computed within the top 25 group.[4]

All ranks of 1, 2, and 3 are highlighted as strengths, except in particular instances at the sub-pillar level where strengths and weaknesses are not signaled when the desired minimum indicator coverage (DMC) is not met for that sub-pillar.[5] For the remaining indicators, strengths and weaknesses of a particular economy are based on the percentage of economies with scores that fall below its score (i.e., percent ranks).

- For a given economy, strengths (●) are those scores with percent ranks greater than the 10th largest percent rank among the 80 indicators in that economy.
- For that economy, weaknesses (○) are those scores with percent ranks lower than the 10th smallest percent rank among the 80 indicators in that economy.
- Similarly, for a given economy, income group strengths (◆) are those scores that are above the income group average plus the standard deviation within the group.
- For that economy, weaknesses (◇) are those scores that are below the income group average minus the standard deviation within the group.

In addition, economies with a sub-pillar that does not meet the DMC will show the score for that sub-pillar within brackets. Those that have more than one sub-pillar that fails to meet the DMC in the same pillar will also show the ranks of the pillar where these are located within brackets. For these pillars and sub-pillars, strengths/weaknesses are not signaled.

Percent ranks embed more information than ranks and allow for comparisons of ranks of series with missing data and ties in ranks. Examples from the Russian Federation and Benin illustrate this point:

1. Strengths for Russia are all indicators with percent ranks equal to or above 0.85 (10th largest percent rank for Russia); weaknesses are all indicators with percent ranks equal to or below 0.26 (Russia's 10th smallest percent rank).
2. Russia ranks 19th out of 131 economies in 2.1.5, Pupil-teacher ratio, secondary, with a percent rank of 0.85; this indicator is a strength for Russia.
3. Russia ranks 22nd in 6.1.5, Citable documents H index, but with a percent rank of 0.84, this indicator is not a strength for Russia.
4. The rank of 76 (percent rank of 0.24) in 7.2.4, Printing & other media, % manufacturing, is a weakness for Russia. By contrast, the similar rank of 75 for in 3.2.2, Logistics performance is a strength for Benin (with a percent rank of 0.40, this is equal to the cutoff for strengths for Benin, which is 0.40).

Percent ranks are not reported in the Economy Profiles but they are presented in the Data Tables online at https://globalinnovationindex.org.

Data Tables

This appendix provides a description of the tables for each of the 80 indicators that make up the Global Innovation Index 2020. These can be found online at https://globalinnovationindex.org.

Structure

Each table is identified by indicator number, with the first digit representing the pillar, the second representing the sub-pillar, and the final digit representing the indicator within that particular sub-pillar. For example, Table 5.1.4 shows results for indicator 5.1.4, GERD financed by business enterprise, which is the fourth indicator of sub-pillar 5.1, Knowledge workers, within pillar 5, Business sophistication.

The sub-heading text provides a detailed description of each indicator and includes information on the units of each variable, the scaling factor (if any), the question asked (for survey questions), and the most frequent year for which data were available.

For each indicator for each economy, the most recent value within the period 2010–19 was used (with few exceptions, which are further explained in Appendix IV). In instances where this base year does not correspond to the most frequent year reported in the sub-heading, the year of the value appears in parentheses after the economy name. These instances are noted in the Economy Profiles after the indicator name with a clock symbol.

A total of 58 variables are hard data. A total of 18 variables are composite indicators and 4 are survey questions from the World Economic Forum's *Executive Opinion Survey*.

The source of each indicator is indicated at the bottom of the page; details for each can be found in Appendix III, Sources and Definitions.

Explanation of scores

The tables list the economies by their rank order, with the best performers at the top. After the rank comes the economy name, the original value of the specific indicator for that economy (in the units specified in the sub-heading), the normalized score in the 0–100 range, and the percentage of economies with scores that fall below the normalized score (i.e., percent ranks). To the far right of each column, a solid circle indicates that an indicator is a strength for the economy in question, and a hollow circle indicates that it is a weakness.

- Strengths (●) are all ranks of 1, 2, and 3, as well as all scores with percent ranks greater than the 10th highest percent rank among the 80 indicators in a specific economy.
- Weaknesses (○) are all scores with percent ranks lower than the 10th smallest percent rank among the 80 indicators in a specific economy.

For four hard data series (7.3.1, 7.3.2, 7.3.3, and 7.3.4), the raw data were provided under the condition that only the normalized scores be published and therefore the original value equals the normalized score. For indicators 1.3.1, 1.3.2, 2.3.4, 3.3.2, 4.1.1, and 4.2.1, the range for both measures is the same—(0–100)—and therefore both measures are also identical.

Details on the computation methodology can be found in Appendix IV.

Notes:

1 Countries/economies are classified according to the World Bank Income Group (June 2019; see https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups) and special classification based on the online version of the United Nations publication *Standard Country or Area Codes for Statistical Use*, originally published as Series M, No. 49, and now commonly referred to as the M49 standard (July 2019; see https://unstats.un.org/unsd/methodology/m49/). These are: EUR = Europe; NAC = Northern America; LCN = Latin America and the Caribbean; CSA = Central and Southern Asia; SEAO = South East Asia, East Asia, and Oceania; NAWA = Northern Africa and Western Asia; SSF = Sub-Saharan Africa.

2 Data are from the United Nations, Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2019 Revision*.

3 Data for GDP and GDP per capita are from the International Monetary Fund *World Economic Outlook 2019* database.

4 As the only non-high-income economy in the top 25, China's income group strengths and weaknesses are computed within the non-top 25 group.

5 Data stringency requirements are used in the attribution of strengths and weaknesses at the sub-pillar level. These levels were revised in 2019. When economies do not meet a data minimum coverage (DMC) requirement at the sub-pillar level (for sub-pillars with two indicators, the DMC is 2; for three it is 2; for four it is 3; and for five it is 4), they are not attributed a strength or weakness at the sub-pillar either. Furthermore, if the economy in question does not meet the DMC requirements at the sub-pillar level, but it still obtains a ranking higher than or equal to 10 or a ranking equal to or lower than 100 at the sub-pillar level, for caution this rank is put in brackets. This procedure is to ensure that incomplete data coverage does not lead to erroneous conclusions about strengths or weaknesses, or particularly about strong or weak sub-pillar rankings.

Index of economy profiles

ALBANIA

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
91	74	Upper middle	EUR	2.9	40.2	12,214.7	83

		Score/Value	Rank	
	INSTITUTIONS	**66.0**	**56**	
1.1	**Political environment**	**59.5**	**61**	
1.1.1	Political and operational stability*	73.2	49	
1.1.2	Government effectiveness*	52.7	63	
1.2	**Regulatory environment**	**58.7**	**83**	
1.2.1	Regulatory quality*	49.2	58	
1.2.2	Rule of law*	36.4	85	
1.2.3	Cost of redundancy dismissal, salary weeks	20.8	89	
1.3	**Business environment**	**79.7**	**34**	● ◆
1.3.1	Ease of starting a business*	91.8	47	●
1.3.2	Ease of resolving insolvency*	67.7	36	●
	HUMAN CAPITAL & RESEARCH	**20.3**	**95**	◇
2.1	**Education**	**31.6**	**100**	
2.1.1	Expenditure on education, % GDP	2.5	110	○ ◇
2.1.2	Government funding/pupil, secondary, % GDP/cap	8.0	100	○ ◇
2.1.3	School life expectancy, years	14.7	58	
2.1.4	PISA scales in reading, maths, & science	419.8	56	
2.1.5	Pupil-teacher ratio, secondary	11.2	46	
2.2	**Tertiary education**	**29.3**	**76**	
2.2.1	Tertiary enrolment, % gross	55.0	52	
2.2.2	Graduates in science & engineering, %	20.6	69	
2.2.3	Tertiary inbound mobility, %	1.5	81	
2.3	**Research & development (R&D)**	**0.0**	**[121]**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**40.9**	**65**	
3.1	**Information & communication technologies (ICTs)**	**61.7**	**78**	
3.1.1	ICT access*	45.5	98	◇
3.1.2	ICT use*	51.9	74	
3.1.3	Government's online service*	73.6	58	
3.1.4	E-participation*	75.8	59	
3.2	**General infrastructure**	**20.0**	**97**	
3.2.1	Electricity output, kWh/mn pop.	1,577.1	87	
3.2.2	Logistics performance*	27.7	86	
3.2.3	Gross capital formation, % GDP	24.1	57	
3.3	**Ecological sustainability**	**41.0**	**35**	●
3.3.1	GDP/unit of energy use	13.9	16	●
3.3.2	Environmental performance*	49.0	59	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.8	26	●
	MARKET SOPHISTICATION	**46.8**	**70**	
4.1	**Credit**	**34.5**	**92**	
4.1.1	Ease of getting credit*	70.0	44	
4.1.2	Domestic credit to private sector, % GDP	33.1	90	
4.1.3	Microfinance gross loans, % GDP ⊕	0.5	37	
4.2	**Investment**	**46.0**	**[30]**	
4.2.1	Ease of protecting minority investors*	46.0	97	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**59.7**	**73**	
4.3.1	Applied tariff rate, weighted avg., %	1.0	12	●
4.3.2	Intensity of local competition†	67.4	72	
4.3.3	Domestic market scale, bn PPP$	40.2	112	◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**24.1**	**73**	
5.1	**Knowledge workers**	**37.9**	**[50]**	
5.1.1	Knowledge-intensive employment, % ⊕	17.5	88	
5.1.2	Firms offering formal training, %	46.2	21	●
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ⊕	9.9	67	
5.2	**Innovation linkages**	**15.5**	**109**	
5.2.1	University/industry research collaboration†	38.2	80	
5.2.2	State of cluster development†	30.4	123	○ ◇
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	95	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	68	
5.3	**Knowledge absorption**	**19.0**	**107**	
5.3.1	Intellectual property payments, % total trade	0.4	73	
5.3.2	High-tech imports, % total trade	2.0	129	○ ◇
5.3.3	ICT services imports, % total trade	1.3	57	
5.3.4	FDI net inflows, % GDP	8.2	13	● ◆
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**9.7**	**119**	◇
6.1	**Knowledge creation**	**3.4**	**120**	
6.1.1	Patents by origin/bn PPP$ GDP	0.4	86	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	69	
6.1.3	Utility models by origin/bn PPP$ GDP	0.0	65	
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.4	102	
6.1.5	Citable documents H-index	2.7	124	○
6.2	**Knowledge impact**	**13.7**	**107**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.4	82	
6.2.2	New businesses/th pop. 15–64	1.5	66	
6.2.3	Computer software spending, % GDP	0.0	86	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	5.6	49	
6.2.5	High- and medium-high-tech manufacturing, %	3.3	102	○ ◇
6.3	**Knowledge diffusion**	**12.1**	**106**	
6.3.1	Intellectual property receipts, % total trade	0.2	42	◆
6.3.2	High-tech net exports, % total trade	0.0	127	○ ◇
6.3.3	ICT services exports, % total trade	1.4	73	
6.3.4	FDI net outflows, % GDP	-0.3	123	◇
	CREATIVE OUTPUTS	**19.5**	**72**	
7.1	**Intangible assets**	**16.6**	**108**	
7.1.1	Trademarks by origin/bn PPP$ GDP	40.3	67	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP ⊕	0.5	83	
7.1.4	ICTs & organizational model creation†	39.5	114	◇
7.2	**Creative goods and services**	**20.2**	**53**	
7.2.1	Cultural & creative services exports, % total trade	1.4	17	● ◆
7.2.2	National feature films/mn pop. 15–69 ⊕	3.3	56	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	2.6	8	● ◆
7.2.5	Creative goods exports, % total trade ⊕	0.2	84	
7.3	**Online creativity**	**24.6**	**46**	●
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	6.7	48	●
7.3.2	Country-code TLDs/th pop. 15–69	3.2	61	
7.3.3	Wikipedia edits/mn pop. 15–69	65.7	48	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊕ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

ALGERIA

GII 2020 rank

121

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
126	111	Upper middle	NAWA	43.1	681.4	13,703.4	113

		Score/Value	Rank	
	INSTITUTIONS	**52.2**	**104**	◇
1.1	**Political environment**	**43.5**	**110**	◇
1.1.1	Political and operational stability*	50.0	126	◇
1.1.2	Government effectiveness*	40.2	95	◇
1.2	**Regulatory environment**	**49.5**	**105**	
1.2.1	Regulatory quality*	8.4	128	○ ◇
1.2.2	Rule of law*	26.5	111	◇
1.2.3	Cost of redundancy dismissal, salary weeks	17.3	69	
1.3	**Business environment**	**63.6**	**92**	
1.3.1	Ease of starting a business*	78.0	113	
1.3.2	Ease of resolving insolvency*	49.2	73	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**28.4**	**74**	
2.1	**Education**	**37.7**	**[85]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years ⊕	14.3	65	
2.1.4	PISA scales in reading, maths, & science ⊕	361.7	77	○
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	**Tertiary education**	**42.3**	**36**	●
2.2.1	Tertiary enrolment, % gross	51.4	56	●
2.2.2	Graduates in science & engineering, %	34.2	9	● ◆
2.2.3	Tertiary inbound mobility, %	0.5	95	
2.3	**Research & development (R&D)**	**5.1**	**76**	
2.3.1	Researchers, FTE/mn pop. ⊕	819.3	55	●
2.3.2	Gross expenditure on R&D, % GDP ⊕	0.5	61	●
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**31.5**	**100**	◇
3.1	**Information & communication technologies (ICTs)**	**37.3**	**114**	◇
3.1.1	ICT access*	59.7	74	
3.1.2	ICT use*	47.6	79	
3.1.3	Government's online service*	21.5	126	◇
3.1.4	E-participation*	20.2	123	◇
3.2	**General infrastructure**	**31.9**	**42**	● ◆
3.2.1	Electricity output, kWh/mn pop.	1,839.7	81	
3.2.2	Logistics performance*	17.7	109	◇
3.2.3	Gross capital formation, % GDP	43.5	5	● ◆
3.3	**Ecological sustainability**	**25.2**	**79**	
3.3.1	GDP/unit of energy use	10.1	53	●
3.3.2	Environmental performance*	44.8	74	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	116	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**24.6**	**130**	○ ◇
4.1	**Credit**	**9.3**	**129**	○ ◇
4.1.1	Ease of getting credit*	10.0	129	○ ◇
4.1.2	Domestic credit to private sector, % GDP	24.1	106	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**10.0**	**130**	○ ◇
4.2.1	Ease of protecting minority investors*	20.0	129	○ ◇
4.2.2	Market capitalization, % GDP	0.2	73	○ ◇
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**54.5**	**99**	◇
4.3.1	Applied tariff rate, weighted avg., %	10.0	114	◇
4.3.2	Intensity of local competition†	55.0	123	◇
4.3.3	Domestic market scale, bn PPP$	681.4	34	●

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**15.6**	**126**	◇
5.1	**Knowledge workers**	**13.5**	**115**	◇
5.1.1	Knowledge-intensive employment, % ⊕	17.9	86	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP ⊕	0.0	77	
5.1.4	GERD financed by business, %	6.7	82	◇
5.1.5	Females employed w/advanced degrees, % ⊕	8.1	79	
5.2	**Innovation linkages**	**15.1**	**111**	
5.2.1	University/industry research collaboration†	37.1	88	
5.2.2	State of cluster development†	48.3	58	●
5.2.3	GERD financed by abroad, % GDP	0.0	98	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	118	◇
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	99	
5.3	**Knowledge absorption**	**18.3**	**113**	◇
5.3.1	Intellectual property payments, % total trade ⊕	0.4	75	
5.3.2	High-tech imports, % total trade ⊕	8.9	49	●
5.3.3	ICT services imports, % total trade ⊕	0.7	94	
5.3.4	FDI net inflows, % GDP	0.9	116	◇
5.3.5	Research talent, % in business enterprise ⊕	0.5	82	◇

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**8.1**	**125**	◇
6.1	**Knowledge creation**	**6.9**	**90**	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	95	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	94	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.2	86	
6.1.5	Citable documents H-index	9.7	77	
6.2	**Knowledge impact**	**9.5**	**119**	◇
6.2.1	Growth rate of PPP$ GDP/worker, %	0.7	69	
6.2.2	New businesses/th pop. 15–64	0.4	105	
6.2.3	Computer software spending, % GDP	0.0	122	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.8	113	
6.2.5	High- and medium-high-tech manufacturing, % ⊕	4.7	98	◇
6.3	**Knowledge diffusion**	**7.9**	**128**	○ ◇
6.3.1	Intellectual property receipts, % total trade ⊕	0.0	100	◇
6.3.2	High-tech net exports, % total trade ⊕	0.0	126	◇
6.3.3	ICT services exports, % total trade ⊕	0.3	109	
6.3.4	FDI net outflows, % GDP	0.3	88	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**8.9**	**118**	◇
7.1	**Intangible assets**	**14.1**	**115**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP	10.8	109	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.6	56	●
7.1.4	ICTs & organizational model creation†	41.3	111	◇
7.2	**Creative goods and services**	**1.1**	**125**	◇
7.2.1	Cultural & creative services exports, % total trade	0.0	105	
7.2.2	National feature films/mn pop. 15–69	0.4	101	
7.2.3	Entertainment & Media market/th pop. 15–69	1.7	55	◇
7.2.4	Printing and other media, % manufacturing ⊕	0.3	97	◇
7.2.5	Creative goods exports, % total trade ⊕	0.0	126	
7.3	**Online creativity**	**6.5**	**101**	◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.5	109	
7.3.2	Country-code TLDs/th pop. 15–69	0.1	115	
7.3.3	Wikipedia edits/mn pop. 15–69	29.3	96	◇
7.3.4	Mobile app creation/bn PPP$ GDP	0.0	100	○

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊕ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

ARGENTINA

GII 2020 rank

80

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
73	80	Upper middle	LCN	44.8	903.5	17,508.9	73

		Score/Value	Rank	
	INSTITUTIONS	**54.3**	**97**	
1.1	**Political environment**	**55.8**	**71**	
1.1.1	Political and operational stability*	66.1	76	
1.1.2	Government effectiveness*	50.7	69	
1.2	**Regulatory environment**	**46.8**	**110**	◇
1.2.1	Regulatory quality*	35.4	92	
1.2.2	Rule of law*	40.4	76	
1.2.3	Cost of redundancy dismissal, salary weeks	30.3	118	○ ◇
1.3	**Business environment**	**60.2**	**106**	
1.3.1	Ease of starting a business*	80.4	109	
1.3.2	Ease of resolving insolvency*	40.0	97	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**35.9**	**48**	
2.1	**Education**	**46.5**	**65**	
2.1.1	Expenditure on education, % GDP ◷	5.5	24	●
2.1.2	Government funding/pupil, secondary, % GDP/cap	20.6	47	
2.1.3	School life expectancy, years	17.7	13	● ◆
2.1.4	PISA scales in reading, maths, & science	395.0	69	○
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	**Tertiary education**	**33.1**	**65**	
2.2.1	Tertiary enrolment, % gross	90.0	4	● ◆
2.2.2	Graduates in science & engineering, % ◷	13.6	98	○ ◇
2.2.3	Tertiary inbound mobility, %	2.8	67	
2.3	**Research & development (R&D)**	**28.1**	**39**	◆
2.3.1	Researchers, FTE/mn pop. ◷	1,192.2	50	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.5	62	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	45.5	34	● ◆
2.3.4	QS university ranking, average score top 3*	42.2	30	● ◆

		Score/Value	Rank	
	INFRASTRUCTURE	**39.5**	**70**	
3.1	**Information & communication technologies (ICTs)**	**67.6**	**64**	
3.1.1	ICT access*	70.9	59	
3.1.2	ICT use*	62.3	55	
3.1.3	Government's online service*	75.0	57	
3.1.4	E-participation*	62.4	85	
3.2	**General infrastructure**	**20.2**	**96**	
3.2.1	Electricity output, kWh/mn pop.	3,281.8	60	
3.2.2	Logistics performance*	38.3	60	
3.2.3	Gross capital formation, % GDP	18.5	108	○
3.3	**Ecological sustainability**	**30.7**	**60**	
3.3.1	GDP/unit of energy use	9.6	62	
3.3.2	Environmental performance*	52.2	52	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.5	53	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**34.6**	**120**	○ ◇
4.1	**Credit**	**21.9**	**121**	○ ◇
4.1.1	Ease of getting credit*	50.0	94	
4.1.2	Domestic credit to private sector, % GDP ◷	16.0	116	○ ◇
4.1.3	Microfinance gross loans, % GDP	0.0	75	○
4.2	**Investment**	**22.9**	**123**	○ ◇
4.2.1	Ease of protecting minority investors*	62.0	60	
4.2.2	Market capitalization, % GDP	12.4	66	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	68	
4.3	**Trade, competition, and market scale**	**59.1**	**77**	
4.3.1	Applied tariff rate, weighted avg., %	7.4	100	
4.3.2	Intensity of local competition†	55.4	122	○ ◇
4.3.3	Domestic market scale, bn PPP$	903.5	28	●

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**26.9**	**61**	
5.1	**Knowledge workers**	**28.7**	**70**	
5.1.1	Knowledge-intensive employment, %	24.1	62	
5.1.2	Firms offering formal training, % ◷	40.2	28	
5.1.3	GERD performed by business, % GDP ◷	0.1	55	
5.1.4	GERD financed by business, %	16.5	71	
5.1.5	Females employed w/advanced degrees, %	14.7	46	
5.2	**Innovation linkages**	**16.0**	**103**	
5.2.1	University/industry research collaboration†	37.4	86	
5.2.2	State of cluster development†	40.8	93	
5.2.3	GERD financed by abroad, % GDP	0.0	51	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	91	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	67	
5.3	**Knowledge absorption**	**36.0**	**38**	
5.3.1	Intellectual property payments, % total trade	2.7	8	● ◆
5.3.2	High-tech imports, % total trade	9.1	43	
5.3.3	ICT services imports, % total trade	1.5	42	
5.3.4	FDI net inflows, % GDP	1.6	98	
5.3.5	Research talent, % in business enterprise ◷	8.3	64	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**17.2**	**75**	
6.1	**Knowledge creation**	**12.9**	**68**	
6.1.1	Patents by origin/bn PPP$ GDP	0.5	83	
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	0.2	51	
6.1.4	Scientific & technical articles/bn PPP$ GDP	7.1	68	
6.1.5	Citable documents H-index	27.2	36	◆
6.2	**Knowledge impact**	**13.6**	**108**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-1.9	113	○ ◇
6.2.2	New businesses/th pop. 15-64	0.2	111	○
6.2.3	Computer software spending, % GDP	0.0	78	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	6.8	40	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**25.2**	**62**	
6.3.1	Intellectual property receipts, % total trade	0.3	32	◆
6.3.2	High-tech net exports, % total trade ◷	1.8	57	
6.3.3	ICT services exports, % total trade	2.3	45	
6.3.4	FDI net outflows, % GDP	0.3	90	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**19.6**	**71**	
7.1	**Intangible assets**	**24.0**	**77**	
7.1.1	Trademarks by origin/bn PPP$ GDP	60.6	34	●
7.1.2	Global brand value, top 5,000, % GDP	11.7	57	
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.0	67	
7.1.4	ICTs & organizational model creation†	50.6	80	
7.2	**Creative goods and services**	**12.4**	**70**	
7.2.1	Cultural & creative services exports, % total trade	1.1	24	●
7.2.2	National feature films/mn pop. 15-69	7.4	26	● ◆
7.2.3	Entertainment & Media market/th pop. 15-69	5.9	47	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.1	94	
7.3	**Online creativity**	**17.9**	**60**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	3.0	62	
7.3.2	Country-code TLDs/th pop. 15-69	5.4	51	
7.3.3	Wikipedia edits/mn pop. 15-69	57.4	55	
7.3.4	Mobile app creation/bn PPP$ GDP	8.1	47	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

ARMENIA

GII 2020 rank

61

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
47	83	Upper middle	NAWA	3.0	32.9	9,675.8	64

		Score/Value	Rank	
	INSTITUTIONS	**64.3**	**64**	
1.1	**Political environment**	**54.5**	**76**	
1.1.1	Political and operational stability*	64.3	83	
1.1.2	Government effectiveness*	49.6	74	
1.2	**Regulatory environment**	**68.0**	**54**	
1.2.1	Regulatory quality*	48.9	60	
1.2.2	Rule of law*	42.8	71	
1.2.3	Cost of redundancy dismissal, salary weeks	13.0	41	
1.3	**Business environment**	**70.3**	**70**	
1.3.1	Ease of starting a business*	96.1	10	● ◆
1.3.2	Ease of resolving insolvency*	44.6	86	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**20.5**	**94**	
2.1	**Education**	**34.4**	**97**	
2.1.1	Expenditure on education, % GDP ⊙	2.7	105	○
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	14.6	82	
2.1.3	School life expectancy, years	13.1	80	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	8.0	11	● ◆
2.2	**Tertiary education**	**25.8**	**79**	
2.2.1	Tertiary enrolment, % gross	54.6	53	
2.2.2	Graduates in science & engineering, %	15.2	96	○ ◇
2.2.3	Tertiary inbound mobility, %	4.5	51	
2.3	**Research & development (R&D)**	**1.2**	**105**	
2.3.1	Researchers, FTE/mn pop	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	0.2	91	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**34.4**	**90**	
3.1	**Information & communication technologies (ICTs)**	**58.6**	**83**	
3.1.1	ICT access*	68.1	62	
3.1.2	ICT use*	53.4	68	
3.1.3	Government's online service*	56.3	96	
3.1.4	E-participation*	56.7	98	
3.2	**General infrastructure**	**19.7**	**101**	
3.2.1	Electricity output, kWh/mn pop	2,650.3	70	
3.2.2	Logistics performance*	25.2	88	
3.2.3	Gross capital formation, % GDP	23.1	70	
3.3	**Ecological sustainability**	**24.8**	**82**	
3.3.1	GDP/unit of energy use	7.9	81	
3.3.2	Environmental performance*	52.3	51	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	126	○

		Score/Value	Rank	
	MARKET SOPHISTICATION	**46.9**	**68**	
4.1	**Credit**	**39.0**	**78**	
4.1.1	Ease of getting credit*	70.0	44	
4.1.2	Domestic credit to private sector, % GDP	55.6	62	
4.1.3	Microfinance gross loans, % GDP	0.6	33	
4.2	**Investment**	**42.0**	**[47]**	
4.2.1	Ease of protecting minority investors*	42.0	102	◇
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**59.8**	**72**	
4.3.1	Applied tariff rate, weighted avg., % ⊙	2.2	59	
4.3.2	Intensity of local competition†	73.6	36	●
4.3.3	Domestic market scale, bn PPP$	32.9	118	○ ◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**24.6**	**69**	
5.1	**Knowledge workers**	**29.6**	**67**	
5.1.1	Knowledge-intensive employment, % ⊙	29.4	48	
5.1.2	Firms offering formal training, % ⊙	16.2	84	○ ◇
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	16.7	70	
5.1.5	Females employed w/advanced degrees, % ⊙	14.9	45	
5.2	**Innovation linkages**	**16.2**	**101**	
5.2.1	University/industry research collaboration†	35.5	97	
5.2.2	State of cluster development†	46.3	71	
5.2.3	GERD financed by abroad, % GDP	0.0	79	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	75	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	61	
5.3	**Knowledge absorption**	**28.0**	**[67]**	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports, % total trade	6.7	80	
5.3.3	ICT services imports, % total trade	0.6	100	
5.3.4	FDI net inflows, % GDP	2.5	69	
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**28.5**	**45**	
6.1	**Knowledge creation**	**27.2**	**37**	●
6.1.1	Patents by origin/bn PPP$ GDP	3.4	29	●
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	62	
6.1.3	Utility models by origin/bn PPP$ GDP	1.1	22	
6.1.4	Scientific & technical articles/bn PPP$ GDP	24.3	18	● ◆
6.1.5	Citable documents H-index	11.2	68	
6.2	**Knowledge impact**	**26.7**	**56**	
6.2.1	Growth rate of PPP$ GDP/worker, %	9.8	1	● ◆
6.2.2	New businesses/th pop. 15-64	3.1	47	
6.2.3	Computer software spending, % GDP	0.0	87	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.9	110	○
6.2.5	High- and medium-high-tech manufacturing, %	4.4	100	○ ◇
6.3	**Knowledge diffusion**	**31.6**	**40**	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade	0.6	75	
6.3.3	ICT services exports, % total trade	4.5	14	● ◆
6.3.4	FDI net outflows, % GDP	0.3	85	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**25.8**	**56**	
7.1	**Intangible assets**	**28.6**	**59**	
7.1.1	Trademarks by origin/bn PPP$ GDP	95.0	14	●
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	2.0	50	
7.1.4	ICTs & organizational model creation†	52.8	67	
7.2	**Creative goods and services**	**20.9**	**51**	
7.2.1	Cultural & creative services exports, % total trade	0.6	41	
7.2.2	National feature films/mn pop. 15-69	13.2	12	● ◆
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	1.3	34	
7.2.5	Creative goods exports, % total trade	0.8	54	
7.3	**Online creativity**	**25.0**	**45**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	2.9	65	
7.3.2	Country-code TLDs/th pop. 15-69	5.2	53	
7.3.3	Wikipedia edits/mn pop. 15-69	90.9	7	● ◆
7.3.4	Mobile app creation/bn PPP$ GDP	1.5	66	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

AUSTRALIA

GII 2020 rank

23

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
31	13	High	SEAO	25.2	1,364.8	46,601.0	22

		Score/Value	Rank	
	INSTITUTIONS	**88.7**	**10**	●
1.1	**Political environment**	**86.4**	**13**	
1.1.1	Political and operational stability*	87.5	11	
1.1.2	Government effectiveness*	85.8	14	
1.2	**Regulatory environment**	**92.1**	**10**	●
1.2.1	Regulatory quality*	92.7	5	●
1.2.2	Rule of law*	91.4	14	
1.2.3	Cost of redundancy dismissal, salary weeks	12.0	38	
1.3	**Business environment**	**87.7**	**11**	
1.3.1	Ease of starting a business*	96.6	7	● ◆
1.3.2	Ease of resolving insolvency*	78.9	19	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**59.0**	**9**	●
2.1	**Education**	**56.4**	**29**	
2.1.1	Expenditure on education, % GDP ⊙	5.3	33	
2.1.2	Government funding/pupil, secondary, % GDP/cap	15.0	79	○ ◇
2.1.3	School life expectancy, years	22.0	1	● ◆
2.1.4	PISA scales in reading, maths, & science	499.0	20	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	**Tertiary education**	**61.4**	**5**	● ◆
2.2.1	Tertiary enrolment, % gross	113.1	2	● ◆
2.2.2	Graduates in science & engineering, %	18.4	78	○
2.2.3	Tertiary inbound mobility, %	21.5	5	● ◆
2.3	**Research & development (R&D)**	**59.4**	**15**	
2.3.1	Researchers, FTE/mn pop. ⊙	4,532.4	22	
2.3.2	Gross expenditure on R&D, % GDP ⊙	1.8	20	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	67.4	19	
2.3.4	QS university ranking, average score top 3*	79.8	6	●

		Score/Value	Rank	
	INFRASTRUCTURE	**55.8**	**22**	
3.1	**Information & communication technologies (ICTs)**	**88.6**	**14**	
3.1.1	ICT access*	79.6	29	
3.1.2	ICT use*	79.2	22	
3.1.3	Government's online service*	97.2	7	●
3.1.4	E-participation*	98.3	5	●
3.2	**General infrastructure**	**39.7**	**22**	
3.2.1	Electricity output, kWh/mn pop.	10,444.3	13	
3.2.2	Logistics performance*	78.9	18	
3.2.3	Gross capital formation, % GDP	22.5	72	○
3.3	**Ecological sustainability**	**39.0**	**37**	
3.3.1	GDP/unit of energy use	9.2	66	○
3.3.2	Environmental performance*	74.9	13	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.0	44	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**67.1**	**7**	●
4.1	**Credit**	**78.9**	**5**	● ◆
4.1.1	Ease of getting credit*	95.0	4	● ◆
4.1.2	Domestic credit to private sector, % GDP	139.6	13	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**43.7**	**40**	
4.2.1	Ease of protecting minority investors*	64.0	56	
4.2.2	Market capitalization, % GDP	102.1	11	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	22	
4.3	**Trade, competition, and market scale**	**78.8**	**9**	●
4.3.1	Applied tariff rate, weighted avg., %	0.9	10	●
4.3.2	Intensity of local competition†	79.2	11	
4.3.3	Domestic market scale, bn PPP$	1,364.8	21	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**43.6**	**26**	◇
5.1	**Knowledge workers**	**53.0**	**[24]**	
5.1.1	Knowledge-intensive employment, %	46.1	15	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP ⊙	0.9	22	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ⊙	22.6	19	
5.2	**Innovation linkages**	**44.1**	**20**	
5.2.1	University/industry research collaboration†	50.4	39	◇
5.2.2	State of cluster development†	54.2	38	◇
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.2	12	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	1.0	26	◇
5.3	**Knowledge absorption**	**33.8**	**47**	◇
5.3.1	Intellectual property payments, % total trade	1.2	30	
5.3.2	High-tech imports, % total trade	10.5	26	
5.3.3	ICT services imports, % total trade	1.0	73	○ ◇
5.3.4	FDI net inflows, % GDP	3.8	39	
5.3.5	Research talent, % in business enterprise ⊙	27.9	44	◇

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**30.4**	**40**	◇
6.1	**Knowledge creation**	**42.5**	**21**	
6.1.1	Patents by origin/bn PPP$ GDP	2.1	39	◇
6.1.2	PCT patents by origin/bn PPP$ GDP	1.3	24	◇
6.1.3	Utility models by origin/bn PPP$ GDP	0.9	25	
6.1.4	Scientific & technical articles/bn PPP$ GDP	29.2	11	
6.1.5	Citable documents H-index	65.9	10	●
6.2	**Knowledge impact**	**28.2**	**48**	◇
6.2.1	Growth rate of PPP$ GDP/worker, %	-0.2	96	○
6.2.2	New businesses/th pop. 15–64	14.5	9	● ◆
6.2.3	Computer software spending, % GDP	0.0	53	◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	6.2	47	
6.2.5	High- and medium-high-tech manufacturing, %	27.0	39	
6.3	**Knowledge diffusion**	**20.3**	**74**	○ ◇
6.3.1	Intellectual property receipts, % total trade	0.3	29	◇
6.3.2	High-tech net exports, % total trade	1.7	62	◇
6.3.3	ICT services exports, % total trade	1.0	82	○
6.3.4	FDI net outflows, % GDP	0.1	101	○

		Score/Value	Rank	
	CREATIVE OUTPUTS	**37.3**	**23**	◇
7.1	**Intangible assets**	**37.1**	**35**	
7.1.1	Trademarks by origin/bn PPP$ GDP	63.4	32	
7.1.2	Global brand value, top 5,000, % GDP	79.8	26	
7.1.3	Industrial designs by origin/bn PPP$ GDP	2.3	48	
7.1.4	ICTs & organizational model creation†	67.3	25	◇
7.2	**Creative goods and services**	**23.7**	**41**	◇
7.2.1	Cultural & creative services exports, % total trade	0.3	63	○
7.2.2	National feature films/mn pop. 15–69	3.2	58	○
7.2.3	Entertainment & Media market/th pop. 15–69	64.9	7	
7.2.4	Printing and other media, % manufacturing	2.3	10	◆
7.2.5	Creative goods exports, % total trade	0.6	59	
7.3	**Online creativity**	**51.5**	**16**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	61.3	10	●
7.3.2	Country-code TLDs/th pop. 15–69	54.7	14	
7.3.3	Wikipedia edits/mn pop. 15–69	79.5	26	
7.3.4	Mobile app creation/bn PPP$ GDP	11.6	41	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

AUSTRIA

GII 2020 rank

19

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
23	18	High	EUR	9.0	479.4	46,758.1	21

		Score/Value	Rank	
	INSTITUTIONS	**86.2**	**15**	
1.1	**Political environment**	**83.6**	**17**	
1.1.1	Political and operational stability*	85.7	17	
1.1.2	Government effectiveness*	82.6	18	
1.2	**Regulatory environment**	**94.5**	**6**	●
1.2.1	Regulatory quality*	82.6	18	
1.2.2	Rule of law*	95.6	6	●
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	**Business environment**	**80.3**	**32**	
1.3.1	Ease of starting a business*	83.2	98	○ ◇
1.3.2	Ease of resolving insolvency*	77.4	21	
	HUMAN CAPITAL & RESEARCH	**59.7**	**7**	●
2.1	**Education**	**58.5**	**18**	
2.1.1	Expenditure on education, % GDP ⊙	5.5	21	
2.1.2	Government funding/pupil, secondary, % GDP/cap	27.7	16	◆
2.1.3	School life expectancy, years	16.1	33	
2.1.4	PISA scales in reading, maths, & science	491.0	27	
2.1.5	Pupil-teacher ratio, secondary ⊙	9.3	25	◆
2.2	**Tertiary education**	**62.4**	**4**	● ◆
2.2.1	Tertiary enrolment, % gross	85.1	11	●
2.2.2	Graduates in science & engineering, % ⊙	30.3	13	◆
2.2.3	Tertiary inbound mobility, %	17.2	10	● ◆
2.3	**Research & development (R&D)**	**58.2**	**17**	
2.3.1	Researchers, FTE/mn pop.	5,733.1	9	●
2.3.2	Gross expenditure on R&D, % GDP	3.2	6	●
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	55.6	26	
2.3.4	QS university ranking, average score top 3*	43.4	26	
	INFRASTRUCTURE	**56.5**	**20**	
3.1	**Information & communication technologies (ICTs)**	**82.1**	**27**	◇
3.1.1	ICT access*	84.8	15	
3.1.2	ICT use*	74.2	31	◇
3.1.3	Government's online service*	86.8	32	
3.1.4	E-participation*	82.6	45	◇
3.2	**General infrastructure**	**42.5**	**17**	
3.2.1	Electricity output, kWh/mn pop.	7,354.0	29	
3.2.2	Logistics performance*	91.8	4	●
3.2.3	Gross capital formation, % GDP	25.7	46	
3.3	**Ecological sustainability**	**45.0**	**30**	
3.3.1	GDP/unit of energy use	12.0	33	
3.3.2	Environmental performance*	79.6	6	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.3	35	
	MARKET SOPHISTICATION	**51.1**	**48**	◇
4.1	**Credit**	**45.9**	**48**	
4.1.1	Ease of getting credit*	55.0	88	○
4.1.2	Domestic credit to private sector, % GDP	84.2	34	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**33.9**	**80**	○ ◇
4.2.1	Ease of protecting minority investors*	70.0	36	
4.2.2	Market capitalization, % GDP	30.8	46	○ ◇
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	27	
4.3	**Trade, competition, and market scale**	**73.4**	**24**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	78.8	13	
4.3.3	Domestic market scale, bn PPP$	479.4	43	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**52.3**	**17**	
5.1	**Knowledge workers**	**60.9**	**13**	
5.1.1	Knowledge-intensive employment, %	41.9	24	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	2.2	6	●
5.1.4	GERD financed by business, %	54.4	18	
5.1.5	Females employed w/advanced degrees, %	17.0	38	◇
5.2	**Innovation linkages**	**55.1**	**12**	
5.2.1	University/industry research collaboration†	64.1	19	
5.2.2	State of cluster development†	65.7	15	
5.2.3	GERD financed by abroad, % GDP	0.5	3	● ◆
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	56	○ ◇
5.2.5	Patent families 2+ offices/bn PPP$ GDP	3.9	13	
5.3	**Knowledge absorption**	**40.9**	**29**	
5.3.1	Intellectual property payments, % total trade	0.8	51	
5.3.2	High-tech imports, % total trade	7.5	69	○
5.3.3	ICT services imports, % total trade	2.5	17	
5.3.4	FDI net inflows, % GDP	-1.1	125	○
5.3.5	Research talent, % in business enterprise	63.0	9	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**40.7**	**19**	
6.1	**Knowledge creation**	**48.5**	**15**	
6.1.1	Patents by origin/bn PPP$ GDP	9.3	12	
6.1.2	PCT patents by origin/bn PPP$ GDP	3.0	11	
6.1.3	Utility models by origin/bn PPP$ GDP	0.8	26	
6.1.4	Scientific & technical articles/bn PPP$ GDP	23.6	20	
6.1.5	Citable documents H-index	44.1	18	
6.2	**Knowledge impact**	**35.9**	**23**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.6	72	○
6.2.2	New businesses/th pop. 15-64	0.6	91	○ ◇
6.2.3	Computer software spending, % GDP	0.0	15	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.1	38	
6.2.5	High- and medium-high-tech manufacturing, %	43.2	16	
6.3	**Knowledge diffusion**	**37.6**	**28**	
6.3.1	Intellectual property receipts, % total trade	0.6	24	◇
6.3.2	High-tech net exports, % total trade	6.8	25	
6.3.3	ICT services exports, % total trade	3.0	31	
6.3.4	FDI net outflows, % GDP	-0.9	127	○
	CREATIVE OUTPUTS	**37.5**	**22**	◇
7.1	**Intangible assets**	**36.7**	**36**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP	55.4	42	
7.1.2	Global brand value, top 5,000, % GDP	51.1	34	◇
7.1.3	Industrial designs by origin/bn PPP$ GDP ⊙	8.1	16	
7.1.4	ICTs & organizational model creation†	64.9	29	◇
7.2	**Creative goods and services**	**26.7**	**36**	
7.2.1	Cultural & creative services exports, % total trade	1.1	22	
7.2.2	National feature films/mn pop. 15-69	7.0	30	
7.2.3	Entertainment & Media market/th pop. 15-69	63.2	9	
7.2.4	Printing and other media, % manufacturing	1.1	45	○
7.2.5	Creative goods exports, % total trade	0.9	48	
7.3	**Online creativity**	**50.1**	**19**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	35.4	19	
7.3.2	Country-code TLDs/th pop. 15-69	62.8	11	●
7.3.3	Wikipedia edits/mn pop. 15-69	85.8	14	
7.3.4	Mobile app creation/bn PPP$ GDP	17.2	28	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

AZERBAIJAN

GII 2020 rank

82

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
86	76	Upper middle	NAWA	10.0	187.3	16,252.1	84

		Score/Value	Rank	
	INSTITUTIONS	**65.0**	**59**	
1.1	**Political environment**	**55.1**	**73**	
1.1.1	Political and operational stability*	69.6	70	
1.1.2	Government effectiveness*	47.9	78	
1.2	**Regulatory environment**	**60.0**	**80**	
1.2.1	Regulatory quality*	31.7	98	
1.2.2	Rule of law*	31.0	102	
1.2.3	Cost of redundancy dismissal, salary weeks	13.7	51	
1.3	**Business environment**	**79.8**	**33**	● ◆
1.3.1	Ease of starting a business*	96.2	9	● ◆
1.3.2	Ease of resolving insolvency*	63.5	43	
	HUMAN CAPITAL & RESEARCH	**21.8**	**89**	
2.1	**Education**	**37.8**	**84**	
2.1.1	Expenditure on education, % GDP ⊙	2.5	109	○ ◇
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	13.3	78	
2.1.4	PISA scales in reading, maths, & science	402.2	65	
2.1.5	Pupil-teacher ratio, secondary	7.6	6	● ◆
2.2	**Tertiary education**	**25.2**	**82**	
2.2.1	Tertiary enrolment, % gross	27.7	85	◇
2.2.2	Graduates in science & engineering, %	23.5	44	
2.2.3	Tertiary inbound mobility, %	2.3	72	
2.3	**Research & development (R&D)**	**2.4**	**91**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	0.2	92	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	3.9	71	
	INFRASTRUCTURE	**36.1**	**85**	
3.1	**Information & communication technologies (ICTs)**	**66.3**	**68**	
3.1.1	ICT access*	67.2	63	
3.1.2	ICT use*	57.0	63	
3.1.3	Government's online service*	72.9	64	
3.1.4	E-participation*	68.0	78	
3.2	**General infrastructure**	**15.3**	**120**	○ ◇
3.2.1	Electricity output, kWh/mn pop.	2,466.6	73	
3.2.2	Logistics performance*	n/a	n/a	
3.2.3	Gross capital formation, % GDP	20.7	92	
3.3	**Ecological sustainability**	**26.9**	**73**	
3.3.1	GDP/unit of energy use	10.6	47	
3.3.2	Environmental performance*	46.5	66	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	96	
	MARKET SOPHISTICATION	**52.2**	**36**	●
4.1	**Credit**	**48.6**	**39**	
4.1.1	Ease of getting credit*	100.0	1	● ◆
4.1.2	Domestic credit to private sector, % GDP	20.8	113	◇
4.1.3	Microfinance gross loans, % GDP	1.9	14	●
4.2	**Investment**	**50.0**	**[23]**	
4.2.1	Ease of protecting minority investors*	50.0	92	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**58.1**	**86**	
4.3.1	Applied tariff rate, weighted avg., % ⊙	5.2	95	
4.3.2	Intensity of local competition†	61.3	103	◇
4.3.3	Domestic market scale, bn PPP$	187.3	71	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**20.6**	**96**	
5.1	**Knowledge workers**	**25.0**	**84**	
5.1.1	Knowledge-intensive employment, %	23.2	67	
5.1.2	Firms offering formal training, % ⊙	20.2	74	
5.1.3	GERD performed by business, % GDP	0.0	88	○ ◇
5.1.4	GERD financed by business, %	30.8	57	
5.1.5	Females employed w/advanced degrees, % ⊙	12.9	54	
5.2	**Innovation linkages**	**20.1**	**67**	
5.2.1	University/industry research collaboration†	59.5	23	● ◆
5.2.2	State of cluster development†	58.3	29	● ◆
5.2.3	GERD financed by abroad, % GDP	0.0	101	○ ◇
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	109	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	93	
5.3	**Knowledge absorption**	**16.8**	**119**	○ ◇
5.3.1	Intellectual property payments, % total trade ⊙	0.1	105	○
5.3.2	High-tech imports, % total trade	4.0	121	○
5.3.3	ICT services imports, % total trade	0.5	105	
5.3.4	FDI net inflows, % GDP	7.3	16	● ◆
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**10.0**	**118**	○ ◇
6.1	**Knowledge creation**	**6.0**	**98**	
6.1.1	Patents by origin/bn PPP$ GDP	1.0	64	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	74	
6.1.3	Utility models by origin/bn PPP$ GDP	0.2	50	
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.8	98	
6.1.5	Citable documents H-index	5.7	97	
6.2	**Knowledge impact**	**12.7**	**112**	◇
6.2.1	Growth rate of PPP$ GDP/worker, %	0.4	83	
6.2.2	New businesses/th pop. 15–64	1.7	62	
6.2.3	Computer software spending, % GDP	0.0	94	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.2	97	
6.2.5	High- and medium-high-tech manufacturing, %	10.8	77	
6.3	**Knowledge diffusion**	**11.4**	**115**	◇
6.3.1	Intellectual property receipts, % total trade ⊙	0.0	106	○ ◇
6.3.2	High-tech net exports, % total trade	0.1	110	
6.3.3	ICT services exports, % total trade	0.4	104	
6.3.4	FDI net outflows, % GDP	5.6	8	● ◆
	CREATIVE OUTPUTS	**20.5**	**65**	
7.1	**Intangible assets**	**29.1**	**56**	
7.1.1	Trademarks by origin/bn PPP$ GDP	21.2	91	
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.3	92	
7.1.4	ICTs & organizational model creation†	63.4	35	● ◆
7.2	**Creative goods and services**	**8.1**	**87**	
7.2.1	Cultural & creative services exports, % total trade	0.2	71	
7.2.2	National feature films/mn pop. 15–69	7.4	27	● ◆
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	0.7	78	
7.2.5	Creative goods exports, % total trade	0.0	120	○
7.3	**Online creativity**	**15.9**	**67**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.0	96	
7.3.2	Country-code TLDs/th pop. 15–69	1.4	76	
7.3.3	Wikipedia edits/mn pop. 15–69	63.2	50	
7.3.4	Mobile app creation/bn PPP$ GDP	0.0	97	○

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

BAHRAIN

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
89	63	High	NAWA	1.6	77.0	44,464.7	78

		Score/Value	Rank	
	INSTITUTIONS	**68.7**	**51**	◇
1.1	**Political environment**	**59.9**	**60**	◇
1.1.1	Political and operational stability*	71.4	59	◇
1.1.2	Government effectiveness*	54.2	60	◇
1.2	**Regulatory environment**	**72.2**	**40**	
1.2.1	Regulatory quality*	53.6	51	◇
1.2.2	Rule of law*	57.4	47	◇
1.2.3	Cost of redundancy dismissal, salary weeks	13.6	49	
1.3	**Business environment**	**73.9**	**56**	
1.3.1	Ease of starting a business*	89.6	57	
1.3.2	Ease of resolving insolvency*	58.2	55	
	HUMAN CAPITAL & RESEARCH	**25.2**	**84**	◇
2.1	**Education**	**39.6**	**82**	◇
2.1.1	Expenditure on education, % GDP ◷	2.3	112	○ ◇
2.1.2	Government funding/pupil, secondary, % GDP/cap ◷	17.5	66	
2.1.3	School life expectancy, years	16.3	28	●
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	10.2	37	●
2.2	**Tertiary education**	**33.5**	**64**	◇
2.2.1	Tertiary enrolment, % gross	50.5	59	
2.2.2	Graduates in science & engineering, %	16.1	88	◇
2.2.3	Tertiary inbound mobility, %	13.4	12	●
2.3	**Research & development (R&D)**	**2.7**	**87**	◇
2.3.1	Researchers, FTE/mn pop. ◷	369.0	74	◇
2.3.2	Gross expenditure on R&D, % GDP ◷	0.1	106	○ ◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	4.6	70	◇
	INFRASTRUCTURE	**49.0**	**43**	
3.1	**Information & communication technologies (ICTs)**	**78.5**	**36**	●
3.1.1	ICT access*	81.6	21	●
3.1.2	ICT use*	72.7	35	●
3.1.3	Government's online service*	79.9	45	
3.1.4	E-participation*	79.8	53	
3.2	**General infrastructure**	**44.8**	**12**	●
3.2.1	Electricity output, kWh/mn pop.	19,614.3	3	● ◆
3.2.2	Logistics performance*	40.6	58	◇
3.2.3	Gross capital formation, % GDP	31.3	23	● ◆
3.3	**Ecological sustainability**	**23.6**	**85**	◇
3.3.1	GDP/unit of energy use	4.5	113	○ ◇
3.3.2	Environmental performance*	51.0	54	◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.4	54	
	MARKET SOPHISTICATION	**45.3**	**80**	
4.1	**Credit**	**43.4**	**56**	
4.1.1	Ease of getting credit*	55.0	88	
4.1.2	Domestic credit to private sector, % GDP ◷	73.7	43	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**33.2**	**83**	
4.2.1	Ease of protecting minority investors*	66.0	50	
4.2.2	Market capitalization, % GDP	59.8	27	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	40	
4.3	**Trade, competition, and market scale**	**59.3**	**76**	◇
4.3.1	Applied tariff rate, weighted avg., %	4.3	80	◇
4.3.2	Intensity of local competition†	70.1	60	
4.3.3	Domestic market scale, bn PPP$	77.0	90	◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**22.1**	**86**	◇
5.1	**Knowledge workers**	**20.5**	**[101]**	
5.1.1	Knowledge-intensive employment, % ◷	21.9	70	◇
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP ◷	0.0	80	◇
5.1.4	GERD financed by business, % ◷	21.8	64	◇
5.1.5	Females employed w/advanced degrees, %	n/a	n/a	
5.2	**Innovation linkages**	**29.8**	**35**	●
5.2.1	University/industry research collaboration†	36.8	90	◇
5.2.2	State of cluster development†	55.8	32	●
5.2.3	GERD financed by abroad, % GDP ◷	0.0	76	◇
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.2	14	●
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	63	
5.3	**Knowledge absorption**	**16.0**	**125**	○ ◇
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports, % total trade	5.2	109	
5.3.3	ICT services imports, % total trade ◷	0.4	111	◇
5.3.4	FDI net inflows, % GDP	0.8	118	○
5.3.5	Research talent, % in business enterprise ◷	0.4	83	○ ◇
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**15.3**	**86**	◇
6.1	**Knowledge creation**	**3.0**	**123**	○ ◇
6.1.1	Patents by origin/bn PPP$ GDP	0.2	102	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	87	◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.2	116	◇
6.1.5	Citable documents H-index	3.9	115	◇
6.2	**Knowledge impact**	**22.3**	**71**	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.3	40	
6.2.2	New businesses/th pop. 15–64	3.1	44	
6.2.3	Computer software spending, % GDP	0.0	41	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	5.0	55	
6.2.5	High- and medium-high-tech manufacturing, % ◷	8.4	88	◇
6.3	**Knowledge diffusion**	**20.8**	**73**	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade	0.0	122	○ ◇
6.3.3	ICT services exports, % total trade ◷	3.0	30	●
6.3.4	FDI net outflows, % GDP	0.6	68	
	CREATIVE OUTPUTS	**14.0**	**98**	◇
7.1	**Intangible assets**	**18.3**	**102**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP	4.1	124	○ ◇
7.1.2	Global brand value, top 5,000, % GDP	13.3	53	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.1	114	○
7.1.4	ICTs & organizational model creation†	58.2	51	
7.2	**Creative goods and services**	**7.9**	**[89]**	
7.2.1	Cultural & creative services exports, % total trade ◷	0.0	113	○ ◇
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15–69	10.3	36	◇
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.8	51	
7.3	**Online creativity**	**11.8**	**77**	◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	4.4	57	
7.3.2	Country-code TLDs/th pop. 15–69	0.5	99	◇
7.3.3	Wikipedia edits/mn pop. 15–69	45.2	71	◇
7.3.4	Mobile app creation/bn PPP$ GDP	0.0	89	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

BANGLADESH

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
114	119	Lower middle	CSA	163.0	837.6	4,389.6	116

		Score/Value	Rank	
	INSTITUTIONS	**45.4**	**124**	◇
1.1	**Political environment**	**41.3**	**116**	
1.1.1	Political and operational stability*	57.1	110	
1.1.2	Government effectiveness*	33.4	117	
1.2	**Regulatory environment**	**39.7**	**120**	
1.2.1	Regulatory quality*	20.0	120	
1.2.2	Rule of law*	30.0	104	
1.2.3	Cost of redundancy dismissal, salary weeks	31.0	120	
1.3	**Business environment**	**55.3**	**117**	
1.3.1	Ease of starting a business*	82.4	101	
1.3.2	Ease of resolving insolvency*	28.1	123	
	HUMAN CAPITAL & RESEARCH	**9.0**	**129**	○ ◇
2.1	**Education**	**15.4**	**129**	○ ◇
2.1.1	Expenditure on education, % GDP	2.0	115	○ ◇
2.1.2	Government funding/pupil, secondary, % GDP/cap	9.9	96	
2.1.3	School life expectancy, years	12.0	94	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	35.1	122	○ ◇
2.2	**Tertiary education**	**7.7**	**117**	◇
2.2.1	Tertiary enrolment, % gross	20.6	93	
2.2.2	Graduates in science & engineering, %	11.2	103	○ ◇
2.2.3	Tertiary inbound mobility, % ⊙	0.1	109	○
2.3	**Research & development (R&D)**	**3.8**	**[82]**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	7.6	67	
	INFRASTRUCTURE	**33.9**	**92**	
3.1	**Information & communication technologies (ICTs)**	**53.5**	**91**	
3.1.1	ICT access*	33.6	117	◇
3.1.2	ICT use*	21.5	113	◇
3.1.3	Government's online service*	78.5	52	● ◆
3.1.4	E-participation*	80.3	51	● ◆
3.2	**General infrastructure**	**23.2**	**81**	
3.2.1	Electricity output, kWh/mn pop.	444.3	108	
3.2.2	Logistics performance*	23.8	96	
3.2.3	Gross capital formation, % GDP	31.2	25	●
3.3	**Ecological sustainability**	**25.1**	**81**	
3.3.1	GDP/unit of energy use	14.1	15	● ◆
3.3.2	Environmental performance*	29.0	123	○ ◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	112	
	MARKET SOPHISTICATION	**42.1**	**100**	
4.1	**Credit**	**29.9**	**109**	
4.1.1	Ease of getting credit*	45.0	101	
4.1.2	Domestic credit to private sector, % GDP	46.9	73	
4.1.3	Microfinance gross loans, % GDP	1.4	23	●
4.2	**Investment**	**37.1**	**65**	
4.2.1	Ease of protecting minority investors*	60.0	71	
4.2.2	Market capitalization, % GDP	31.5	45	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**59.3**	**75**	
4.3.1	Applied tariff rate, weighted avg., % ⊙	10.7	118	◇
4.3.2	Intensity of local competition†	67.5	71	
4.3.3	Domestic market scale, bn PPP$	837.6	29	●

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**17.0**	**122**	
5.1	**Knowledge workers**	**13.0**	**[118]**	
5.1.1	Knowledge-intensive employment, % ⊙	8.3	109	
5.1.2	Firms offering formal training, % ⊙	21.9	68	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ⊙	1.3	108	
5.2	**Innovation linkages**	**18.2**	**85**	
5.2.1	University/industry research collaboration†	26.4	121	○ ◇
5.2.2	State of cluster development†	43.9	81	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	68	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	98	
5.3	**Knowledge absorption**	**19.7**	**102**	
5.3.1	Intellectual property payments, % total trade	0.1	106	◇
5.3.2	High-tech imports, % total trade ⊙	8.1	56	●
5.3.3	ICT services imports, % total trade	0.1	125	○ ◇
5.3.4	FDI net inflows, % GDP	1.0	111	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**13.2**	**95**	
6.1	**Knowledge creation**	**6.0**	**[97]**	
6.1.1	Patents by origin/bn PPP$ GDP	0.1	114	
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.6	109	
6.1.5	Citable documents H-index	11.7	64	●
6.2	**Knowledge impact**	**21.6**	**76**	
6.2.1	Growth rate of PPP$ GDP/worker, %	5.7	5	● ◆
6.2.2	New businesses/th pop. 15-64	0.0	120	○
6.2.3	Computer software spending, % GDP	0.0	72	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.7	116	◇
6.2.5	High- and medium-high-tech manufacturing, % ⊙	9.4	85	
6.3	**Knowledge diffusion**	**12.0**	**108**	
6.3.1	Intellectual property receipts, % total trade	0.0	103	○
6.3.2	High-tech net exports, % total trade ⊙	0.2	95	
6.3.3	ICT services exports, % total trade	1.1	80	
6.3.4	FDI net outflows, % GDP	0.0	114	
	CREATIVE OUTPUTS	**9.4**	**115**	
7.1	**Intangible assets**	**15.2**	**110**	
7.1.1	Trademarks by origin/bn PPP$ GDP	10.4	110	
7.1.2	Global brand value, top 5,000, % GDP	2.5	76	
7.1.3	Industrial designs by origin/bn PPP$ GDP	2.5	47	●
7.1.4	ICTs & organizational model creation†	42.1	108	
7.2	**Creative goods and services**	**1.2**	**124**	◇
7.2.1	Cultural & creative services exports, % total trade	0.1	80	
7.2.2	National feature films/mn pop. 15-69	0.3	104	○
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing ⊙	0.2	99	○
7.2.5	Creative goods exports, % total trade ⊙	0.1	108	
7.3	**Online creativity**	**5.9**	**104**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	0.4	113	
7.3.2	Country-code TLDs/th pop. 15-69	0.1	122	
7.3.3	Wikipedia edits/mn pop. 15-69	26.8	99	
7.3.4	Mobile app creation/bn PPP$ GDP	0.4	73	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

BELARUS

GII 2020 rank

64

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
61	67	Upper middle	EUR	9.5	195.6	18,022.5	72

		Score/Value	Rank	
	INSTITUTIONS	**58.4**	**84**	
1.1	**Political environment**	**53.4**	**79**	
1.1.1	Political and operational stability*	73.2	49	
1.1.2	Government effectiveness*	43.4	89	
1.2	**Regulatory environment**	**48.8**	**106**	
1.2.1	Regulatory quality*	24.4	111	○ ◇
1.2.2	Rule of law*	25.0	116	○ ◇
1.2.3	Cost of redundancy dismissal, salary weeks	21.7	92	
1.3	**Business environment**	**73.2**	**58**	
1.3.1	Ease of starting a business*	93.5	28	
1.3.2	Ease of resolving insolvency*	52.9	68	
	HUMAN CAPITAL & RESEARCH	**40.9**	**37**	◆
2.1	**Education**	**58.7**	**16**	● ◆
2.1.1	Expenditure on education, % GDP ⓘ	4.8	51	
2.1.2	Government funding/pupil, secondary, % GDP/cap	35.7	8	● ◆
2.1.3	School life expectancy, years	15.4	43	
2.1.4	PISA scales in reading, maths, & science	472.3	36	◆
2.1.5	Pupil-teacher ratio, secondary	8.6	16	●
2.2	**Tertiary education**	**55.1**	**10**	● ◆
2.2.1	Tertiary enrolment, % gross	87.4	10	● ◆
2.2.2	Graduates in science & engineering, %	33.2	11	● ◆
2.2.3	Tertiary inbound mobility, %	4.3	53	
2.3	**Research & development (R&D)**	**9.0**	**61**	
2.3.1	Researchers, FTE/mn pop	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	0.6	55	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	14.9	57	
	INFRASTRUCTURE	**43.2**	**58**	
3.1	**Information & communication technologies (ICTs)**	**79.5**	**34**	◆
3.1.1	ICT access*	82.1	19	● ◆
3.1.2	ICT use*	74.0	33	◆
3.1.3	Government's online service*	73.6	58	
3.1.4	E-participation*	88.2	33	
3.2	**General infrastructure**	**22.5**	**86**	
3.2.1	Electricity output, kWh/mn pop	3,629.3	55	
3.2.2	Logistics performance*	23.7	99	
3.2.3	Gross capital formation, % GDP	26.2	43	
3.3	**Ecological sustainability**	**27.7**	**69**	
3.3.1	GDP/unit of energy use	6.3	99	○ ◇
3.3.2	Environmental performance*	53.0	47	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.9	47	
	MARKET SOPHISTICATION	**39.1**	**107**	○
4.1	**Credit**	**24.1**	**119**	○ ◇
4.1.1	Ease of getting credit*	50.0	94	
4.1.2	Domestic credit to private sector, % GDP	27.8	98	
4.1.3	Microfinance gross loans, % GDP	0.0	82	○ ◇
4.2	**Investment**	**29.2**	**97**	
4.2.1	Ease of protecting minority investors*	58.0	77	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	76	○
4.3	**Trade, competition, and market scale**	**64.0**	**59**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	21	●
4.3.2	Intensity of local competition†	n/a	n/a	
4.3.3	Domestic market scale, bn PPP$	195.6	68	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**24.9**	**67**	
5.1	**Knowledge workers**	**47.6**	**30**	◆
5.1.1	Knowledge-intensive employment, %	40.1	27	◆
5.1.2	Firms offering formal training, % ⓘ	31.5	47	
5.1.3	GERD performed by business, % GDP	0.4	40	
5.1.4	GERD financed by business, %	45.0	37	
5.1.5	Females employed w/advanced degrees, % ⓘ	32.6	2	● ◆
5.2	**Innovation linkages**	**6.2**	**[127]**	
5.2.1	University/industry research collaboration†	n/a	n/a	
5.2.2	State of cluster development†	n/a	n/a	
5.2.3	GERD financed by abroad, % GDP	0.1	44	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	93	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	53	
5.3	**Knowledge absorption**	**20.7**	**96**	
5.3.1	Intellectual property payments, % total trade	0.4	72	
5.3.2	High-tech imports, % total trade	5.5	105	
5.3.3	ICT services imports, % total trade	0.7	93	
5.3.4	FDI net inflows, % GDP	2.4	70	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**27.7**	**46**	
6.1	**Knowledge creation**	**17.2**	**58**	
6.1.1	Patents by origin/bn PPP$ GDP	3.0	31	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	66	
6.1.3	Utility models by origin/bn PPP$ GDP	1.5	16	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.7	78	
6.1.5	Citable documents H-index	10.8	72	
6.2	**Knowledge impact**	**34.7**	**29**	◆
6.2.1	Growth rate of PPP$ GDP/worker, %	3.0	28	
6.2.2	New businesses/th pop. 15–64	1.3	74	
6.2.3	Computer software spending, % GDP	0.0	104	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	24.6	5	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	26.1	41	
6.3	**Knowledge diffusion**	**31.2**	**41**	
6.3.1	Intellectual property receipts, % total trade	0.1	54	
6.3.2	High-tech net exports, % total trade	1.7	59	
6.3.3	ICT services exports, % total trade	4.5	15	● ◆
6.3.4	FDI net outflows, % GDP	0.2	97	
	CREATIVE OUTPUTS	**14.8**	**97**	
7.1	**Intangible assets**	**4.9**	**130**	○ ◇
7.1.1	Trademarks by origin/bn PPP$ GDP	23.9	86	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.0	70	
7.1.4	ICTs & organizational model creation†	n/a	n/a	
7.2	**Creative goods and services**	**5.1**	**104**	
7.2.1	Cultural & creative services exports, % total trade	0.3	65	
7.2.2	National feature films/mn pop. 15–69 ⓘ	0.1	107	○ ◇
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	0.5	91	○ ◇
7.2.5	Creative goods exports, % total trade	0.5	63	
7.3	**Online creativity**	**44.1**	**26**	◆
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.7	82	
7.3.2	Country-code TLDs/th pop. 15–69	5.9	48	
7.3.3	Wikipedia edits/mn pop. 15–69	70.6	38	◆
7.3.4	Mobile app creation/bn PPP$ GDP	100.0	1	● ◆

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⓘ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

BELGIUM

GII 2020 rank

22

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
25	21	High	EUR	11.5	567.5	43,240.2	23

		Score/Value	Rank	Mark
	INSTITUTIONS	**81.2**	**21**	
1.1	**Political environment**	**77.7**	**26**	◇
1.1.1	Political and operational stability*	80.4	33	
1.1.2	Government effectiveness*	76.3	27	◇
1.2	**Regulatory environment**	**77.6**	**32**	
1.2.1	Regulatory quality*	74.3	25	
1.2.2	Rule of law*	82.3	21	
1.2.3	Cost of redundancy dismissal, salary weeks	19.7	82	○
1.3	**Business environment**	**88.2**	**8**	●
1.3.1	Ease of starting a business*	92.3	44	
1.3.2	Ease of resolving insolvency*	84.1	9	●

		Score/Value	Rank	Mark
	HUMAN CAPITAL & RESEARCH	**57.8**	**11**	●
2.1	**Education**	**75.4**	**2**	● ◆
2.1.1	Expenditure on education, % GDP ◷	6.5	9	●
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	19.8	2	● ◆
2.1.4	PISA scales in reading, maths, & science	499.9	19	
2.1.5	Pupil-teacher ratio, secondary ◷	9.0	21	◆
2.2	**Tertiary education**	**38.4**	**49**	
2.2.1	Tertiary enrolment, % gross	79.7	19	
2.2.2	Graduates in science & engineering, %	16.7	83	○ ◇
2.2.3	Tertiary inbound mobility, %	8.5	24	
2.3	**Research & development (R&D)**	**59.6**	**14**	
2.3.1	Researchers, FTE/mn pop.	5,023.3	16	
2.3.2	Gross expenditure on R&D, % GDP	2.8	10	●
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	66.3	20	
2.3.4	QS university ranking, average score top 3*	54.9	16	

		Score/Value	Rank	Mark
	INFRASTRUCTURE	**52.2**	**35**	◇
3.1	**Information & communication technologies (ICTs)**	**77.1**	**40**	◇
3.1.1	ICT access*	80.2	27	
3.1.2	ICT use*	76.6	27	
3.1.3	Government's online service*	75.7	56	◇
3.1.4	E-participation*	75.8	59	◇
3.2	**General infrastructure**	**41.4**	**20**	
3.2.1	Electricity output, kWh/mn pop.	6,486.6	31	
3.2.2	Logistics performance*	92.4	3	●
3.2.3	Gross capital formation, % GDP	25.1	51	
3.3	**Ecological sustainability**	**38.0**	**41**	
3.3.1	GDP/unit of energy use	9.2	66	○
3.3.2	Environmental performance*	73.3	15	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.8	49	

		Score/Value	Rank	Mark
	MARKET SOPHISTICATION	**54.5**	**29**	
4.1	**Credit**	**47.5**	**46**	
4.1.1	Ease of getting credit*	65.0	61	○
4.1.2	Domestic credit to private sector, % GDP	69.5	45	◇
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**42.0**	**46**	
4.2.1	Ease of protecting minority investors*	68.0	44	
4.2.2	Market capitalization, % GDP	75.2	20	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	21	
4.3	**Trade, competition, and market scale**	**74.0**	**21**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	78.6	14	
4.3.3	Domestic market scale, bn PPP$	567.5	36	

		Score/Value	Rank	Mark
	BUSINESS SOPHISTICATION	**52.5**	**16**	
5.1	**Knowledge workers**	**68.7**	**6**	●
5.1.1	Knowledge-intensive employment, %	47.3	12	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	1.9	9	●
5.1.4	GERD financed by business, %	63.5	9	●
5.1.5	Females employed w/advanced degrees, %	25.4	12	
5.2	**Innovation linkages**	**50.5**	**15**	
5.2.1	University/industry research collaboration† ◷	68.7	12	
5.2.2	State of cluster development† ◷	64.9	17	
5.2.3	GERD financed by abroad, % GDP	0.3	6	●
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	29	◇
5.2.5	Patent families 2+ offices/bn PPP$ GDP	3.5	15	
5.3	**Knowledge absorption**	**38.3**	**34**	◇
5.3.1	Intellectual property payments, % total trade	0.8	52	
5.3.2	High-tech imports, % total trade	7.6	66	○
5.3.3	ICT services imports, % total trade	2.3	21	
5.3.4	FDI net inflows, % GDP	-2.2	128	○
5.3.5	Research talent, % in business enterprise	56.3	18	

		Score/Value	Rank	Mark
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**42.3**	**17**	
6.1	**Knowledge creation**	**52.6**	**13**	
6.1.1	Patents by origin/bn PPP$ GDP	5.9	18	
6.1.2	PCT patents by origin/bn PPP$ GDP	2.4	14	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	23.9	19	
6.1.5	Citable documents H-index	53.6	14	
6.2	**Knowledge impact**	**34.8**	**28**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.1	87	○
6.2.2	New businesses/th pop. 15-64	3.4	40	
6.2.3	Computer software spending, % GDP	0.0	7	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	5.7	48	
6.2.5	High- and medium-high-tech manufacturing, %	37.0	28	
6.3	**Knowledge diffusion**	**39.6**	**27**	
6.3.1	Intellectual property receipts, % total trade	0.8	21	
6.3.2	High-tech net exports, % total trade	7.9	21	
6.3.3	ICT services exports, % total trade	3.0	32	
6.3.4	FDI net outflows, % GDP	-1.2	128	○

		Score/Value	Rank	Mark
	CREATIVE OUTPUTS	**35.0**	**32**	◇
7.1	**Intangible assets**	**33.9**	**40**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP	42.6	61	○
7.1.2	Global brand value, top 5,000, % GDP	58.9	32	◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	2.7	41	
7.1.4	ICTs & organizational model creation†	72.2	16	
7.2	**Creative goods and services**	**30.3**	**26**	
7.2.1	Cultural & creative services exports, % total trade	1.3	20	
7.2.2	National feature films/mn pop. 15-69	10.9	16	
7.2.3	Entertainment & Media market/th pop. 15-69	54.6	13	
7.2.4	Printing and other media, % manufacturing	1.1	43	
7.2.5	Creative goods exports, % total trade	1.4	38	
7.3	**Online creativity**	**41.7**	**28**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	21.0	27	◇
7.3.2	Country-code TLDs/th pop. 15-69	62.0	12	●
7.3.3	Wikipedia edits/mn pop. 15-69	81.0	21	
7.3.4	Mobile app creation/bn PPP$ GDP	3.7	59	○ ◇

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

BENIN

GII 2020 rank

126

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
131	116	Low	SSF	11.8	40.7	3,008.8	123

		Score/Value	Rank	
	INSTITUTIONS	**57.8**	**85**	
1.1	**Political environment**	**45.8**	**101**	
1.1.1	Political and operational stability*	62.5	92	
1.1.2	Government effectiveness*	37.5	102	
1.2	**Regulatory environment**	**61.9**	**75**	●
1.2.1	Regulatory quality*	32.8	95	
1.2.2	Rule of law*	29.1	107	
1.2.3	Cost of redundancy dismissal, salary weeks	11.6	37	●
1.3	**Business environment**	**65.8**	**81**	
1.3.1	Ease of starting a business*	90.6	55	●
1.3.2	Ease of resolving insolvency*	41.0	95	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**18.9**	**97**	◆
2.1	**Education**	**35.0**	**95**	
2.1.1	Expenditure on education, % GDP	4.0	71	●
2.1.2	Government funding/pupil, secondary, % GDP/cap. ◷	10.8	92	
2.1.3	School life expectancy, years ◷	12.6	86	◆
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ◷	11.0	42	● ◆
2.2	**Tertiary education**	**21.6**	**90**	◆
2.2.1	Tertiary enrolment, % gross	12.3	105	
2.2.2	Graduates in science & engineering, % ◷	20.7	68	
2.2.3	Tertiary inbound mobility, %	7.0	34	● ◆
2.3	**Research & development (R&D)**	**0.0**	**[121]**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**22.2**	**122**	
3.1	**Information & communication technologies (ICTs)**	**32.2**	**118**	
3.1.1	ICT access*	31.3	120	
3.1.2	ICT use*	13.4	124	
3.1.3	Government's online service*	47.2	110	
3.1.4	E-participation*	37.1	115	
3.2	**General infrastructure**	**21.5**	**91**	
3.2.1	Electricity output, kWh/mn pop.	29.6	121	○
3.2.2	Logistics performance*	31.9	75	● ◆
3.2.3	Gross capital formation, % GDP	26.6	39	●
3.3	**Ecological sustainability**	**12.8**	**131**	○
3.3.1	GDP/unit of energy use	4.4	114	
3.3.2	Environmental performance*	30.0	120	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	128	○

		Score/Value	Rank	
	MARKET SOPHISTICATION	**34.3**	**122**	
4.1	**Credit**	**21.5**	**122**	
4.1.1	Ease of getting credit*	30.0	122	
4.1.2	Domestic credit to private sector, % GDP	23.1	109	
4.1.3	Microfinance gross loans, % GDP	2.1	12	●
4.2	**Investment**	**42.0**	**[47]**	
4.2.1	Ease of protecting minority investors*	42.0	102	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**39.5**	**128**	○
4.3.1	Applied tariff rate, weighted avg., %	15.3	130	○ ◇
4.3.2	Intensity of local competition†	63.2	90	
4.3.3	Domestic market scale, bn PPP$	40.7	109	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**15.7**	**125**	
5.1	**Knowledge workers**	**13.4**	**[116]**	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % ◷	20.0	75	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ◷	0.8	112	
5.2	**Innovation linkages**	**17.1**	**94**	
5.2.1	University/industry research collaboration†	35.6	96	
5.2.2	State of cluster development†	36.5	108	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	81	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**16.6**	**121**	
5.3.1	Intellectual property payments, % total trade ◷	0.0	117	○
5.3.2	High-tech imports, % total trade	4.0	120	
5.3.3	ICT services imports, % total trade ◷	1.1	64	●
5.3.4	FDI net inflows, % GDP	1.9	85	
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**5.5**	**130**	○ ◇
6.1	**Knowledge creation**	**6.1**	**95**	
6.1.1	Patents by origin/bn PPP$ GDP	0.1	111	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	89	◆
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.3	72	●
6.1.5	Citable documents H-index	4.7	110	
6.2	**Knowledge impact**	**3.0**	**[128]**	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	0.5	94	
6.2.3	Computer software spending, % GDP	0.0	99	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.0	108	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**7.4**	**129**	○ ◇
6.3.1	Intellectual property receipts, % total trade ◷	0.0	108	○ ◇
6.3.2	High-tech net exports, % total trade	0.0	124	
6.3.3	ICT services exports, % total trade ◷	0.1	120	
6.3.4	FDI net outflows, % GDP	0.2	94	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**7.4**	**128**	○
7.1	**Intangible assets**	**11.5**	**127**	○
7.1.1	Trademarks by origin/bn PPP$ GDP	4.6	120	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.1	113	
7.1.4	ICTs & organizational model creation†	39.2	115	
7.2	**Creative goods and services**	**0.4**	**[129]**	
7.2.1	Cultural & creative services exports, % total trade ◷	0.0	96	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.0	121	
7.3	**Online creativity**	**6.3**	**103**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.6	103	◆
7.3.2	Country-code TLDs/th pop. 15–69	0.0	127	○
7.3.3	Wikipedia edits/mn pop. 15–69	22.5	103	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

BOLIVIA (PLURINATIONAL STATE OF)

GII 2020 rank

105

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
117	97	Lower middle	LCN	11.5	94.4	7,134.6	110

		Score/Value	Rank	
	INSTITUTIONS	**39.7**	**129**	○ ◇
1.1	**Political environment**	**45.9**	**100**	
1.1.1	Political and operational stability*	51.8	123	○ ◇
1.1.2	Government effectiveness*	42.9	90	
1.2	**Regulatory environment**	**17.4**	**131**	○ ◇
1.2.1	Regulatory quality*	18.2	124	◇
1.2.2	Rule of law*	16.7	127	○ ◇
1.2.3	Cost of redundancy dismissal, salary weeks	n/a	n/a	
1.3	**Business environment**	**55.8**	**116**	
1.3.1	Ease of starting a business*	69.4	125	○ ◇
1.3.2	Ease of resolving insolvency*	42.3	92	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**33.1**	**[56]**	
2.1	**Education**	**65.0**	**[10]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	18.5	91	
2.2	**Tertiary education**	**n/a**	**[n/a]**	
2.2.1	Tertiary enrolment, % gross	n/a	n/a	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**1.2**	**106**	
2.3.1	Researchers, FTE/mn pop. ◷	163.8	83	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.2	96	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**29.1**	**104**	
3.1	**Information & communication technologies (ICTs)**	**50.1**	**97**	
3.1.1	ICT access*	42.2	103	
3.1.2	ICT use*	43.9	86	
3.1.3	Government's online service*	56.3	96	
3.1.4	E-participation*	57.9	94	
3.2	**General infrastructure**	**13.4**	**123**	◇
3.2.1	Electricity output, kWh/mn pop.	901.8	97	
3.2.2	Logistics performance*	13.5	117	◇
3.2.3	Gross capital formation, % GDP	20.7	90	
3.3	**Ecological sustainability**	**23.8**	**84**	
3.3.1	GDP/unit of energy use	8.3	75	
3.3.2	Environmental performance*	44.3	77	◆
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.5	80	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**45.7**	**78**	
4.1	**Credit**	**42.1**	**64**	●
4.1.1	Ease of getting credit*	35.0	118	◇
4.1.2	Domestic credit to private sector, % GDP	65.9	51	●
4.1.3	Microfinance gross loans, % GDP	28.0	2	● ◆
4.2	**Investment**	**38.0**	**[64]**	
4.2.1	Ease of protecting minority investors*	38.0	115	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**57.0**	**89**	
4.3.1	Applied tariff rate, weighted avg., %	4.7	85	
4.3.2	Intensity of local competition†	63.8	85	
4.3.3	Domestic market scale, bn PPP$	94.4	85	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**21.8**	**90**	
5.1	**Knowledge workers**	**29.0**	**69**	●
5.1.1	Knowledge-intensive employment, %	14.4	93	
5.1.2	Firms offering formal training, % ◷	49.9	17	● ◆
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, % ◷	5.2	84	
5.1.5	Females employed w/advanced degrees, %	10.4	65	●
5.2	**Innovation linkages**	**13.3**	**121**	
5.2.1	University/industry research collaboration†	25.2	123	○ ◇
5.2.2	State of cluster development†	30.7	121	○ ◇
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	98	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**23.1**	**88**	
5.3.1	Intellectual property payments, % total trade	0.9	41	●
5.3.2	High-tech imports, % total trade	10.7	24	●
5.3.3	ICT services imports, % total trade	0.8	87	
5.3.4	FDI net inflows, % GDP	1.2	106	
5.3.5	Research talent, % in business enterprise ◷	0.4	84	○

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**10.4**	**114**	
6.1	**Knowledge creation**	**4.4**	**111**	
6.1.1	Patents by origin/bn PPP$ GDP ◷	0.7	74	
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP ◷	0.1	54	
6.1.4	Scientific & technical articles/bn PPP$ GDP	1.7	120	
6.1.5	Citable documents H-index	6.9	91	
6.2	**Knowledge impact**	**15.0**	**100**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.0	92	◇
6.2.2	New businesses/th pop. 15-64	0.5	98	
6.2.3	Computer software spending, % GDP	0.0	52	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.4	82	
6.2.5	High- and medium-high-tech manufacturing, % ◷	7.2	93	
6.3	**Knowledge diffusion**	**11.8**	**110**	
6.3.1	Intellectual property receipts, % total trade	0.2	34	●
6.3.2	High-tech net exports, % total trade	0.2	101	
6.3.3	ICT services exports, % total trade	0.8	87	
6.3.4	FDI net outflows, % GDP	0.1	105	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**11.5**	**109**	
7.1	**Intangible assets**	**14.3**	**112**	
7.1.1	Trademarks by origin/bn PPP$ GDP ◷	41.8	64	●
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP ◷	0.2	100	
7.1.4	ICTs & organizational model creation†	31.7	122	○ ◇
7.2	**Creative goods and services**	**9.3**	**80**	
7.2.1	Cultural & creative services exports, % total trade	0.1	91	
7.2.2	National feature films/mn pop. 15-69	0.8	90	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing ◷	1.0	55	
7.2.5	Creative goods exports, % total trade	1.0	43	●
7.3	**Online creativity**	**8.0**	**96**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	1.7	81	
7.3.2	Country-code TLDs/th pop. 15-69	0.5	98	
7.3.3	Wikipedia edits/mn pop. 15-69	33.3	91	
7.3.4	Mobile app creation/bn PPP$ GDP	0.0	93	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

BOSNIA AND HERZEGOVINA

GII 2020 rank

74

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
75	72	Upper middle	EUR	3.3	49.8	12,414.2	76

		Score/Value	Rank	
	INSTITUTIONS	**59.3**	**80**	
1.1	**Political environment**	**45.6**	**103**	◇
1.1.1	Political and operational stability*	64.3	83	
1.1.2	Government effectiveness*	36.3	110	◇
1.2	**Regulatory environment**	**68.0**	**53**	
1.2.1	Regulatory quality*	36.3	87	
1.2.2	Rule of law*	40.6	74	
1.2.3	Cost of redundancy dismissal, salary weeks	9.2	24	●
1.3	**Business environment**	**64.1**	**88**	
1.3.1	Ease of starting a business*	60.0	130	○ ◇
1.3.2	Ease of resolving insolvency*	68.2	34	● ◆
	HUMAN CAPITAL & RESEARCH	**35.0**	**50**	
2.1	**Education**	**70.8**	**[4]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap	43.5	2	● ◆
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	402.6	63	
2.1.5	Pupil-teacher ratio, secondary	9.1	23	●
2.2	**Tertiary education**	**32.0**	**68**	
2.2.1	Tertiary enrolment, % gross	n/a	n/a	
2.2.2	Graduates in science & engineering, %	21.2	61	
2.2.3	Tertiary inbound mobility, %	7.4	32	● ◆
2.3	**Research & development (R&D)**	**2.3**	**92**	
2.3.1	Researchers, FTE/mn pop.	471.3	71	
2.3.2	Gross expenditure on R&D, % GDP	0.2	90	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**36.8**	**84**	
3.1	**Information & communication technologies (ICTs)**	**52.0**	**94**	
3.1.1	ICT access*	68.1	61	
3.1.2	ICT use*	53.4	67	
3.1.3	Government's online service*	43.1	114	○ ◇
3.1.4	E-participation*	43.3	110	◇
3.2	**General infrastructure**	**22.7**	**82**	
3.2.1	Electricity output, kWh/mn pop.	4,683.2	46	
3.2.2	Logistics performance*	34.7	71	
3.2.3	Gross capital formation, % GDP	21.4	85	
3.3	**Ecological sustainability**	**35.9**	**47**	
3.3.1	GDP/unit of energy use	5.8	103	◇
3.3.2	Environmental performance*	45.4	70	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	6.1	15	● ◆
	MARKET SOPHISTICATION	**50.1**	**51**	
4.1	**Credit**	**38.0**	**80**	
4.1.1	Ease of getting credit*	65.0	61	
4.1.2	Domestic credit to private sector, % GDP	58.6	59	
4.1.3	Microfinance gross loans, % GDP	0.7	29	
4.2	**Investment**	**56.0**	**[19]**	
4.2.1	Ease of protecting minority investors*	56.0	82	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**56.2**	**92**	
4.3.1	Applied tariff rate, weighted avg., %	2.8	63	
4.3.2	Intensity of local competition†	61.9	98	
4.3.3	Domestic market scale, bn PPP$	49.8	100	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**18.7**	**102**	◇
5.1	**Knowledge workers**	**27.4**	**76**	
5.1.1	Knowledge-intensive employment, %	21.8	71	
5.1.2	Firms offering formal training, %	37.9	34	
5.1.3	GERD performed by business, % GDP	0.1	65	
5.1.4	GERD financed by business, %	28.9	62	
5.1.5	Females employed w/advanced degrees, %	6.1	83	◇
5.2	**Innovation linkages**	**13.0**	**123**	○ ◇
5.2.1	University/industry research collaboration†	23.7	124	○ ◇
5.2.2	State of cluster development†	33.6	116	○ ◇
5.2.3	GERD financed by abroad, % GDP	0.0	54	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	77	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	82	
5.3	**Knowledge absorption**	**15.7**	**128**	○ ◇
5.3.1	Intellectual property payments, % total trade	0.1	102	○
5.3.2	High-tech imports, % total trade	5.5	106	
5.3.3	ICT services imports, % total trade	0.5	104	
5.3.4	FDI net inflows, % GDP	2.3	73	
5.3.5	Research talent, % in business enterprise	8.4	63	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**21.2**	**61**	
6.1	**Knowledge creation**	**11.0**	**76**	
6.1.1	Patents by origin/bn PPP$ GDP	1.8	42	●
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	84	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	8.0	60	
6.1.5	Citable documents H-index	4.8	106	
6.2	**Knowledge impact**	**27.4**	**53**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-1.2	110	○
6.2.2	New businesses/th pop. 15–64	1.1	83	
6.2.3	Computer software spending, % GDP	0.0	91	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	28.3	4	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	13.0	74	
6.3	**Knowledge diffusion**	**25.3**	**59**	
6.3.1	Intellectual property receipts, % total trade	0.2	40	◆
6.3.2	High-tech net exports, % total trade	2.7	50	
6.3.3	ICT services exports, % total trade	1.8	62	
6.3.4	FDI net outflows, % GDP	0.2	98	
	CREATIVE OUTPUTS	**14.8**	**96**	
7.1	**Intangible assets**	**14.7**	**111**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP	20.8	92	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.6	54	
7.1.4	ICTs & organizational model creation†	39.0	116	○ ◇
7.2	**Creative goods and services**	**11.6**	**73**	
7.2.1	Cultural & creative services exports, % total trade	0.0	94	
7.2.2	National feature films/mn pop. 15–69	8.4	24	● ◆
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	1.1	47	
7.2.5	Creative goods exports, % total trade	0.4	68	
7.3	**Online creativity**	**18.0**	**58**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.8	67	
7.3.2	Country-code TLDs/th pop. 15–69	2.8	62	
7.3.3	Wikipedia edits/mn pop. 15–69	68.2	41	● ◆
7.3.4	Mobile app creation/bn PPP$ GDP	0.1	83	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

BOTSWANA

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
105	84	Upper middle	SSF	2.3	44.1	16,202.0	93

		Score/Value	Rank	
	INSTITUTIONS	**64.9**	**60**	
1.1	**Political environment**	**66.4**	**45**	◆
1.1.1	Political and operational stability*	83.9	21	● ◆
1.1.2	Government effectiveness*	57.6	52	
1.2	**Regulatory environment**	**66.0**	**62**	
1.2.1	Regulatory quality*	53.8	49	
1.2.2	Rule of law*	58.8	43	● ◆
1.2.3	Cost of redundancy dismissal, salary weeks	20.3	85	
1.3	**Business environment**	**62.2**	**95**	
1.3.1	Ease of starting a business*	76.2	116	◇
1.3.2	Ease of resolving insolvency*	48.2	76	
	HUMAN CAPITAL & RESEARCH	**33.6**	**53**	
2.1	**Education**	**82.5**	**[1]**	
2.1.1	Expenditure on education, % GDP ⊙	9.6	1	● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	35.9	7	● ◆
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	**Tertiary education**	**15.2**	**103**	◇
2.2.1	Tertiary enrolment, % gross	24.9	88	◇
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	2.4	71	
2.3	**Research & development (R&D)**	**3.2**	**86**	
2.3.1	Researchers, FTE/mn pop. ⊙	185.2	82	
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.5	63	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**29.4**	**103**	◇
3.1	**Information & communication technologies (ICTs)**	**33.7**	**116**	◇
3.1.1	ICT access*	51.9	88	
3.1.2	ICT use*	42.5	95	◇
3.1.3	Government's online service*	20.8	127	○ ◇
3.1.4	E-participation*	19.7	125	○ ◇
3.2	**General infrastructure**	**27.4**	**61**	
3.2.1	Electricity output, kWh/mn pop.	1,319.4	91	◇
3.2.2	Logistics performance*	n/a	n/a	
3.2.3	Gross capital formation, % GDP	34.6	16	● ◆
3.3	**Ecological sustainability**	**27.0**	**72**	
3.3.1	GDP/unit of energy use	12.5	31	●
3.3.2	Environmental performance*	40.4	87	◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	100	
	MARKET SOPHISTICATION	**42.2**	**96**	
4.1	**Credit**	**36.1**	**83**	
4.1.1	Ease of getting credit*	60.0	74	
4.1.2	Domestic credit to private sector, % GDP	31.8	93	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**31.8**	**91**	
4.2.1	Ease of protecting minority investors*	60.0	71	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	53	
4.3	**Trade, competition, and market scale**	**58.8**	**82**	
4.3.1	Applied tariff rate, weighted avg., %	0.3	4	● ◆
4.3.2	Intensity of local competition†	61.7	101	
4.3.3	Domestic market scale, bn PPP$	44.1	107	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**20.4**	**99**	
5.1	**Knowledge workers**	**28.1**	**75**	
5.1.1	Knowledge-intensive employment, % ⊙	17.9	85	
5.1.2	Firms offering formal training, % ⊙	51.9	15	●
5.1.3	GERD performed by business, % GDP ⊙	0.1	62	
5.1.4	GERD financed by business, % ⊙	17.7	69	
5.1.5	Females employed w/advanced degrees, % ⊙	9.1	72	
5.2	**Innovation linkages**	**18.9**	**78**	
5.2.1	University/industry research collaboration†	36.9	89	
5.2.2	State of cluster development†	36.3	109	◇
5.2.3	GERD financed by abroad, % GDP ⊙	0.1	34	● ◆
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	49	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**14.1**	**130**	○ ◇
5.3.1	Intellectual property payments, % total trade ⊙	0.1	96	
5.3.2	High-tech imports, % total trade	4.9	111	
5.3.3	ICT services imports, % total trade ⊙	1.0	69	
5.3.4	FDI net inflows, % GDP	1.0	109	◇
5.3.5	Research talent, % in business enterprise ⊙	1.0	79	○ ◇
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**14.5**	**89**	
6.1	**Knowledge creation**	**5.7**	**100**	
6.1.1	Patents by origin/bn PPP$ GDP ⊙	0.1	121	○
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	0.3	41	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.8	75	
6.1.5	Citable documents H-index	5.3	100	
6.2	**Knowledge impact**	**26.0**	**61**	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.3	42	
6.2.2	New businesses/th pop. 15–64 ⊙	20.1	3	● ◆
6.2.3	Computer software spending, % GDP	0.0	84	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.4	124	○
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**11.9**	**109**	
6.3.1	Intellectual property receipts, % total trade ⊙	0.0	92	
6.3.2	High-tech net exports, % total trade	0.6	78	
6.3.3	ICT services exports, % total trade ⊙	0.3	110	
6.3.4	FDI net outflows, % GDP	0.6	74	
	CREATIVE OUTPUTS	**11.0**	**111**	◇
7.1	**Intangible assets**	**13.8**	**116**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP	14.5	103	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP ⊙	0.3	91	
7.1.4	ICTs & organizational model creation†	41.9	109	◇
7.2	**Creative goods and services**	**2.1**	**[118]**	
7.2.1	Cultural & creative services exports, % total trade	0.0	99	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.2	77	
7.3	**Online creativity**	**14.3**	**70**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.1	94	
7.3.2	Country-code TLDs/th pop. 15–69	1.3	78	
7.3.3	Wikipedia edits/mn pop. 15–69	43.6	74	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

BRAZIL

GII 2020 rank

62

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
64	59	Upper middle	LCN	211.0	3,456.4	14,371.6	66

		Score/Value	Rank	
	INSTITUTIONS	**58.5**	**82**	
1.1	**Political environment**	**48.8**	**91**	
1.1.1	Political and operational stability*	66.1	76	
1.1.2	Government effectiveness*	40.1	97	◇
1.2	**Regulatory environment**	**60.9**	**77**	
1.2.1	Regulatory quality*	33.5	94	
1.2.2	Rule of law*	39.4	78	
1.2.3	Cost of redundancy dismissal, salary weeks	15.4	60	
1.3	**Business environment**	**65.9**	**80**	
1.3.1	Ease of starting a business*	81.3	106	○
1.3.2	Ease of resolving insolvency*	50.4	69	
	HUMAN CAPITAL & RESEARCH	**35.8**	**49**	
2.1	**Education**	**49.2**	**56**	
2.1.1	Expenditure on education, % GDP ⓘ	6.2	12	● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap ⓘ	21.5	41	
2.1.3	School life expectancy, years	15.4	42	
2.1.4	PISA scales in reading, maths, & science	400.0	68	○
2.1.5	Pupil-teacher ratio, secondary ⓘ	16.7	82	
2.2	**Tertiary education**	**24.0**	**85**	
2.2.1	Tertiary enrolment, % gross	51.3	57	
2.2.2	Graduates in science & engineering, %	17.7	81	○
2.2.3	Tertiary inbound mobility, %	0.2	105	○ ◇
2.3	**Research & development (R&D)**	**34.3**	**34**	● ◆
2.3.1	Researchers, FTE/mn pop. ⓘ	887.7	53	
2.3.2	Gross expenditure on R&D, % GDP ⓘ	1.3	30	● ◆
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	58.6	23	● ◆
2.3.4	QS university ranking, average score top 3*	42.7	28	● ◆
	INFRASTRUCTURE	**41.8**	**61**	
3.1	**Information & communication technologies (ICTs)**	**77.5**	**38**	◆
3.1.1	ICT access*	59.2	76	
3.1.2	ICT use*	61.1	56	
3.1.3	Government's online service*	92.4	22	● ◆
3.1.4	E-participation*	97.2	12	● ◆
3.2	**General infrastructure**	**18.9**	**108**	○
3.2.1	Electricity output, kWh/mn pop.	2,816.2	65	
3.2.2	Logistics performance*	43.0	55	
3.2.3	Gross capital formation, % GDP	15.7	118	○ ◇
3.3	**Ecological sustainability**	**29.0**	**65**	
3.3.1	GDP/unit of energy use	10.0	55	
3.3.2	Environmental performance*	51.2	53	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.9	66	
	MARKET SOPHISTICATION	**42.7**	**91**	
4.1	**Credit**	**30.9**	**105**	○
4.1.1	Ease of getting credit*	50.0	94	○
4.1.2	Domestic credit to private sector, % GDP	61.8	56	
4.1.3	Microfinance gross loans, % GDP	0.1	59	
4.2	**Investment**	**28.6**	**99**	
4.2.1	Ease of protecting minority investors*	62.0	60	
4.2.2	Market capitalization, % GDP	45.9	34	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	55	
4.3	**Trade, competition, and market scale**	**68.8**	**36**	
4.3.1	Applied tariff rate, weighted avg., %	8.0	103	○ ◇
4.3.2	Intensity of local competition†	68.2	67	
4.3.3	Domestic market scale, bn PPP$	3,456.4	8	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**35.8**	**35**	◆
5.1	**Knowledge workers**	**46.1**	**[32]**	
5.1.1	Knowledge-intensive employment, %	23.5	64	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	47.5	33	
5.1.5	Females employed w/advanced degrees, %	13.8	50	
5.2	**Innovation linkages**	**21.4**	**62**	
5.2.1	University/industry research collaboration†	40.0	74	
5.2.2	State of cluster development†	48.7	55	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	87	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	55	
5.3	**Knowledge absorption**	**40.0**	**31**	● ◆
5.3.1	Intellectual property payments, % total trade	2.2	11	● ◆
5.3.2	High-tech imports, % total trade	10.0	32	●
5.3.3	ICT services imports, % total trade	1.7	35	
5.3.4	FDI net inflows, % GDP	3.9	38	
5.3.5	Research talent, % in business enterprise ⓘ	26.6	49	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**23.3**	**56**	
6.1	**Knowledge creation**	**20.6**	**48**	
6.1.1	Patents by origin/bn PPP$ GDP	1.5	52	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.2	50	
6.1.3	Utility models by origin/bn PPP$ GDP	0.7	29	
6.1.4	Scientific & technical articles/bn PPP$ GDP	10.5	50	
6.1.5	Citable documents H-index	37.4	24	● ◆
6.2	**Knowledge impact**	**22.8**	**69**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.0	93	○
6.2.2	New businesses/th pop. 15-64	1.3	76	
6.2.3	Computer software spending, % GDP	0.0	75	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.9	56	
6.2.5	High- and medium-high-tech manufacturing, %	34.5	31	
6.3	**Knowledge diffusion**	**26.4**	**53**	
6.3.1	Intellectual property receipts, % total trade	0.3	30	◆
6.3.2	High-tech net exports, % total trade	4.2	38	
6.3.3	ICT services exports, % total trade	1.0	83	
6.3.4	FDI net outflows, % GDP	0.7	67	
	CREATIVE OUTPUTS	**18.6**	**77**	
7.1	**Intangible assets**	**25.8**	**71**	
7.1.1	Trademarks by origin/bn PPP$ GDP	52.3	43	
7.1.2	Global brand value, top 5,000, % GDP	33.8	43	
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.1	66	
7.1.4	ICTs & organizational model creation†	52.6	69	
7.2	**Creative goods and services**	**6.5**	**98**	
7.2.1	Cultural & creative services exports, % total trade	0.5	52	
7.2.2	National feature films/mn pop. 15-69	1.1	86	○
7.2.3	Entertainment & Media market/th pop. 15-69	7.4	42	
7.2.4	Printing and other media, % manufacturing	0.6	82	○
7.2.5	Creative goods exports, % total trade	0.3	73	
7.3	**Online creativity**	**16.4**	**65**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	1.5	88	
7.3.2	Country-code TLDs/th pop. 15-69	8.1	43	
7.3.3	Wikipedia edits/mn pop. 15-69	46.4	67	
7.3.4	Mobile app creation/bn PPP$ GDP	12.3	39	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⓘ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

BRUNEI DARUSSALAM

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
113	39	High	SEAO	0.4	35.9	70,177.3	71

		Score/Value	Rank	
	INSTITUTIONS	**80.3**	**25**	
1.1	**Political environment**	**83.6**	**18**	●
1.1.1	Political and operational stability*	94.6	3	● ◆
1.1.2	Government effectiveness*	78.1	22	●
1.2	**Regulatory environment**	**80.7**	**30**	
1.2.1	Regulatory quality*	59.9	39	
1.2.2	Rule of law*	63.1	37	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	● ◆
1.3	**Business environment**	**76.6**	**43**	
1.3.1	Ease of starting a business*	94.9	15	●
1.3.2	Ease of resolving insolvency*	58.2	54	
	HUMAN CAPITAL & RESEARCH	**34.3**	**51**	◇
2.1	**Education**	**46.9**	**63**	
2.1.1	Expenditure on education, % GDP	4.4	64	
2.1.2	Government funding/pupil, secondary, % GDP/cap	23.6	25	
2.1.3	School life expectancy, years	14.3	66	◇
2.1.4	PISA scales in reading, maths, & science	423.1	53	
2.1.5	Pupil-teacher ratio, secondary	8.3	12	● ◆
2.2	**Tertiary education**	**45.4**	**25**	
2.2.1	Tertiary enrolment, % gross	31.4	80	◇
2.2.2	Graduates in science & engineering, %	39.2	5	● ◆
2.2.3	Tertiary inbound mobility, %	4.6	49	
2.3	**Research & development (R&D)**	**10.6**	**[56]**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	21.2	49	
	INFRASTRUCTURE	**47.0**	**46**	◇
3.1	**Information & communication technologies (ICTs)**	**69.2**	**59**	◇
3.1.1	ICT access*	72.7	52	◇
3.1.2	ICT use*	71.4	38	
3.1.3	Government's online service*	72.2	68	◇
3.1.4	E-participation*	60.7	93	◇
3.2	**General infrastructure**	**44.0**	**14**	●
3.2.1	Electricity output, kWh/mn pop.	9,668.3	14	●
3.2.2	Logistics performance*	29.9	79	◇
3.2.3	Gross capital formation, % GDP	46.2	3	● ◆
3.3	**Ecological sustainability**	**27.6**	**70**	◇
3.3.1	GDP/unit of energy use	8.3	75	
3.3.2	Environmental performance*	54.8	44	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.7	72	◇
	MARKET SOPHISTICATION	**45.7**	**76**	
4.1	**Credit**	**56.9**	**19**	●
4.1.1	Ease of getting credit*	100.0	1	● ◆
4.1.2	Domestic credit to private sector, % GDP	35.0	86	◇
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**22.2**	**124**	○ ◇
4.2.1	Ease of protecting minority investors*	40.0	110	◇
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	47	
4.3	**Trade, competition, and market scale**	**58.1**	**87**	◇
4.3.1	Applied tariff rate, weighted avg., %	0.0	2	● ◆
4.3.2	Intensity of local competition†	61.2	105	◇
4.3.3	Domestic market scale, bn PPP$	35.9	114	◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**33.5**	**44**	
5.1	**Knowledge workers**	**56.9**	**[22]**	
5.1.1	Knowledge-intensive employment, %	40.7	25	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, %	11.7	59	◇
5.2	**Innovation linkages**	**23.9**	**53**	
5.2.1	University/industry research collaboration†	39.4	78	◇
5.2.2	State of cluster development†	44.2	80	◇
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	35	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	46	
5.3	**Knowledge absorption**	**19.7**	**103**	◇
5.3.1	Intellectual property payments, % total trade	0.5	70	
5.3.2	High-tech imports, % total trade	4.4	115	○
5.3.3	ICT services imports, % total trade	0.8	88	
5.3.4	FDI net inflows, % GDP	2.1	81	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**6.5**	**129**	○ ◇
6.1	**Knowledge creation**	**5.6**	**103**	◇
6.1.1	Patents by origin/bn PPP$ GDP	0.7	75	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	77	◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	4.3	95	◇
6.1.5	Citable documents H-index	3.3	119	○ ◇
6.2	**Knowledge impact**	**4.7**	**[125]**	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15-64	2.4	53	
6.2.3	Computer software spending, % GDP	n/a	n/a	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.2	83	◇
6.2.5	High- and medium-high-tech manufacturing, %	2.7	106	○ ◇
6.3	**Knowledge diffusion**	**9.1**	**125**	○ ◇
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade	0.0	128	○ ◇
6.3.3	ICT services exports, % total trade	0.0	130	○ ◇
6.3.4	FDI net outflows, % GDP	2.1	35	
	CREATIVE OUTPUTS	**16.5**	**89**	◇
7.1	**Intangible assets**	**19.6**	**93**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP	5.5	116	○ ◇
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.0	116	○
7.1.4	ICTs & organizational model creation†	47.5	90	◇
7.2	**Creative goods and services**	**2.6**	**[113]**	
7.2.1	Cultural & creative services exports, % total trade	0.0	111	○ ◇
7.2.2	National feature films/mn pop. 15-69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	0.5	89	○
7.2.5	Creative goods exports, % total trade	0.1	90	
7.3	**Online creativity**	**24.2**	**49**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	7.2	45	
7.3.2	Country-code TLDs/th pop. 15-69	0.9	88	◇
7.3.3	Wikipedia edits/mn pop. 15-69	66.2	46	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⓘ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

BULGARIA

GII 2020 rank

37

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
30	45	Upper middle	EUR	7.0	171.2	21,472.2	40

		Score/Value	Rank	
	INSTITUTIONS	**69.1**	**48**	
1.1	**Political environment**	**60.7**	**56**	
1.1.1	Political and operational stability*	69.6	70	
1.1.2	Government effectiveness*	56.2	56	
1.2	**Regulatory environment**	**75.1**	**37**	◆
1.2.1	Regulatory quality*	57.0	43	◆
1.2.2	Rule of law*	45.9	65	
1.2.3	Cost of redundancy dismissal, salary weeks	8.6	16	●
1.3	**Business environment**	**71.6**	**64**	
1.3.1	Ease of starting a business*	85.4	86	○
1.3.2	Ease of resolving insolvency*	57.8	56	
	HUMAN CAPITAL & RESEARCH	**31.0**	**64**	
2.1	**Education**	**43.5**	**73**	
2.1.1	Expenditure on education, % GDP ⊙	4.1	70	
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	21.8	38	
2.1.3	School life expectancy, years	14.4	62	
2.1.4	PISA scales in reading, maths, & science	426.7	50	○
2.1.5	Pupil-teacher ratio, secondary ⊙	12.6	58	
2.2	**Tertiary education**	**37.4**	**54**	
2.2.1	Tertiary enrolment, % gross	71.0	26	◆
2.2.2	Graduates in science & engineering, %	20.5	70	○
2.2.3	Tertiary inbound mobility, %	5.5	40	
2.3	**Research & development (R&D)**	**12.1**	**51**	
2.3.1	Researchers, FTE/mn pop.	2,339.8	37	◆
2.3.2	Gross expenditure on R&D, % GDP	0.8	48	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	5.0	68	
	INFRASTRUCTURE	**53.2**	**30**	◆
3.1	**Information & communication technologies (ICTs)**	**76.2**	**44**	◆
3.1.1	ICT access*	71.3	58	
3.1.2	ICT use*	69.9	42	◆
3.1.3	Government's online service*	76.4	55	
3.1.4	E-participation*	87.1	35	
3.2	**General infrastructure**	**26.8**	**67**	
3.2.1	Electricity output, kWh/mn pop.	6,348.6	32	◆
3.2.2	Logistics performance*	45.2	51	
3.2.3	Gross capital formation, % GDP	21.4	86	○
3.3	**Ecological sustainability**	**56.8**	**6**	● ◆
3.3.1	GDP/unit of energy use	6.8	92	○
3.3.2	Environmental performance*	57.0	39	◆
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	12.0	2	● ◆
	MARKET SOPHISTICATION	**42.2**	**97**	○
4.1	**Credit**	**34.6**	**91**	○
4.1.1	Ease of getting credit*	65.0	61	
4.1.2	Domestic credit to private sector, % GDP	51.3	67	
4.1.3	Microfinance gross loans, % GDP	0.0	81	○
4.2	**Investment**	**28.0**	**102**	○
4.2.1	Ease of protecting minority investors*	74.0	24	
4.2.2	Market capitalization, % GDP ⊙	14.5	62	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	51	
4.3	**Trade, competition, and market scale**	**63.9**	**61**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	65.1	81	○
4.3.3	Domestic market scale, bn PPP$	171.2	72	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**34.3**	**40**	◆
5.1	**Knowledge workers**	**43.4**	**39**	
5.1.1	Knowledge-intensive employment, %	31.6	43	◆
5.1.2	Firms offering formal training, % ⊙	42.7	24	
5.1.3	GERD performed by business, % GDP	0.5	37	
5.1.4	GERD financed by business, %	43.2	39	
5.1.5	Females employed w/advanced degrees, %	19.1	32	◆
5.2	**Innovation linkages**	**26.9**	**40**	◆
5.2.1	University/industry research collaboration†	42.3	63	
5.2.2	State of cluster development†	52.8	41	
5.2.3	GERD financed by abroad, % GDP	0.2	14	● ◆
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	80	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	48	
5.3	**Knowledge absorption**	**32.7**	**49**	
5.3.1	Intellectual property payments, % total trade	0.5	64	
5.3.2	High-tech imports, % total trade	7.1	74	
5.3.3	ICT services imports, % total trade	1.1	68	
5.3.4	FDI net inflows, % GDP	2.7	62	
5.3.5	Research talent, % in business enterprise	48.5	26	◆
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**34.5**	**29**	◆
6.1	**Knowledge creation**	**19.9**	**50**	
6.1.1	Patents by origin/bn PPP$ GDP	1.3	57	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.3	43	
6.1.3	Utility models by origin/bn PPP$ GDP ⊙	1.7	13	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	10.1	51	
6.1.5	Citable documents H-index	15.9	52	
6.2	**Knowledge impact**	**48.3**	**7**	● ◆
6.2.1	Growth rate of PPP$ GDP/worker, %	2.6	35	
6.2.2	New businesses/th pop. 15–64	10.1	14	● ◆
6.2.3	Computer software spending, % GDP	0.0	56	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	36.6	1	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	23.5	47	
6.3	**Knowledge diffusion**	**35.3**	**30**	◆
6.3.1	Intellectual property receipts, % total trade	0.2	43	
6.3.2	High-tech net exports, % total trade	4.8	33	
6.3.3	ICT services exports, % total trade	3.4	25	◆
6.3.4	FDI net outflows, % GDP	1.3	49	
	CREATIVE OUTPUTS	**33.5**	**37**	◆
7.1	**Intangible assets**	**43.8**	**21**	● ◆
7.1.1	Trademarks by origin/bn PPP$ GDP	91.9	16	●
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	5.8	23	●
7.1.4	ICTs & organizational model creation†	53.7	64	
7.2	**Creative goods and services**	**19.8**	**55**	
7.2.1	Cultural & creative services exports, % total trade	1.4	14	● ◆
7.2.2	National feature films/mn pop. 15–69	4.7	45	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	1.1	46	
7.2.5	Creative goods exports, % total trade	1.0	44	
7.3	**Online creativity**	**26.5**	**41**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	23.4	24	● ◆
7.3.2	Country-code TLDs/th pop. 15–69	3.7	59	
7.3.3	Wikipedia edits/mn pop. 15–69	74.3	33	◆
7.3.4	Mobile app creation/bn PPP$ GDP	6.1	52	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

BURKINA FASO

GII 2020 rank

118

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
124	106	Low	SSF	20.3	42.2	1,813.5	117

		Score/Value	Rank	
	INSTITUTIONS	**57.3**	**86**	
1.1	**Political environment**	**43.3**	**112**	
1.1.1	Political and operational stability*	55.4	116	
1.1.2	Government effectiveness*	37.2	105	
1.2	**Regulatory environment**	**64.2**	**68**	●
1.2.1	Regulatory quality*	31.6	100	
1.2.2	Rule of law*	35.1	93	
1.2.3	Cost of redundancy dismissal, salary weeks	10.5	33	●
1.3	**Business environment**	**64.5**	**85**	
1.3.1	Ease of starting a business*	88.2	71	●
1.3.2	Ease of resolving insolvency*	40.8	96	
	HUMAN CAPITAL & RESEARCH	**18.1**	**102**	◆
2.1	**Education**	**35.8**	**94**	
2.1.1	Expenditure on education, % GDP	6.0	15	● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap	18.5	58	●
2.1.3	School life expectancy, years	9.3	111	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	23.1	104	
2.2	**Tertiary education**	**15.1**	**105**	
2.2.1	Tertiary enrolment, % gross	6.5	117	
2.2.2	Graduates in science & engineering, %	19.7	74	
2.2.3	Tertiary inbound mobility, %	2.7	70	
2.3	**Research & development (R&D)**	**3.6**	**83**	◆
2.3.1	Researchers, FTE/mn pop. ◷	47.6	94	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.7	52	● ◆
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**26.4**	**111**	
3.1	**Information & communication technologies (ICTs)**	**41.0**	**107**	
3.1.1	ICT access*	32.9	118	
3.1.2	ICT use*	15.3	118	
3.1.3	Government's online service*	53.5	102	
3.1.4	E-participation*	62.4	85	
3.2	**General infrastructure**	**18.8**	**109**	
3.2.1	Electricity output, kWh/mn pop.	n/a	n/a	
3.2.2	Logistics performance*	25.9	87	
3.2.3	Gross capital formation, % GDP	18.4	109	
3.3	**Ecological sustainability**	**19.5**	**105**	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	38.3	93	◆
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	125	○
	MARKET SOPHISTICATION	**36.9**	**113**	
4.1	**Credit**	**21.5**	**123**	
4.1.1	Ease of getting credit*	30.0	122	○
4.1.2	Domestic credit to private sector, % GDP	29.9	94	
4.1.3	Microfinance gross loans, % GDP	1.7	21	●
4.2	**Investment**	**42.0**	**[47]**	
4.2.1	Ease of protecting minority investors*	42.0	102	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**47.2**	**122**	
4.3.1	Applied tariff rate, weighted avg., %	7.8	102	
4.3.2	Intensity of local competition†	57.7	116	
4.3.3	Domestic market scale, bn PPP$	42.2	108	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**17.6**	**[116]**	
5.1	**Knowledge workers**	**10.2**	**[123]**	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, % ◷	11.9	73	◆
5.1.5	Females employed w/advanced degrees, % ◷	0.5	116	○
5.2	**Innovation linkages**	**19.7**	**[70]**	
5.2.1	University/industry research collaboration†	30.2	110	
5.2.2	State of cluster development†	28.7	125	○ ◇
5.2.3	GERD financed by abroad, % GDP	0.0	58	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	n/a	n/a	
5.3	**Knowledge absorption**	**22.8**	**89**	
5.3.1	Intellectual property payments, % total trade ◷	0.0	116	○
5.3.2	High-tech imports, % total trade	6.6	82	
5.3.3	ICT services imports, % total trade ◷	2.2	24	●
5.3.4	FDI net inflows, % GDP	2.3	71	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**11.1**	**111**	
6.1	**Knowledge creation**	**5.5**	**105**	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	105	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	90	◆
6.1.3	Utility models by origin/bn PPP$ GDP ◷	0.1	53	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.0	74	●
6.1.5	Citable documents H-index	5.6	98	
6.2	**Knowledge impact**	**15.9**	**94**	
6.2.1	Growth rate of PPP$ GDP/worker, %	3.0	27	●
6.2.2	New businesses/th pop. 15–64	0.3	107	
6.2.3	Computer software spending, % GDP	0.0	111	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.6	118	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**12.0**	**107**	
6.3.1	Intellectual property receipts, % total trade ◷	0.0	82	
6.3.2	High-tech net exports, % total trade	0.1	105	
6.3.3	ICT services exports, % total trade ◷	1.2	75	
6.3.4	FDI net outflows, % GDP	0.3	83	
	CREATIVE OUTPUTS	**6.3**	**[129]**	
7.1	**Intangible assets**	**11.8**	**124**	
7.1.1	Trademarks by origin/bn PPP$ GDP	5.3	117	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.2	104	
7.1.4	ICTs & organizational model creation†	39.5	113	
7.2	**Creative goods and services**	**1.7**	**[121]**	
7.2.1	Cultural & creative services exports, % total trade ◷	0.2	69	
7.2.2	National feature films/mn pop. 15–69 ◷	0.5	100	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.0	117	
7.3	**Online creativity**	**0.0**	**[129]**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.1	125	○
7.3.2	Country-code TLDs/th pop. 15–69	0.0	125	○
7.3.3	Wikipedia edits/mn pop. 15–69	n/a	n/a	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

CABO VERDE

GII 2020 rank

100

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
90	99	Lower middle	SSF	0.5	4.3	6,747.9	n/a

		Score/Value	Rank	
	INSTITUTIONS	**56.9**	**87**	
1.1	**Political environment**	**64.4**	**48**	● ◆
1.1.1	Political and operational stability*	78.6	38	● ◆
1.1.2	Government effectiveness*	57.3	54	◆
1.2	**Regulatory environment**	**64.1**	**69**	◆
1.2.1	Regulatory quality*	35.4	90	
1.2.2	Rule of law*	58.3	45	● ◆
1.2.3	Cost of redundancy dismissal, salary weeks	17.4	73	
1.3	**Business environment**	**42.2**	**130**	○ ◇
1.3.1	Ease of starting a business*	84.5	93	
1.3.2	Ease of resolving insolvency*	0.0	129	○ ◇

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**19.4**	**96**	
2.1	**Education**	**42.8**	**74**	
2.1.1	Expenditure on education, % GDP ⊙	5.2	37	●
2.1.2	Government funding/pupil, secondary, % GDP/cap	19.7	50	
2.1.3	School life expectancy, years	12.7	84	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	15.4	77	
2.2	**Tertiary education**	**15.1**	**104**	
2.2.1	Tertiary enrolment, % gross	23.6	89	
2.2.2	Graduates in science & engineering, %	16.1	89	
2.2.3	Tertiary inbound mobility, %	1.4	82	
2.3	**Research & development (R&D)**	**0.4**	**114**	
2.3.1	Researchers, FTE/mn pop. ⊙	50.1	93	
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.1	110	○ ◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**36.1**	**86**	
3.1	**Information & communication technologies (ICTs)**	**48.1**	**101**	
3.1.1	ICT access*	58.3	77	◆
3.1.2	ICT use*	42.9	93	
3.1.3	Government's online service*	48.6	107	
3.1.4	E-participation*	42.7	111	
3.2	**General infrastructure**	**42.9**	**[16]**	
3.2.1	Electricity output, kWh/mn pop.	n/a	n/a	
3.2.2	Logistics performance*	n/a	n/a	
3.2.3	Gross capital formation, % GDP	37.5	14	● ◆
3.3	**Ecological sustainability**	**17.3**	**113**	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	32.8	112	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	101	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**27.4**	**128**	○ ◇
4.1	**Credit**	**30.1**	**106**	
4.1.1	Ease of getting credit*	35.0	118	◇
4.1.2	Domestic credit to private sector, % GDP	59.6	58	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**24.0**	**[120]**	
4.2.1	Ease of protecting minority investors*	24.0	127	○ ◇
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**28.2**	**130**	○ ◇
4.3.1	Applied tariff rate, weighted avg., % ⊙	10.9	120	◇
4.3.2	Intensity of local competition†	56.1	120	○ ◇
4.3.3	Domestic market scale, bn PPP$	4.3	131	○ ◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**25.5**	**[65]**	
5.1	**Knowledge workers**	**26.2**	**[82]**	
5.1.1	Knowledge-intensive employment, %	17.6	87	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, %	9.3	70	
5.2	**Innovation linkages**	**24.5**	**[49]**	
5.2.1	University/industry research collaboration†	37.9	82	
5.2.2	State of cluster development†	42.3	87	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**25.9**	**74**	
5.3.1	Intellectual property payments, % total trade	0.6	61	
5.3.2	High-tech imports, % total trade	5.1	110	
5.3.3	ICT services imports, % total trade	1.9	30	● ◆
5.3.4	FDI net inflows, % GDP	6.5	18	● ◆
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**10.1**	**[117]**	
6.1	**Knowledge creation**	**5.7**	**[102]**	
6.1.1	Patents by origin/bn PPP$ GDP	0.7	73	
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	4.9	89	
6.1.5	Citable documents H-index	0.0	131	○ ◇
6.2	**Knowledge impact**	**10.5**	**[116]**	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15-64	4.0	36	● ◆
6.2.3	Computer software spending, % GDP	n/a	n/a	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	5.2	53	◆
6.2.5	High- and medium-high-tech manufacturing, %	5.2	95	◇
6.3	**Knowledge diffusion**	**14.1**	**102**	
6.3.1	Intellectual property receipts, % total trade	0.0	96	
6.3.2	High-tech net exports, % total trade ⊙	0.0	130	○ ◇
6.3.3	ICT services exports, % total trade	2.1	52	
6.3.4	FDI net outflows, % GDP	0.8	63	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**19.2**	**[73]**	
7.1	**Intangible assets**	**31.3**	**44**	●
7.1.1	Trademarks by origin/bn PPP$ GDP	32.9	73	
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	7.7	17	●
7.1.4	ICTs & organizational model creation†	44.6	98	
7.2	**Creative goods and services**	**12.2**	**[71]**	
7.2.1	Cultural & creative services exports, % total trade	0.5	45	●
7.2.2	National feature films/mn pop. 15-69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	1.8	19	●
7.2.5	Creative goods exports, % total trade ⊙	0.1	110	
7.3	**Online creativity**	**2.0**	**[121]**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	2.1	76	
7.3.2	Country-code TLDs/th pop. 15-69	1.8	71	
7.3.3	Wikipedia edits/mn pop. 15-69	n/a	n/a	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

CAMBODIA

GII 2020 rank

110

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
101	117	Lower middle	SEAO	16.5	76.9	4,072.2	98

		Score/Value	Rank	
	INSTITUTIONS	**50.0**	**112**	
1.1	**Political environment**	**49.4**	**90**	
1.1.1	Political and operational stability*	73.2	49	● ◆
1.1.2	Government effectiveness*	37.4	103	
1.2	**Regulatory environment**	**50.3**	**103**	
1.2.1	Regulatory quality*	28.5	104	
1.2.2	Rule of law*	17.6	126	○ ◇
1.2.3	Cost of redundancy dismissal, salary weeks	19.4	81	
1.3	**Business environment**	**50.5**	**127**	○ ◇
1.3.1	Ease of starting a business*	52.4	131	○ ◇
1.3.2	Ease of resolving insolvency*	48.5	74	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**11.1**	**122**	◇
2.1	**Education**	**20.0**	**[127]**	
2.1.1	Expenditure on education, % GDP	2.2	113	○ ◇
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	21.9	102	
2.2	**Tertiary education**	**12.8**	**110**	
2.2.1	Tertiary enrolment, % gross	13.7	101	
2.2.2	Graduates in science & engineering, % ◷	15.4	93	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**0.6**	**111**	
2.3.1	Researchers, FTE/mn pop. ◷	30.4	102	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.1	102	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**23.1**	**120**	◇
3.1	**Information & communication technologies (ICTs)**	**32.7**	**117**	◇
3.1.1	ICT access*	46.8	95	
3.1.2	ICT use*	41.5	96	
3.1.3	Government's online service*	25.0	123	◇
3.1.4	E-participation*	17.4	126	○ ◇
3.2	**General infrastructure**	**17.6**	**114**	
3.2.1	Electricity output, kWh/mn pop.	437.1	109	
3.2.2	Logistics performance*	23.9	94	
3.2.3	Gross capital formation, % GDP	23.5	64	
3.3	**Ecological sustainability**	**19.0**	**109**	
3.3.1	GDP/unit of energy use	7.1	88	
3.3.2	Environmental performance*	33.6	108	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.7	71	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**46.6**	**72**	
4.1	**Credit**	**66.4**	**11**	● ◆
4.1.1	Ease of getting credit*	80.0	23	●
4.1.2	Domestic credit to private sector, % GDP	99.6	24	● ◆
4.1.3	Microfinance gross loans, % GDP	38.3	2	● ◆
4.2	**Investment**	**25.6**	**114**	
4.2.1	Ease of protecting minority investors*	40.0	110	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	33	● ◆
4.3	**Trade, competition, and market scale**	**47.9**	**121**	
4.3.1	Applied tariff rate, weighted avg., % ◷	9.8	113	
4.3.2	Intensity of local competition†	59.6	108	
4.3.3	Domestic market scale, bn PPP$	76.9	91	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**17.3**	**119**	
5.1	**Knowledge workers**	**11.8**	**121**	◇
5.1.1	Knowledge-intensive employment, % ◷	5.3	114	◇
5.1.2	Firms offering formal training, % ◷	22.2	66	
5.1.3	GERD performed by business, % GDP ◷	0.0	82	
5.1.4	GERD financed by business, % ◷	19.4	65	
5.1.5	Females employed w/advanced degrees, % ◷	2.3	99	
5.2	**Innovation linkages**	**25.7**	**45**	● ◆
5.2.1	University/industry research collaboration†	36.7	91	
5.2.2	State of cluster development†	48.1	61	●
5.2.3	GERD financed by abroad, % GDP ◷	0.0	53	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	36	● ◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	n/a	n/a	
5.3	**Knowledge absorption**	**14.3**	**129**	○ ◇
5.3.1	Intellectual property payments, % total trade	0.1	104	◇
5.3.2	High-tech imports, % total trade ◷	2.8	127	○ ◇
5.3.3	ICT services imports, % total trade	0.8	85	
5.3.4	FDI net inflows, % GDP	12.6	7	● ◆
5.3.5	Research talent, % in business enterprise ◷	4.3	73	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**13.2**	**96**	
6.1	**Knowledge creation**	**3.1**	**121**	
6.1.1	Patents by origin/bn PPP$ GDP ◷	0.1	126	○
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.3	113	
6.1.5	Citable documents H-index	5.6	99	
6.2	**Knowledge impact**	**21.9**	**73**	
6.2.1	Growth rate of PPP$ GDP/worker, %	5.1	8	●
6.2.2	New businesses/th pop. 15-64	0.7	90	
6.2.3	Computer software spending, % GDP	0.0	113	◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.6	79	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**14.6**	**97**	
6.3.1	Intellectual property receipts, % total trade	0.0	88	
6.3.2	High-tech net exports, % total trade ◷	1.1	66	
6.3.3	ICT services exports, % total trade	0.3	108	
6.3.4	FDI net outflows, % GDP	0.5	78	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**13.4**	**102**	
7.1	**Intangible assets**	**21.6**	**88**	
7.1.1	Trademarks by origin/bn PPP$ GDP	34.2	71	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP ◷	0.2	105	
7.1.4	ICTs & organizational model creation†	60.6	41	● ◆
7.2	**Creative goods and services**	**7.2**	**[93]**	
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15-69	3.2	57	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.4	66	
7.3	**Online creativity**	**3.1**	**116**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	0.8	100	
7.3.2	Country-code TLDs/th pop. 15-69	0.1	117	
7.3.3	Wikipedia edits/mn pop. 15-69	16.2	114	
7.3.4	Mobile app creation/bn PPP$ GDP	0.1	84	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

CAMEROON

GII 2020 rank

119

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
119	120	Lower middle	SSF	25.9	100.9	3,453.0	115

		Score/Value	Rank	
	INSTITUTIONS	**50.0**	**113**	
1.1	**Political environment**	**40.6**	**118**	◇
1.1.1	Political and operational stability*	57.1	110	
1.1.2	Government effectiveness*	32.3	120	
1.2	**Regulatory environment**	**48.1**	**109**	
1.2.1	Regulatory quality*	20.7	119	
1.2.2	Rule of law*	18.5	125	○ ◇
1.2.3	Cost of redundancy dismissal, salary weeks	19.9	83	
1.3	**Business environment**	**61.4**	**103**	
1.3.1	Ease of starting a business*	86.3	80	
1.3.2	Ease of resolving insolvency*	36.6	110	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**17.4**	**103**	
2.1	**Education**	**31.4**	**103**	
2.1.1	Expenditure on education, % GDP	3.1	95	
2.1.2	Government funding/pupil, secondary, % GDP/cap. ◷	17.8	62	
2.1.3	School life expectancy, years ◷	12.1	91	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ◷	19.3	95	
2.2	**Tertiary education**	**20.7**	**94**	
2.2.1	Tertiary enrolment, % gross	12.8	103	
2.2.2	Graduates in science & engineering, %	24.2	41	●
2.2.3	Tertiary inbound mobility, %	1.4	84	
2.3	**Research & development (R&D)**	**0.0**	**[121]**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**24.1**	**117**	◇
3.1	**Information & communication technologies (ICTs)**	**30.9**	**121**	○ ◇
3.1.1	ICT access*	32.6	119	◇
3.1.2	ICT use*	12.5	125	○ ◇
3.1.3	Government's online service*	45.8	112	
3.1.4	E-participation*	32.6	117	◇
3.2	**General infrastructure**	**21.7**	**89**	
3.2.1	Electricity output, kWh/mn pop.	340.8	112	
3.2.2	Logistics performance*	24.7	91	
3.2.3	Gross capital formation, % GDP	28.9	29	●
3.3	**Ecological sustainability**	**19.6**	**102**	
3.3.1	GDP/unit of energy use	8.6	71	
3.3.2	Environmental performance*	33.6	108	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	115	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**34.2**	**123**	○ ◇
4.1	**Credit**	**27.9**	**112**	
4.1.1	Ease of getting credit*	60.0	74	
4.1.2	Domestic credit to private sector, % GDP	15.2	117	
4.1.3	Microfinance gross loans, % GDP	0.7	28	●
4.2	**Investment**	**28.0**	**[103]**	
4.2.1	Ease of protecting minority investors*	28.0	123	○ ◇
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**46.6**	**125**	○ ◇
4.3.1	Applied tariff rate, weighted avg., % ◷	12.7	127	○ ◇
4.3.2	Intensity of local competition†	63.2	89	
4.3.3	Domestic market scale, bn PPP$	100.9	81	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**20.3**	**100**	
5.1	**Knowledge workers**	**23.9**	**[86]**	
5.1.1	Knowledge-intensive employment, % ◷	10.9	104	
5.1.2	Firms offering formal training, % ◷	37.6	35	●
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ◷	2.0	102	
5.2	**Innovation linkages**	**17.9**	**88**	
5.2.1	University/industry research collaboration†	40.5	71	●
5.2.2	State of cluster development†	40.0	97	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	111	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	81	
5.3	**Knowledge absorption**	**19.2**	**106**	
5.3.1	Intellectual property payments, % total trade ◷	0.1	109	○ ◇
5.3.2	High-tech imports, % total trade ◷	5.7	101	
5.3.3	ICT services imports, % total trade ◷	1.1	67	●
5.3.4	FDI net inflows, % GDP	2.1	78	
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**13.4**	**94**	
6.1	**Knowledge creation**	**8.2**	**81**	
6.1.1	Patents by origin/bn PPP$ GDP	0.4	84	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	95	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	7.3	65	●
6.1.5	Citable documents H-index	7.3	89	
6.2	**Knowledge impact**	**17.0**	**[92]**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.8	64	● ◇
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	76	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.6	117	◇
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**14.9**	**94**	
6.3.1	Intellectual property receipts, % total trade ◷	0.0	89	
6.3.2	High-tech net exports, % total trade ◷	0.2	98	
6.3.3	ICT services exports, % total trade ◷	1.9	57	●
6.3.4	FDI net outflows, % GDP	0.1	107	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**8.2**	**123**	○ ◇
7.1	**Intangible assets**	**12.9**	**122**	○
7.1.1	Trademarks by origin/bn PPP$ GDP	6.1	115	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.4	89	
7.1.4	ICTs & organizational model creation†	42.4	107	
7.2	**Creative goods and services**	**3.8**	**[109]**	
7.2.1	Cultural & creative services exports, % total trade ◷	0.3	59	●
7.2.2	National feature films/mn pop. 15–69 ◷	1.9	71	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade ◷	0.0	123	○
7.3	**Online creativity**	**3.2**	**115**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.2	119	
7.3.2	Country-code TLDs/th pop. 15–69	1.3	79	
7.3.3	Wikipedia edits/mn pop. 15–69	12.9	115	○ ◇
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

CANADA

GII 2020 rank

17

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
22	9	High	NAC	37.4	1,899.9	44,284.8	17

		Score/Value	Rank	
	INSTITUTIONS	**90.2**	**6**	●
1.1	**Political environment**	**88.2**	**12**	
1.1.1	Political and operational stability*	87.5	11	
1.1.2	Government effectiveness*	88.5	10	●
1.2	**Regulatory environment**	**92.7**	**9**	●
1.2.1	Regulatory quality*	85.7	14	
1.2.2	Rule of law*	92.8	12	
1.2.3	Cost of redundancy dismissal, salary weeks	10.0	29	
1.3	**Business environment**	**89.6**	**4**	●
1.3.1	Ease of starting a business*	98.2	3	● ◆
1.3.2	Ease of resolving insolvency*	81.0	12	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**51.8**	**19**	
2.1	**Education**	**54.1**	**40**	
2.1.1	Expenditure on education, % GDP ◷	5.3	32	
2.1.2	Government funding/pupil, secondary, % GDP/cap ◷	18.3	59	○ ◇
2.1.3	School life expectancy, years	16.2	31	
2.1.4	PISA scales in reading, maths, & science	516.7	7	
2.1.5	Pupil-teacher ratio, secondary ◷	9.7	28	
2.2	**Tertiary education**	**44.1**	**31**	
2.2.1	Tertiary enrolment, % gross	68.9	30	
2.2.2	Graduates in science & engineering, % ◷	21.3	60	
2.2.3	Tertiary inbound mobility, %	12.9	13	
2.3	**Research & development (R&D)**	**57.2**	**18**	
2.3.1	Researchers, FTE/mn pop. ◷	4,263.8	24	
2.3.2	Gross expenditure on R&D, % GDP	1.5	23	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	67.7	17	
2.3.4	QS university ranking, average score top 3*	78.9	7	●

		Score/Value	Rank	
	INFRASTRUCTURE	**53.3**	**29**	◇
3.1	**Information & communication technologies (ICTs)**	**85.3**	**22**	
3.1.1	ICT access*	79.6	30	
3.1.2	ICT use*	77.4	25	
3.1.3	Government's online service*	93.1	17	
3.1.4	E-participation*	91.0	27	
3.2	**General infrastructure**	**45.9**	**8**	●
3.2.1	Electricity output, kWh/mn pop.	17,559.0	5	● ◆
3.2.2	Logistics performance*	77.7	20	
3.2.3	Gross capital formation, % GDP	22.6	71	○
3.3	**Ecological sustainability**	**28.7**	**66**	◇
3.3.1	GDP/unit of energy use	5.4	105	○ ◇
3.3.2	Environmental performance*	71.0	20	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.5	83	○ ◇

		Score/Value	Rank	
	MARKET SOPHISTICATION	**78.5**	**3**	● ◆
4.1	**Credit**	**85.0**	**[4]**	
4.1.1	Ease of getting credit*	85.0	14	◆
4.1.2	Domestic credit to private sector, % GDP	n/a	n/a	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**73.0**	**6**	● ◆
4.2.1	Ease of protecting minority investors*	84.0	7	◆
4.2.2	Market capitalization, % GDP	129.1	6	●
4.2.3	Venture capital deals/bn PPP$ GDP	0.4	6	● ◆
4.3	**Trade, competition, and market scale**	**77.4**	**13**	
4.3.1	Applied tariff rate, weighted avg., %	1.5	17	
4.3.2	Intensity of local competition†	74.5	31	
4.3.3	Domestic market scale, bn PPP$	1,899.9	16	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**50.5**	**20**	
5.1	**Knowledge workers**	**48.3**	**28**	◇
5.1.1	Knowledge-intensive employment, % ◷	43.7	20	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	0.8	29	◇
5.1.4	GERD financed by business, %	41.1	44	◇
5.1.5	Females employed w/advanced degrees, %	18.2	34	
5.2	**Innovation linkages**	**55.4**	**10**	●
5.2.1	University/industry research collaboration†	65.9	17	
5.2.2	State of cluster development†	63.8	21	
5.2.3	GERD financed by abroad, % GDP	0.1	29	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.3	1	● ◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	1.9	20	
5.3	**Knowledge absorption**	**47.7**	**21**	
5.3.1	Intellectual property payments, % total trade	2.2	10	
5.3.2	High-tech imports, % total trade	10.5	25	
5.3.3	ICT services imports, % total trade	0.9	83	○ ◇
5.3.4	FDI net inflows, % GDP	2.2	75	○
5.3.5	Research talent, % in business enterprise ◷	56.7	16	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**39.1**	**21**	
6.1	**Knowledge creation**	**49.3**	**14**	
6.1.1	Patents by origin/bn PPP$ GDP	2.4	35	◇
6.1.2	PCT patents by origin/bn PPP$ GDP	1.4	22	◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	22.1	24	
6.1.5	Citable documents H-index	79.9	4	● ◆
6.2	**Knowledge impact**	**33.2**	**33**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.5	78	○
6.2.2	New businesses/th pop. 15-64	0.2	113	○ ◇
6.2.3	Computer software spending, % GDP	0.0	6	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.7	78	○ ◇
6.2.5	High- and medium-high-tech manufacturing, %	38.4	27	
6.3	**Knowledge diffusion**	**34.9**	**33**	
6.3.1	Intellectual property receipts, % total trade	0.8	20	
6.3.2	High-tech net exports, % total trade	5.4	30	
6.3.3	ICT services exports, % total trade	1.6	64	
6.3.4	FDI net outflows, % GDP	4.1	14	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**40.2**	**17**	
7.1	**Intangible assets**	**43.2**	**22**	
7.1.1	Trademarks by origin/bn PPP$ GDP	57.8	37	
7.1.2	Global brand value, top 5,000, % GDP	133.2	12	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.4	86	○
7.1.4	ICTs & organizational model creation†	77.0	11	
7.2	**Creative goods and services**	**24.0**	**39**	◇
7.2.1	Cultural & creative services exports, % total trade	0.8	34	
7.2.2	National feature films/mn pop. 15-69	3.4	54	
7.2.3	Entertainment & Media market/th pop. 15-69	60.1	10	
7.2.4	Printing and other media, % manufacturing	1.4	31	
7.2.5	Creative goods exports, % total trade	0.9	47	
7.3	**Online creativity**	**50.6**	**17**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	76.7	6	●
7.3.2	Country-code TLDs/th pop. 15-69	32.2	20	
7.3.3	Wikipedia edits/mn pop. 15-69	79.3	27	
7.3.4	Mobile app creation/bn PPP$ GDP	15.5	31	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

CHILE

GII 2020 rank

54

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
66	41	High	LCN	19.0	502.8	22,975.6	51

		Score/Value	Rank	
	INSTITUTIONS	**73.3**	**38**	
1.1	**Political environment**	**75.2**	**34**	
1.1.1	Political and operational stability*	76.8	43	
1.1.2	Government effectiveness*	74.4	29	
1.2	**Regulatory environment**	**69.0**	**50**	
1.2.1	Regulatory quality*	77.2	20	●
1.2.2	Rule of law*	75.7	25	●
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	109	○ ◇
1.3	**Business environment**	**75.7**	**46**	
1.3.1	Ease of starting a business*	91.4	50	
1.3.2	Ease of resolving insolvency*	60.1	48	
	HUMAN CAPITAL & RESEARCH	**33.1**	**55**	◇
2.1	**Education**	**47.9**	**61**	
2.1.1	Expenditure on education, % GDP ◷	5.4	28	
2.1.2	Government funding/pupil, secondary, % GDP/cap	18.7	56	
2.1.3	School life expectancy, years	16.4	24	●
2.1.4	PISA scales in reading, maths, & science	437.8	46	
2.1.5	Pupil-teacher ratio, secondary ◷	18.4	89	○ ◇
2.2	**Tertiary education**	**38.0**	**50**	
2.2.1	Tertiary enrolment, % gross	88.5	6	●
2.2.2	Graduates in science & engineering, %	20.5	71	
2.2.3	Tertiary inbound mobility, %	0.4	102	○ ◇
2.3	**Research & development (R&D)**	**13.4**	**50**	◇
2.3.1	Researchers, FTE/mn pop. ◷	493.3	68	◇
2.3.2	Gross expenditure on R&D, % GDP ◷	0.4	75	◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	40.9	32	
	INFRASTRUCTURE	**46.4**	**51**	◇
3.1	**Information & communication technologies (ICTs)**	**76.2**	**43**	
3.1.1	ICT access*	72.0	55	◇
3.1.2	ICT use*	67.6	47	◇
3.1.3	Government's online service*	83.3	37	
3.1.4	E-participation*	82.0	46	
3.2	**General infrastructure**	**29.6**	**53**	
3.2.1	Electricity output, kWh/mn pop.	4,324.2	50	
3.2.2	Logistics performance*	58.5	33	
3.2.3	Gross capital formation, % GDP	23.2	68	
3.3	**Ecological sustainability**	**33.3**	**52**	
3.3.1	GDP/unit of energy use	10.2	52	
3.3.2	Environmental performance*	55.3	42	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.8	50	
	MARKET SOPHISTICATION	**51.7**	**41**	
4.1	**Credit**	**45.1**	**52**	
4.1.1	Ease of getting credit*	55.0	88	○
4.1.2	Domestic credit to private sector, % GDP	116.6	19	●
4.1.3	Microfinance gross loans, % GDP	0.8	26	◆
4.2	**Investment**	**36.4**	**68**	
4.2.1	Ease of protecting minority investors*	66.0	50	
4.2.2	Market capitalization, % GDP	91.7	15	●
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	65	○
4.3	**Trade, competition, and market scale**	**73.5**	**23**	●
4.3.1	Applied tariff rate, weighted avg., %	0.5	5	● ◆
4.3.2	Intensity of local competition†	74.5	30	
4.3.3	Domestic market scale, bn PPP$	502.8	41	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**30.4**	**49**	
5.1	**Knowledge workers**	**37.1**	**54**	
5.1.1	Knowledge-intensive employment, %	26.4	55	◇
5.1.2	Firms offering formal training, % ◷	57.5	8	● ◆
5.1.3	GERD performed by business, % GDP ◷	0.1	57	◇
5.1.4	GERD financed by business, %	31.4	55	
5.1.5	Females employed w/advanced degrees, %	8.8	76	◇
5.2	**Innovation linkages**	**17.4**	**92**	◇
5.2.1	University/industry research collaboration†	41.2	66	
5.2.2	State of cluster development†	45.6	75	
5.2.3	GERD financed by abroad, % GDP	0.0	68	◇
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	72	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	44	
5.3	**Knowledge absorption**	**36.7**	**37**	
5.3.1	Intellectual property payments, % total trade	2.1	12	●
5.3.2	High-tech imports, % total trade	8.5	53	
5.3.3	ICT services imports, % total trade	0.7	95	○
5.3.4	FDI net inflows, % GDP	3.0	54	
5.3.5	Research talent, % in business enterprise ◷	29.0	43	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**19.9**	**64**	◇
6.1	**Knowledge creation**	**17.4**	**57**	
6.1.1	Patents by origin/bn PPP$ GDP	0.8	69	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.5	34	
6.1.3	Utility models by origin/bn PPP$ GDP	0.2	43	
6.1.4	Scientific & technical articles/bn PPP$ GDP	14.0	38	
6.1.5	Citable documents H-index	24.0	37	
6.2	**Knowledge impact**	**27.6**	**52**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.6	74	
6.2.2	New businesses/th pop. 15–64	10.3	12	●
6.2.3	Computer software spending, % GDP	0.0	44	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.6	34	
6.2.5	High- and medium-high-tech manufacturing, %	21.4	53	
6.3	**Knowledge diffusion**	**14.6**	**98**	○ ◇
6.3.1	Intellectual property receipts, % total trade	0.1	65	
6.3.2	High-tech net exports, % total trade	0.8	71	
6.3.3	ICT services exports, % total trade	0.5	100	○
6.3.4	FDI net outflows, % GDP	1.8	41	
	CREATIVE OUTPUTS	**21.6**	**61**	◇
7.1	**Intangible assets**	**29.6**	**53**	
7.1.1	Trademarks by origin/bn PPP$ GDP	68.3	29	
7.1.2	Global brand value, top 5,000, % GDP	43.6	37	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.1	109	○
7.1.4	ICTs & organizational model creation†	57.8	54	
7.2	**Creative goods and services**	**8.1**	**88**	◇
7.2.1	Cultural & creative services exports, % total trade	0.3	64	
7.2.2	National feature films/mn pop. 15–69	3.7	51	
7.2.3	Entertainment & Media market/th pop. 15–69	14.5	32	◇
7.2.4	Printing and other media, % manufacturing	0.7	79	○
7.2.5	Creative goods exports, % total trade	0.1	88	
7.3	**Online creativity**	**19.2**	**56**	◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.0	77	◇
7.3.2	Country-code TLDs/th pop. 15–69	13.2	36	
7.3.3	Wikipedia edits/mn pop. 15–69	61.5	51	
7.3.4	Mobile app creation/bn PPP$ GDP	2.2	64	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

CHINA

GII 2020 rank

14

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
6	26	Upper middle	SEAO	1,433.8	27,308.9	17,027.5	14

		Score/Value	Rank	
	INSTITUTIONS	**64.6**	**62**	
1.1	**Political environment**	**64.9**	**47**	◆
1.1.1	Political and operational stability*	73.2	49	
1.1.2	Government effectiveness*	60.8	45	◆
1.2	**Regulatory environment**	**50.7**	**102**	○
1.2.1	Regulatory quality*	38.2	82	
1.2.2	Rule of law*	41.4	72	
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	109	○
1.3	**Business environment**	**78.1**	**39**	
1.3.1	Ease of starting a business*	94.1	25	◆
1.3.2	Ease of resolving insolvency*	62.1	46	
	HUMAN CAPITAL & RESEARCH	**49.4**	**21**	◆
2.1	**Education**	**64.5**	**[12]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years 🕒	12.4	87	○ ◇
2.1.4	PISA scales in reading, maths, & science	579.0	1	● ◆
2.1.5	Pupil-teacher ratio, secondary	13.3	62	
2.2	**Tertiary education**	**25.0**	**83**	
2.2.1	Tertiary enrolment, % gross	50.6	58	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	0.4	101	○ ◇
2.3	**Research & development (R&D)**	**58.8**	**16**	◆
2.3.1	Researchers, FTE/mn pop.	1,307.1	48	
2.3.2	Gross expenditure on R&D, % GDP	2.2	13	◆
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	91.8	3	● ◆
2.3.4	QS university ranking, average score top 3*	83.8	3	● ◆
	INFRASTRUCTURE	**52.1**	**36**	◆
3.1	**Information & communication technologies (ICTs)**	**75.8**	**45**	◆
3.1.1	ICT access*	61.5	71	
3.1.2	ICT use*	65.1	53	◆
3.1.3	Government's online service*	86.1	34	◆
3.1.4	E-participation*	90.5	29	◆
3.2	**General infrastructure**	**48.1**	**6**	◆
3.2.1	Electricity output, kWh/mn pop.	4,762.1	45	
3.2.2	Logistics performance*	72.0	26	◆
3.2.3	Gross capital formation, % GDP	43.4	6	◆
3.3	**Ecological sustainability**	**32.5**	**54**	
3.3.1	GDP/unit of energy use	6.8	94	○
3.3.2	Environmental performance*	37.3	98	○ ◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	5.4	19	
	MARKET SOPHISTICATION	**58.5**	**19**	◆
4.1	**Credit**	**53.1**	**25**	◆
4.1.1	Ease of getting credit*	60.0	74	
4.1.2	Domestic credit to private sector, % GDP	161.1	6	◆
4.1.3	Microfinance gross loans, % GDP	0.0	73	○
4.2	**Investment**	**37.1**	**66**	
4.2.1	Ease of protecting minority investors*	72.0	27	
4.2.2	Market capitalization, % GDP	61.3	24	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	32	
4.3	**Trade, competition, and market scale**	**85.3**	**3**	● ◆
4.3.1	Applied tariff rate, weighted avg., %	3.4	68	
4.3.2	Intensity of local competition†	74.4	32	◆
4.3.3	Domestic market scale, bn PPP$	27,308.9	1	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**52.9**	**15**	◆
5.1	**Knowledge workers**	**77.9**	**[1]**	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % 🕒	79.2	1	● ◆
5.1.3	GERD performed by business, % GDP	1.7	12	◆
5.1.4	GERD financed by business, %	76.6	4	● ◆
5.1.5	Females employed w/advanced degrees, %	n/a	n/a	
5.2	**Innovation linkages**	**24.5**	**48**	◆
5.2.1	University/industry research collaboration† 🕒	56.5	29	◆
5.2.2	State of cluster development† 🕒	59.6	25	◆
5.2.3	GERD financed by abroad, % GDP	0.0	81	○
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	76	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	1.0	27	◆
5.3	**Knowledge absorption**	**56.3**	**6**	◆
5.3.1	Intellectual property payments, % total trade	1.2	28	
5.3.2	High-tech imports, % total trade	23.9	5	◆
5.3.3	ICT services imports, % total trade	0.9	78	
5.3.4	FDI net inflows, % GDP	1.5	100	○
5.3.5	Research talent, % in business enterprise	61.3	12	◆
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**55.1**	**7**	◆
6.1	**Knowledge creation**	**70.4**	**4**	● ◆
6.1.1	Patents by origin/bn PPP$ GDP	55.1	1	● ◆
6.1.2	PCT patents by origin/bn PPP$ GDP	2.2	15	◆
6.1.3	Utility models by origin/bn PPP$ GDP	81.6	1	● ◆
6.1.4	Scientific & technical articles/bn PPP$ GDP	13.8	39	
6.1.5	Citable documents H-index	57.0	13	◆
6.2	**Knowledge impact**	**50.4**	**6**	◆
6.2.1	Growth rate of PPP$ GDP/worker, %	6.6	2	● ◆
6.2.2	New businesses/th pop. 15-64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	23	◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	11.7	24	
6.2.5	High- and medium-high-tech manufacturing, %	46.4	13	◆
6.3	**Knowledge diffusion**	**44.5**	**21**	◆
6.3.1	Intellectual property receipts, % total trade	0.2	44	
6.3.2	High-tech net exports, % total trade	28.0	5	◆
6.3.3	ICT services exports, % total trade	1.8	61	
6.3.4	FDI net outflows, % GDP	1.3	48	
	CREATIVE OUTPUTS	**47.0**	**12**	◆
7.1	**Intangible assets**	**72.1**	**1**	● ◆
7.1.1	Trademarks by origin/bn PPP$ GDP	281.9	1	● ◆
7.1.2	Global brand value, top 5,000, % GDP	118.3	17	◆
7.1.3	Industrial designs by origin/bn PPP$ GDP	27.3	1	● ◆
7.1.4	ICTs & organizational model creation†	59.7	46	◆
7.2	**Creative goods and services**	**39.7**	**12**	◆
7.2.1	Cultural & creative services exports, % total trade	0.5	46	
7.2.2	National feature films/mn pop. 15-69	0.8	93	○
7.2.3	Entertainment & Media market/th pop. 15-69	9.7	37	◆
7.2.4	Printing and other media, % manufacturing	0.8	72	○
7.2.5	Creative goods exports, % total trade	11.8	1	● ◆
7.3	**Online creativity**	**4.1**	**[113]**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	2.2	74	
7.3.2	Country-code TLDs/th pop. 15-69	6.1	47	
7.3.3	Wikipedia edits/mn pop. 15-69	n/a	n/a	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. 🕒 indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

COLOMBIA

GII 2020 rank

68

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
74	56	Upper middle	LCN	50.3	783.0	13,567.9	67

		Score/Value	Rank	
	INSTITUTIONS	**65.1**	**57**	
1.1	**Political environment**	**53.0**	**81**	
1.1.1	Political and operational stability*	62.5	92	○
1.1.2	Government effectiveness*	48.2	76	
1.2	**Regulatory environment**	**63.0**	**73**	
1.2.1	Regulatory quality*	50.4	55	
1.2.2	Rule of law*	36.0	87	
1.2.3	Cost of redundancy dismissal, salary weeks	16.7	66	
1.3	**Business environment**	**79.2**	**36**	
1.3.1	Ease of starting a business*	87.0	74	
1.3.2	Ease of resolving insolvency*	71.4	30	◆
	HUMAN CAPITAL & RESEARCH	**25.9**	**82**	
2.1	**Education**	**36.7**	**89**	
2.1.1	Expenditure on education, % GDP	4.5	63	
2.1.2	Government funding/pupil, secondary, % GDP/cap	17.6	64	
2.1.3	School life expectancy, years	14.4	63	
2.1.4	PISA scales in reading, maths, & science	405.5	62	○
2.1.5	Pupil-teacher ratio, secondary	25.9	107	○ ◇
2.2	**Tertiary education**	**31.0**	**72**	
2.2.1	Tertiary enrolment, % gross	55.3	50	
2.2.2	Graduates in science & engineering, %	23.1	51	
2.2.3	Tertiary inbound mobility, %	0.2	107	○ ◇
2.3	**Research & development (R&D)**	**9.9**	**59**	
2.3.1	Researchers, FTE/mn pop. ⊙	88.0	90	○ ◇
2.3.2	Gross expenditure on R&D, % GDP	0.2	87	○
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	34.1	33	
	INFRASTRUCTURE	**46.4**	**50**	
3.1	**Information & communication technologies (ICTs)**	**71.9**	**53**	
3.1.1	ICT access*	60.9	73	
3.1.2	ICT use*	46.3	81	
3.1.3	Government's online service*	88.2	30	◆
3.1.4	E-participation*	92.1	23	● ◆
3.2	**General infrastructure**	**21.7**	**88**	
3.2.1	Electricity output, kWh/mn pop.	1,609.4	86	
3.2.2	Logistics performance*	40.9	57	
3.2.3	Gross capital formation, % GDP	21.8	80	
3.3	**Ecological sustainability**	**45.5**	**29**	◆
3.3.1	GDP/unit of energy use	16.4	10	● ◆
3.3.2	Environmental performance*	52.9	48	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.8	27	●
	MARKET SOPHISTICATION	**51.2**	**45**	
4.1	**Credit**	**49.7**	**35**	◆
4.1.1	Ease of getting credit*	90.0	10	● ◆
4.1.2	Domestic credit to private sector, % GDP	50.2	69	
4.1.3	Microfinance gross loans, % GDP	1.8	16	●
4.2	**Investment**	**32.2**	**87**	
4.2.1	Ease of protecting minority investors*	80.0	13	● ◆
4.2.2	Market capitalization, % GDP	35.7	41	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	72	○
4.3	**Trade, competition, and market scale**	**71.8**	**32**	
4.3.1	Applied tariff rate, weighted avg., %	3.3	67	
4.3.2	Intensity of local competition†	75.0	28	● ◆
4.3.3	Domestic market scale, bn PPP$	783.0	31	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**29.8**	**52**	
5.1	**Knowledge workers**	**46.0**	**33**	◆
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % ⊙	63.0	6	● ◆
5.1.3	GERD performed by business, % GDP	0.1	61	
5.1.4	GERD financed by business, %	49.1	30	
5.1.5	Females employed w/advanced degrees, %	14.1	49	
5.2	**Innovation linkages**	**15.5**	**108**	○
5.2.1	University/industry research collaboration†	42.6	61	
5.2.2	State of cluster development†	43.2	83	
5.2.3	GERD financed by abroad, % GDP	0.0	95	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	85	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	73	
5.3	**Knowledge absorption**	**27.8**	**68**	
5.3.1	Intellectual property payments, % total trade	0.9	43	
5.3.2	High-tech imports, % total trade	13.4	17	●
5.3.3	ICT services imports, % total trade	1.4	51	
5.3.4	FDI net inflows, % GDP	4.3	35	
5.3.5	Research talent, % in business enterprise ⊙	2.4	75	○ ◇
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**17.9**	**72**	
6.1	**Knowledge creation**	**9.4**	**78**	
6.1.1	Patents by origin/bn PPP$ GDP	0.6	80	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.2	52	
6.1.3	Utility models by origin/bn PPP$ GDP	0.2	45	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.4	83	
6.1.5	Citable documents H-index	17.4	46	
6.2	**Knowledge impact**	**27.8**	**50**	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.2	44	
6.2.2	New businesses/th pop. 15–64	2.0	55	
6.2.3	Computer software spending, % GDP	0.0	74	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	13.5	21	●
6.2.5	High- and medium-high-tech manufacturing, %	20.2	56	
6.3	**Knowledge diffusion**	**16.5**	**88**	
6.3.1	Intellectual property receipts, % total trade	0.1	51	
6.3.2	High-tech net exports, % total trade	1.0	68	
6.3.3	ICT services exports, % total trade	0.7	90	
6.3.4	FDI net outflows, % GDP	1.4	45	
	CREATIVE OUTPUTS	**18.2**	**80**	
7.1	**Intangible assets**	**23.9**	**78**	
7.1.1	Trademarks by origin/bn PPP$ GDP	34.8	70	
7.1.2	Global brand value, top 5,000, % GDP	37.9	40	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.4	88	
7.1.4	ICTs & organizational model creation†	54.5	62	
7.2	**Creative goods and services**	**7.8**	**90**	
7.2.1	Cultural & creative services exports, % total trade	0.2	67	
7.2.2	National feature films/mn pop. 15–69	1.4	77	
7.2.3	Entertainment & Media market/th pop. 15–69	7.2	44	
7.2.4	Printing and other media, % manufacturing	1.3	33	
7.2.5	Creative goods exports, % total trade	0.2	76	
7.3	**Online creativity**	**16.9**	**63**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.8	66	
7.3.2	Country-code TLDs/th pop. 15–69	20.0	29	
7.3.3	Wikipedia edits/mn pop. 15–69	46.3	69	
7.3.4	Mobile app creation/bn PPP$ GDP	1.6	65	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

COSTA RICA

GII 2020 rank

56

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
51	**66**	**Upper middle**	**LCN**	**5.0**	**91.6**	**15,747.5**	**55**

		Score/Value	Rank	
	INSTITUTIONS	**62.6**	**66**	
1.1	**Political environment**	**62.9**	**50**	
1.1.1	Political and operational stability*	71.4	59	
1.1.2	Government effectiveness*	58.6	48	
1.2	**Regulatory environment**	**67.8**	**56**	
1.2.1	Regulatory quality*	54.4	48	
1.2.2	Rule of law*	59.1	42	◆
1.2.3	Cost of redundancy dismissal, salary weeks	18.7	76	
1.3	**Business environment**	**57.3**	**112**	○ ◇
1.3.1	Ease of starting a business*	79.9	110	○
1.3.2	Ease of resolving insolvency*	34.6	114	○ ◇
	HUMAN CAPITAL & RESEARCH	**30.0**	**66**	
2.1	**Education**	**54.7**	**37**	
2.1.1	Expenditure on education, % GDP	7.0	6	● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap	21.1	45	
2.1.3	School life expectancy, years	15.9	37	
2.1.4	PISA scales in reading, maths, & science	414.8	59	
2.1.5	Pupil-teacher ratio, secondary	12.4	57	
2.2	**Tertiary education**	**28.1**	**78**	
2.2.1	Tertiary enrolment, % gross	55.2	51	
2.2.2	Graduates in science & engineering, %	15.5	92	○ ◇
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**7.2**	**67**	
2.3.1	Researchers, FTE/mn pop. ◷	380.4	73	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.4	71	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	15.9	56	
	INFRASTRUCTURE	**41.1**	**62**	
3.1	**Information & communication technologies (ICTs)**	**69.4**	**58**	
3.1.1	ICT access*	66.8	64	
3.1.2	ICT use*	66.4	50	◆
3.1.3	Government's online service*	67.4	75	
3.1.4	E-participation*	77.0	57	
3.2	**General infrastructure**	**18.0**	**113**	○
3.2.1	Electricity output, kWh/mn pop.	2,303.2	74	
3.2.2	Logistics performance*	33.9	72	
3.2.3	Gross capital formation, % GDP	18.3	110	○
3.3	**Ecological sustainability**	**36.0**	**46**	
3.3.1	GDP/unit of energy use	14.9	13	● ◆
3.3.2	Environmental performance*	52.5	50	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.9	63	
	MARKET SOPHISTICATION	**42.1**	**98**	
4.1	**Credit**	**44.9**	**53**	
4.1.1	Ease of getting credit*	85.0	14	●
4.1.2	Domestic credit to private sector, % GDP	62.6	54	
4.1.3	Microfinance gross loans, % GDP	0.1	64	
4.2	**Investment**	**17.2**	**128**	○ ◇
4.2.1	Ease of protecting minority investors*	48.0	96	
4.2.2	Market capitalization, % GDP ◷	5.1	69	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	66	
4.3	**Trade, competition, and market scale**	**64.3**	**55**	
4.3.1	Applied tariff rate, weighted avg., %	1.8	53	
4.3.2	Intensity of local competition†	72.9	39	
4.3.3	Domestic market scale, bn PPP$	91.6	86	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**31.1**	**48**	
5.1	**Knowledge workers**	**29.9**	**66**	
5.1.1	Knowledge-intensive employment, % ◷	27.4	52	
5.1.2	Firms offering formal training, % ◷	54.7	11	● ◆
5.1.3	GERD performed by business, % GDP ◷	0.1	56	
5.1.4	GERD financed by business, %	3.7	88	○ ◇
5.1.5	Females employed w/advanced degrees, %	11.6	60	
5.2	**Innovation linkages**	**18.0**	**87**	
5.2.1	University/industry research collaboration†	42.5	62	
5.2.2	State of cluster development†	47.9	62	
5.2.3	GERD financed by abroad, % GDP	0.0	63	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	70	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	76	
5.3	**Knowledge absorption**	**45.4**	**23**	● ◆
5.3.1	Intellectual property payments, % total trade	2.8	7	● ◆
5.3.2	High-tech imports, % total trade	8.9	50	
5.3.3	ICT services imports, % total trade	1.5	44	
5.3.4	FDI net inflows, % GDP	4.7	31	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**24.4**	**53**	
6.1	**Knowledge creation**	**6.8**	**91**	
6.1.1	Patents by origin/bn PPP$ GDP	0.1	120	○
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	57	
6.1.3	Utility models by origin/bn PPP$ GDP	0.2	49	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.3	84	
6.1.5	Citable documents H-index	10.9	70	
6.2	**Knowledge impact**	**21.2**	**78**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-0.3	98	○
6.2.2	New businesses/th pop. 15–64	2.6	50	
6.2.3	Computer software spending, % GDP	0.0	47	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.8	77	
6.2.5	High- and medium-high-tech manufacturing, % ◷	25.6	43	
6.3	**Knowledge diffusion**	**45.3**	**19**	● ◆
6.3.1	Intellectual property receipts, % total trade	0.0	75	
6.3.2	High-tech net exports, % total trade	5.7	28	●
6.3.3	ICT services exports, % total trade	6.2	6	● ◆
6.3.4	FDI net outflows, % GDP	0.8	64	
	CREATIVE OUTPUTS	**26.8**	**53**	
7.1	**Intangible assets**	**28.4**	**62**	
7.1.1	Trademarks by origin/bn PPP$ GDP	79.7	22	●
7.1.2	Global brand value, top 5,000, % GDP	2.6	75	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.1	110	○
7.1.4	ICTs & organizational model creation†	63.0	36	◆
7.2	**Creative goods and services**	**31.2**	**23**	● ◆
7.2.1	Cultural & creative services exports, % total trade ◷	3.7	1	● ◆
7.2.2	National feature films/mn pop. 15–69	3.6	52	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing ◷	2.2	12	● ◆
7.2.5	Creative goods exports, % total trade	0.1	96	
7.3	**Online creativity**	**19.3**	**55**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	11.2	37	◆
7.3.2	Country-code TLDs/th pop. 15–69	1.5	75	
7.3.3	Wikipedia edits/mn pop. 15–69	59.5	53	
7.3.4	Mobile app creation/bn PPP$ GDP	7.3	50	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

CROATIA

GII 2020 rank

41

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
43	44	High	EUR	4.1	112.6	24,207.9	44

		Score/Value	Rank	
	INSTITUTIONS	**69.1**	**47**	
1.1	**Political environment**	**66.4**	**43**	◇
1.1.1	Political and operational stability*	78.6	38	
1.1.2	Government effectiveness*	60.4	46	◇
1.2	**Regulatory environment**	**70.1**	**46**	
1.2.1	Regulatory quality*	53.6	50	◇
1.2.2	Rule of law*	55.1	50	◇
1.2.3	Cost of redundancy dismissal, salary weeks	15.1	59	
1.3	**Business environment**	**70.9**	**68**	
1.3.1	Ease of starting a business*	85.3	87	○ ◇
1.3.2	Ease of resolving insolvency*	56.5	58	
	HUMAN CAPITAL & RESEARCH	**36.5**	**47**	
2.1	**Education**	**56.2**	**30**	●
2.1.1	Expenditure on education, % GDP ⊙	4.6	61	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	15.2	45	
2.1.4	PISA scales in reading, maths, & science	471.9	37	
2.1.5	Pupil-teacher ratio, secondary ⊙	6.7	1	● ◆
2.2	**Tertiary education**	**41.3**	**39**	
2.2.1	Tertiary enrolment, % gross	67.9	33	
2.2.2	Graduates in science & engineering, %	27.0	28	
2.2.3	Tertiary inbound mobility, %	2.9	66	◇
2.3	**Research & development (R&D)**	**11.8**	**53**	◇
2.3.1	Researchers, FTE/mn pop.	1,921.1	41	
2.3.2	Gross expenditure on R&D, % GDP	1.0	38	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	5.0	69	◇
	INFRASTRUCTURE	**51.1**	**39**	
3.1	**Information & communication technologies (ICTs)**	**72.2**	**52**	◇
3.1.1	ICT access*	77.2	35	
3.1.2	ICT use*	66.7	49	◇
3.1.3	Government's online service*	68.1	74	◇
3.1.4	E-participation*	77.0	57	
3.2	**General infrastructure**	**24.5**	**76**	◇
3.2.1	Electricity output, kWh/mn pop.	2,853.1	64	◇
3.2.2	Logistics performance*	48.5	48	
3.2.3	Gross capital formation, % GDP	21.4	84	○
3.3	**Ecological sustainability**	**56.7**	**7**	● ◆
3.3.1	GDP/unit of energy use	10.3	51	
3.3.2	Environmental performance*	63.1	34	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	9.6	5	● ◆
	MARKET SOPHISTICATION	**46.4**	**73**	
4.1	**Credit**	**36.8**	**81**	
4.1.1	Ease of getting credit*	50.0	94	○
4.1.2	Domestic credit to private sector, % GDP	55.9	61	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**43.6**	**41**	
4.2.1	Ease of protecting minority investors*	70.0	36	
4.2.2	Market capitalization, % GDP	38.0	39	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**59.0**	**79**	◇
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	57.1	117	○ ◇
4.3.3	Domestic market scale, bn PPP$	112.6	78	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**28.3**	**56**	◇
5.1	**Knowledge workers**	**39.6**	**46**	
5.1.1	Knowledge-intensive employment, %	37.0	33	
5.1.2	Firms offering formal training, %	26.2	59	○
5.1.3	GERD performed by business, % GDP	0.5	38	
5.1.4	GERD financed by business, %	42.6	41	
5.1.5	Females employed w/advanced degrees, %	17.6	36	
5.2	**Innovation linkages**	**16.6**	**98**	○ ◇
5.2.1	University/industry research collaboration†	28.3	118	○ ◇
5.2.2	State of cluster development†	30.7	122	○ ◇
5.2.3	GERD financed by abroad, % GDP	0.1	41	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	44	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	49	
5.3	**Knowledge absorption**	**28.7**	**63**	
5.3.1	Intellectual property payments, % total trade	1.1	34	
5.3.2	High-tech imports, % total trade	6.5	83	○
5.3.3	ICT services imports, % total trade	1.6	41	
5.3.4	FDI net inflows, % GDP	3.1	48	
5.3.5	Research talent, % in business enterprise	22.7	53	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**28.6**	**43**	
6.1	**Knowledge creation**	**24.3**	**43**	
6.1.1	Patents by origin/bn PPP$ GDP	1.3	59	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.4	38	
6.1.3	Utility models by origin/bn PPP$ GDP	0.6	34	
6.1.4	Scientific & technical articles/bn PPP$ GDP	24.9	17	●
6.1.5	Citable documents H-index	17.3	48	
6.2	**Knowledge impact**	**30.6**	**39**	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.1	62	
6.2.2	New businesses/th pop. 15–64	5.9	28	●
6.2.3	Computer software spending, % GDP	0.0	98	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	21.8	10	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	21.0	54	
6.3	**Knowledge diffusion**	**30.9**	**42**	
6.3.1	Intellectual property receipts, % total trade	0.2	37	
6.3.2	High-tech net exports, % total trade	3.3	43	
6.3.3	ICT services exports, % total trade	3.0	34	●
6.3.4	FDI net outflows, % GDP	0.4	79	
	CREATIVE OUTPUTS	**27.9**	**49**	
7.1	**Intangible assets**	**30.9**	**47**	
7.1.1	Trademarks by origin/bn PPP$ GDP	35.1	69	
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	4.0	31	●
7.1.4	ICTs & organizational model creation†	51.9	73	◇
7.2	**Creative goods and services**	**24.2**	**38**	
7.2.1	Cultural & creative services exports, % total trade	1.5	13	●
7.2.2	National feature films/mn pop. 15–69	2.0	67	◇
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	2.6	7	● ◆
7.2.5	Creative goods exports, % total trade	0.9	49	
7.3	**Online creativity**	**25.5**	**43**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	14.5	32	●
7.3.2	Country-code TLDs/th pop. 15–69	11.2	39	
7.3.3	Wikipedia edits/mn pop. 15–69	69.9	40	
7.3.4	Mobile app creation/bn PPP$ GDP	7.9	48	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

CÔTE D'IVOIRE

GII 2020 rank

112

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
115	105	Lower middle	SSF	25.7	117.1	3,891.2	103

		Score/Value	Rank	
	INSTITUTIONS	**59.5**	**79**	
1.1	**Political environment**	**45.8**	**102**	
1.1.1	Political and operational stability*	62.5	92	
1.1.2	Government effectiveness*	37.4	104	
1.2	**Regulatory environment**	**62.1**	**74**	◆
1.2.1	Regulatory quality*	36.8	85	
1.2.2	Rule of law*	31.6	99	
1.2.3	Cost of redundancy dismissal, salary weeks	13.1	46	●
1.3	**Business environment**	**70.8**	**69**	●
1.3.1	Ease of starting a business*	93.7	27	● ◆
1.3.2	Ease of resolving insolvency*	47.9	77	
	HUMAN CAPITAL & RESEARCH	**12.2**	**117**	◇
2.1	**Education**	**28.9**	**109**	
2.1.1	Expenditure on education, % GDP	4.4	65	
2.1.2	Government funding/pupil, secondary, % GDP/cap	18.3	60	
2.1.3	School life expectancy, years	10.0	110	◇
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	27.3	113	◇
2.2	**Tertiary education**	**7.3**	**118**	◇
2.2.1	Tertiary enrolment, % gross	9.3	112	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	2.2	76	
2.3	**Research & development (R&D)**	**0.5**	**113**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.1	108	○
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**22.4**	**121**	◇
3.1	**Information & communication technologies (ICTs)**	**27.8**	**125**	○ ◇
3.1.1	ICT access*	37.6	109	
3.1.2	ICT use*	33.9	102	
3.1.3	Government's online service*	22.2	125	○ ◇
3.1.4	E-participation*	17.4	126	○ ◇
3.2	**General infrastructure**	**22.5**	**84**	
3.2.1	Electricity output, kWh/mn pop.	421.9	110	
3.2.2	Logistics performance*	47.5	49	● ◆
3.2.3	Gross capital formation, % GDP	22.1	78	
3.3	**Ecological sustainability**	**16.9**	**118**	◇
3.3.1	GDP/unit of energy use	8.2	77	
3.3.2	Environmental performance*	25.8	128	○ ◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	95	
	MARKET SOPHISTICATION	**42.6**	**92**	
4.1	**Credit**	**32.6**	**100**	
4.1.1	Ease of getting credit*	70.0	44	●
4.1.2	Domestic credit to private sector, % GDP	26.2	101	
4.1.3	Microfinance gross loans, % GDP	0.3	44	●
4.2	**Investment**	**42.0**	**[47]**	
4.2.1	Ease of protecting minority investors*	42.0	102	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**53.3**	**101**	
4.3.1	Applied tariff rate, weighted avg., %	10.2	116	◇
4.3.2	Intensity of local competition†	70.2	57	●
4.3.3	Domestic market scale, bn PPP$	117.1	76	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**19.7**	**101**	
5.1	**Knowledge workers**	**21.9**	**[95]**	
5.1.1	Knowledge-intensive employment, % ◷	10.3	106	
5.1.2	Firms offering formal training, % ◷	35.5	40	●
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ◷	1.3	107	
5.2	**Innovation linkages**	**15.9**	**104**	
5.2.1	University/industry research collaboration†	30.8	108	
5.2.2	State of cluster development†	38.3	102	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	110	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**21.3**	**95**	
5.3.1	Intellectual property payments, % total trade ◷	0.0	115	○ ◇
5.3.2	High-tech imports, % total trade	6.1	95	
5.3.3	ICT services imports, % total trade ◷	1.9	32	● ◆
5.3.4	FDI net inflows, % GDP	2.1	79	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**13.1**	**98**	
6.1	**Knowledge creation**	**3.5**	**118**	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	98	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	96	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.0	119	
6.1.5	Citable documents H-index	6.3	94	
6.2	**Knowledge impact**	**20.3**	**82**	
6.2.1	Growth rate of PPP$ GDP/worker, %	4.8	11	●
6.2.2	New businesses/th pop. 15–64	0.7	89	
6.2.3	Computer software spending, % GDP	0.0	119	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.7	87	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**15.4**	**92**	
6.3.1	Intellectual property receipts, % total trade ◷	0.0	91	
6.3.2	High-tech net exports, % total trade	0.6	76	
6.3.3	ICT services exports, % total trade ◷	1.2	78	
6.3.4	FDI net outflows, % GDP	1.3	47	●
	CREATIVE OUTPUTS	**9.3**	**116**	
7.1	**Intangible assets**	**16.7**	**106**	
7.1.1	Trademarks by origin/bn PPP$ GDP	11.0	108	
7.1.2	Global brand value, top 5,000, % GDP	5.5	68	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.9	74	
7.1.4	ICTs & organizational model creation†	50.3	81	
7.2	**Creative goods and services**	**0.9**	**[127]**	
7.2.1	Cultural & creative services exports, % total trade	0.1	87	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.0	113	
7.3	**Online creativity**	**2.9**	**117**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.4	112	
7.3.2	Country-code TLDs/th pop. 15–69	0.2	110	
7.3.3	Wikipedia edits/mn pop. 15–69	12.8	116	○ ◇
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

CYPRUS

GII 2020 rank

29

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
26	30	High	NAWA	1.2	36.3	36,149.4	28

		Score/Value	Rank	
	INSTITUTIONS	**80.0**	**27**	
1.1	**Political environment**	**73.9**	**36**	
1.1.1	Political and operational stability*	80.4	33	
1.1.2	Government effectiveness*	70.7	36	
1.2	**Regulatory environment**	**83.7**	**21**	
1.2.1	Regulatory quality*	68.6	32	
1.2.2	Rule of law*	66.3	35	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	● ◆
1.3	**Business environment**	**82.3**	**26**	
1.3.1	Ease of starting a business*	92.0	45	
1.3.2	Ease of resolving insolvency*	72.5	29	
	HUMAN CAPITAL & RESEARCH	**39.3**	**40**	
2.1	**Education**	**63.4**	**13**	◆
2.1.1	Expenditure on education, % GDP ⊙	6.3	11	◆
2.1.2	Government funding/pupil, secondary, % GDP/cap	39.3	4	● ◆
2.1.3	School life expectancy, years	15.2	48	
2.1.4	PISA scales in reading, maths, & science	438.0	45	
2.1.5	Pupil-teacher ratio, secondary ⊙	8.3	14	◆
2.2	**Tertiary education**	**48.0**	**20**	
2.2.1	Tertiary enrolment, % gross	75.9	23	
2.2.2	Graduates in science & engineering, %	15.0	97	○ ◇
2.2.3	Tertiary inbound mobility, %	23.1	1	● ◆
2.3	**Research & development (R&D)**	**6.5**	**72**	◇
2.3.1	Researchers, FTE/mn pop	1,255.9	49	◇
2.3.2	Gross expenditure on R&D, % GDP	0.6	59	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**53.6**	**27**	
3.1	**Information & communication technologies (ICTs)**	**81.4**	**28**	
3.1.1	ICT access*	83.4	17	
3.1.2	ICT use*	81.6	17	
3.1.3	Government's online service*	78.5	52	
3.1.4	E-participation*	82.0	46	
3.2	**General infrastructure**	**27.1**	**63**	◇
3.2.1	Electricity output, kWh/mn pop	5,819.0	34	
3.2.2	Logistics performance*	50.7	44	
3.2.3	Gross capital formation, % GDP	20.6	93	○
3.3	**Ecological sustainability**	**52.4**	**18**	
3.3.1	GDP/unit of energy use	12.5	29	
3.3.2	Environmental performance*	64.8	31	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	6.7	12	◆
	MARKET SOPHISTICATION	**50.9**	**49**	
4.1	**Credit**	**62.0**	**14**	
4.1.1	Ease of getting credit*	60.0	74	
4.1.2	Domestic credit to private sector, % GDP	142.3	12	◆
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**28.7**	**98**	○
4.2.1	Ease of protecting minority investors*	76.0	21	
4.2.2	Market capitalization, % GDP	12.6	65	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	48	
4.3	**Trade, competition, and market scale**	**61.9**	**69**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	76.0	20	
4.3.3	Domestic market scale, bn PPP$	36.3	113	○ ◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**42.0**	**28**	
5.1	**Knowledge workers**	**41.4**	**42**	
5.1.1	Knowledge-intensive employment, %	35.6	37	
5.1.2	Firms offering formal training, %	39.7	30	
5.1.3	GERD performed by business, % GDP	0.2	51	
5.1.4	GERD financed by business, %	32.8	53	
5.1.5	Females employed w/advanced degrees, %	25.1	14	
5.2	**Innovation linkages**	**44.4**	**19**	
5.2.1	University/industry research collaboration†	39.7	75	◇
5.2.2	State of cluster development†	48.2	59	
5.2.3	GERD financed by abroad, % GDP	0.1	32	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.3	4	● ◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	1.8	22	
5.3	**Knowledge absorption**	**40.3**	**30**	
5.3.1	Intellectual property payments, % total trade	0.9	42	
5.3.2	High-tech imports, % total trade	3.9	124	○ ◇
5.3.3	ICT services imports, % total trade	6.7	1	● ◆
5.3.4	FDI net inflows, % GDP	47.6	1	● ◆
5.3.5	Research talent, % in business enterprise	27.3	46	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**40.3**	**20**	
6.1	**Knowledge creation**	**32.4**	**31**	
6.1.1	Patents by origin/bn PPP$ GDP	1.6	49	
6.1.2	PCT patents by origin/bn PPP$ GDP	1.2	25	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	28.0	12	
6.1.5	Citable documents H-index	12.3	60	
6.2	**Knowledge impact**	**34.2**	**30**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-0.3	97	○
6.2.2	New businesses/th pop. 15–64	17.6	5	● ◆
6.2.3	Computer software spending, % GDP	0.0	70	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	22.3	9	◆
6.2.5	High- and medium-high-tech manufacturing, %	15.8	63	
6.3	**Knowledge diffusion**	**54.2**	**9**	◆
6.3.1	Intellectual property receipts, % total trade	0.0	85	○
6.3.2	High-tech net exports, % total trade	0.6	77	◇
6.3.3	ICT services exports, % total trade	14.6	1	● ◆
6.3.4	FDI net outflows, % GDP	30.5	1	● ◆
	CREATIVE OUTPUTS	**36.1**	**25**	
7.1	**Intangible assets**	**33.1**	**41**	
7.1.1	Trademarks by origin/bn PPP$ GDP	79.3	23	
7.1.2	Global brand value, top 5,000, % GDP	6.2	67	◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	12.1	11	◆
7.1.4	ICTs & organizational model creation†	47.3	93	○ ◇
7.2	**Creative goods and services**	**15.1**	**64**	
7.2.1	Cultural & creative services exports, % total trade ⊙	0.2	73	
7.2.2	National feature films/mn pop. 15–69	6.9	32	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	2.1	13	
7.2.5	Creative goods exports, % total trade	0.3	72	
7.3	**Online creativity**	**62.9**	**9**	◆
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	74.3	7	● ◆
7.3.2	Country-code TLDs/th pop. 15–69	5.0	55	
7.3.3	Wikipedia edits/mn pop. 15–69	73.8	35	
7.3.4	Mobile app creation/bn PPP$ GDP	100.0	1	● ◆

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

CZECH REPUBLIC

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
17	28	High	EUR	10.7	413.1	33,903.0	26

		Score/Value	Rank	
	INSTITUTIONS	**77.1**	**32**	
1.1	**Political environment**	**75.1**	**35**	
1.1.1	Political and operational stability*	83.9	21	
1.1.2	Government effectiveness*	70.7	35	
1.2	**Regulatory environment**	**75.2**	**36**	
1.2.1	Regulatory quality*	75.1	23	
1.2.2	Rule of law*	74.0	28	
1.2.3	Cost of redundancy dismissal, salary weeks	20.2	84	○
1.3	**Business environment**	**81.1**	**29**	
1.3.1	Ease of starting a business*	82.1	103	○ ◇
1.3.2	Ease of resolving insolvency*	80.1	15	
	HUMAN CAPITAL & RESEARCH	**43.4**	**33**	
2.1	**Education**	**56.5**	**27**	
2.1.1	Expenditure on education, % GDP ⓘ	5.6	19	
2.1.2	Government funding/pupil, secondary, % GDP/cap	22.3	34	
2.1.3	School life expectancy, years	16.8	20	
2.1.4	PISA scales in reading, maths, & science	495.5	23	
2.1.5	Pupil-teacher ratio, secondary ⓘ	11.5	52	
2.2	**Tertiary education**	**45.1**	**27**	
2.2.1	Tertiary enrolment, % gross	64.1	39	
2.2.2	Graduates in science & engineering, %	23.9	42	
2.2.3	Tertiary inbound mobility, %	12.5	14	
2.3	**Research & development (R&D)**	**28.8**	**38**	
2.3.1	Researchers, FTE/mn pop	3,862.7	26	
2.3.2	Gross expenditure on R&D, % GDP	1.9	19	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	29.9	40	
	INFRASTRUCTURE	**55.8**	**21**	
3.1	**Information & communication technologies (ICTs)**	**68.1**	**63**	◇
3.1.1	ICT access*	72.3	53	◇
3.1.2	ICT use*	73.0	34	
3.1.3	Government's online service*	65.3	83	○ ◇
3.1.4	E-participation*	61.8	89	○ ◇
3.2	**General infrastructure**	**39.7**	**24**	
3.2.1	Electricity output, kWh/mn pop	8,171.8	20	
3.2.2	Logistics performance*	75.6	22	
3.2.3	Gross capital formation, % GDP	26.4	40	
3.3	**Ecological sustainability**	**59.6**	**4**	● ◆
3.3.1	GDP/unit of energy use	8.0	78	○
3.3.2	Environmental performance*	71.0	20	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	10.8	3	● ◆
	MARKET SOPHISTICATION	**51.1**	**47**	
4.1	**Credit**	**45.9**	**49**	
4.1.1	Ease of getting credit*	70.0	44	
4.1.2	Domestic credit to private sector, % GDP	52.1	66	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**34.9**	**76**	○
4.2.1	Ease of protecting minority investors*	62.0	60	○
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	37	
4.3	**Trade, competition, and market scale**	**72.6**	**29**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	78.2	16	
4.3.3	Domestic market scale, bn PPP$	413.1	45	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**46.2**	**23**	
5.1	**Knowledge workers**	**48.2**	**29**	
5.1.1	Knowledge-intensive employment, %	38.0	31	
5.1.2	Firms offering formal training, % ⓘ	55.1	10	● ◆
5.1.3	GERD performed by business, % GDP	1.2	17	
5.1.4	GERD financed by business, %	33.0	52	
5.1.5	Females employed w/advanced degrees, %	12.5	57	◇
5.2	**Innovation linkages**	**42.1**	**23**	
5.2.1	University/industry research collaboration†	51.0	37	
5.2.2	State of cluster development†	46.8	66	○
5.2.3	GERD financed by abroad, % GDP	0.6	1	● ◆
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	74	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.7	29	
5.3	**Knowledge absorption**	**48.4**	**17**	
5.3.1	Intellectual property payments, % total trade	0.8	50	
5.3.2	High-tech imports, % total trade	19.9	8	● ◆
5.3.3	ICT services imports, % total trade	1.3	53	
5.3.4	FDI net inflows, % GDP	4.7	30	
5.3.5	Research talent, % in business enterprise	51.3	22	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**45.2**	**15**	
6.1	**Knowledge creation**	**39.5**	**24**	
6.1.1	Patents by origin/bn PPP$ GDP	2.3	36	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.5	35	
6.1.3	Utility models by origin/bn PPP$ GDP	3.0	6	● ◆
6.1.4	Scientific & technical articles/bn PPP$ GDP	25.2	14	
6.1.5	Citable documents H-index	29.8	31	
6.2	**Knowledge impact**	**51.7**	**4**	● ◆
6.2.1	Growth rate of PPP$ GDP/worker, %	2.0	47	
6.2.2	New businesses/th pop. 15-64	4.4	34	
6.2.3	Computer software spending, % GDP	0.0	36	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	29.6	3	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	57.1	5	● ◆
6.3	**Knowledge diffusion**	**44.4**	**22**	
6.3.1	Intellectual property receipts, % total trade	0.3	31	
6.3.2	High-tech net exports, % total trade	19.7	7	● ◆
6.3.3	ICT services exports, % total trade	2.3	46	
6.3.4	FDI net outflows, % GDP	2.6	27	
	CREATIVE OUTPUTS	**38.7**	**20**	
7.1	**Intangible assets**	**32.7**	**43**	
7.1.1	Trademarks by origin/bn PPP$ GDP	58.1	36	
7.1.2	Global brand value, top 5,000, % GDP	36.1	41	
7.1.3	Industrial designs by origin/bn PPP$ GDP	3.8	33	
7.1.4	ICTs & organizational model creation†	66.3	26	
7.2	**Creative goods and services**	**46.5**	**4**	● ◆
7.2.1	Cultural & creative services exports, % total trade	0.5	47	
7.2.2	National feature films/mn pop. 15-69	7.0	29	
7.2.3	Entertainment & Media market/th pop. 15-69	25.5	26	
7.2.4	Printing and other media, % manufacturing ⓘ	1.0	58	○
7.2.5	Creative goods exports, % total trade	10.8	1	● ◆
7.3	**Online creativity**	**42.8**	**27**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	16.5	30	
7.3.2	Country-code TLDs/th pop. 15-69	53.7	15	
7.3.3	Wikipedia edits/mn pop. 15-69	85.9	13	●
7.3.4	Mobile app creation/bn PPP$ GDP	15.9	30	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⓘ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

DENMARK

GII 2020 rank

6

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
9	5	High	EUR	5.8	312.8	47,040.4	7

		Score/Value	Rank	
	INSTITUTIONS	**88.3**	**12**	
1.1	**Political environment**	**91.7**	**5**	●
1.1.1	Political and operational stability*	91.1	5	
1.1.2	Government effectiveness*	92.0	6	●
1.2	**Regulatory environment**	**84.5**	**19**	
1.2.1	Regulatory quality*	86.0	13	
1.2.2	Rule of law*	94.5	8	
1.2.3	Cost of redundancy dismissal, salary weeks	18.8	78	○
1.3	**Business environment**	**88.9**	**6**	●
1.3.1	Ease of starting a business*	92.7	42	
1.3.2	Ease of resolving insolvency*	85.1	6	●
	HUMAN CAPITAL & RESEARCH	**62.9**	**2**	● ◆
2.1	**Education**	**71.6**	**3**	● ◆
2.1.1	Expenditure on education, % GDP ⊙	7.6	4	● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	31.1	10	◆
2.1.3	School life expectancy, years	18.9	7	
2.1.4	PISA scales in reading, maths, & science	501.1	17	
2.1.5	Pupil-teacher ratio, secondary ⊙	11.3	48	
2.2	**Tertiary education**	**45.3**	**26**	
2.2.1	Tertiary enrolment, % gross	80.6	18	
2.2.2	Graduates in science & engineering, %	21.0	65	○
2.2.3	Tertiary inbound mobility, %	10.8	17	
2.3	**Research & development (R&D)**	**71.8**	**8**	
2.3.1	Researchers, FTE/mn pop.	8,065.9	2	● ◆
2.3.2	Gross expenditure on R&D, % GDP	3.1	8	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	71.3	15	
2.3.4	QS university ranking, average score top 3*	57.4	15	
	INFRASTRUCTURE	**61.5**	**4**	● ◆
3.1	**Information & communication technologies (ICTs)**	**92.4**	**3**	● ◆
3.1.1	ICT access*	79.5	32	
3.1.2	ICT use*	90.3	1	● ◆
3.1.3	Government's online service*	100.0	1	● ◆
3.1.4	E-participation*	100.0	1	●
3.2	**General infrastructure**	**38.6**	**27**	
3.2.1	Electricity output, kWh/mn pop.	5,179.9	40	
3.2.2	Logistics performance*	90.2	8	
3.2.3	Gross capital formation, % GDP	23.6	63	○
3.3	**Ecological sustainability**	**53.6**	**16**	◆
3.3.1	GDP/unit of energy use	15.9	11	
3.3.2	Environmental performance*	82.5	1	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.3	29	
	MARKET SOPHISTICATION	**66.3**	**8**	
4.1	**Credit**	**72.0**	**7**	
4.1.1	Ease of getting credit*	70.0	44	○
4.1.2	Domestic credit to private sector, % GDP	163.4	5	●
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**58.3**	**16**	
4.2.1	Ease of protecting minority investors*	72.0	27	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.2	12	
4.3	**Trade, competition, and market scale**	**68.6**	**38**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	70.9	50	
4.3.3	Domestic market scale, bn PPP$	312.8	56	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**54.8**	**11**	
5.1	**Knowledge workers**	**65.6**	**9**	
5.1.1	Knowledge-intensive employment, %	47.0	13	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	1.9	10	
5.1.4	GERD financed by business, %	58.5	13	
5.1.5	Females employed w/advanced degrees, %	22.5	20	
5.2	**Innovation linkages**	**57.8**	**9**	
5.2.1	University/industry research collaboration†	69.1	10	
5.2.2	State of cluster development†	67.1	12	
5.2.3	GERD financed by abroad, % GDP	0.3	11	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.2	15	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	4.0	12	
5.3	**Knowledge absorption**	**40.9**	**28**	
5.3.1	Intellectual property payments, % total trade	0.9	40	
5.3.2	High-tech imports, % total trade	5.8	100	○
5.3.3	ICT services imports, % total trade	3.1	8	◆
5.3.4	FDI net inflows, % GDP	1.3	104	○
5.3.5	Research talent, % in business enterprise	60.5	14	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**48.3**	**12**	
6.1	**Knowledge creation**	**62.0**	**10**	
6.1.1	Patents by origin/bn PPP$ GDP	12.1	8	
6.1.2	PCT patents by origin/bn PPP$ GDP	4.6	8	
6.1.3	Utility models by origin/bn PPP$ GDP	0.2	44	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	38.2	1	● ◆
6.1.5	Citable documents H-index	50.4	15	
6.2	**Knowledge impact**	**40.3**	**18**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.8	65	○
6.2.2	New businesses/th pop. 15–64	10.0	16	
6.2.3	Computer software spending, % GDP	0.0	12	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.4	36	
6.2.5	High- and medium-high-tech manufacturing, %	42.2	20	
6.3	**Knowledge diffusion**	**42.5**	**25**	
6.3.1	Intellectual property receipts, % total trade	1.8	13	
6.3.2	High-tech net exports, % total trade	5.3	31	
6.3.3	ICT services exports, % total trade	2.7	37	
6.3.4	FDI net outflows, % GDP	2.8	22	
	CREATIVE OUTPUTS	**48.3**	**10**	
7.1	**Intangible assets**	**45.8**	**19**	
7.1.1	Trademarks by origin/bn PPP$ GDP	40.9	65	○
7.1.2	Global brand value, top 5,000, % GDP	131.1	14	
7.1.3	Industrial designs by origin/bn PPP$ GDP	6.5	20	
7.1.4	ICTs & organizational model creation†	78.9	7	
7.2	**Creative goods and services**	**33.1**	**20**	
7.2.1	Cultural & creative services exports, % total trade	0.6	43	
7.2.2	National feature films/mn pop. 15–69	13.4	10	
7.2.3	Entertainment & Media market/th pop. 15–69	81.6	4	◆
7.2.4	Printing and other media, % manufacturing ⊙	1.0	60	○
7.2.5	Creative goods exports, % total trade	1.5	35	
7.3	**Online creativity**	**68.6**	**4**	●
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	48.6	16	
7.3.2	Country-code TLDs/th pop. 15–69	100.0	1	● ◆
7.3.3	Wikipedia edits/mn pop. 15–69	83.2	17	
7.3.4	Mobile app creation/bn PPP$ GDP	43.6	12	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

DOMINICAN REPUBLIC

GII 2020 rank

90

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
85	94	Upper middle	LCN	10.7	201.3	16,946.2	87

		Score/Value	Rank	
	INSTITUTIONS	**54.3**	**98**	
1.1	**Political environment**	**50.1**	**89**	
1.1.1	Political and operational stability*	67.9	73	
1.1.2	Government effectiveness*	41.2	91	
1.2	**Regulatory environment**	**51.0**	**101**	
1.2.1	Regulatory quality*	39.8	78	
1.2.2	Rule of law*	36.3	86	
1.2.3	Cost of redundancy dismissal, salary weeks	26.2	105	
1.3	**Business environment**	**61.7**	**99**	
1.3.1	Ease of starting a business*	85.4	85	
1.3.2	Ease of resolving insolvency*	38.0	108	◇
	HUMAN CAPITAL & RESEARCH	**18.5**	**100**	◇
2.1	**Education**	**34.4**	**96**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap	15.1	78	
2.1.3	School life expectancy, years	14.2	69	
2.1.4	PISA scales in reading, maths, & science	334.1	79	○ ◇
2.1.5	Pupil-teacher ratio, secondary ⊙	18.6	92	
2.2	**Tertiary education**	**21.1**	**93**	
2.2.1	Tertiary enrolment, % gross	59.9	47	●
2.2.2	Graduates in science & engineering, %	11.6	101	○ ◇
2.2.3	Tertiary inbound mobility, %	1.7	79	
2.3	**Research & development (R&D)**	**0.0**	**[121]**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**37.9**	**77**	
3.1	**Information & communication technologies (ICTs)**	**57.2**	**85**	
3.1.1	ICT access*	45.4	99	◇
3.1.2	ICT use*	49.4	77	
3.1.3	Government's online service*	66.0	80	
3.1.4	E-participation*	68.0	78	
3.2	**General infrastructure**	**21.4**	**92**	
3.2.1	Electricity output, kWh/mn pop.	1,767.6	83	
3.2.2	Logistics performance*	27.8	85	
3.2.3	Gross capital formation, % GDP	25.7	45	●
3.3	**Ecological sustainability**	**35.1**	**48**	●
3.3.1	GDP/unit of energy use	17.5	9	● ◆
3.3.2	Environmental performance*	46.3	68	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	120	
	MARKET SOPHISTICATION	**40.6**	**105**	
4.1	**Credit**	**24.3**	**117**	◇
4.1.1	Ease of getting credit*	45.0	101	◇
4.1.2	Domestic credit to private sector, % GDP	28.6	95	
4.1.3	Microfinance gross loans, % GDP	0.7	30	●
4.2	**Investment**	**34.0**	**[78]**	
4.2.1	Ease of protecting minority investors*	34.0	118	◇
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**63.3**	**64**	
4.3.1	Applied tariff rate, weighted avg., %	4.2	79	
4.3.2	Intensity of local competition†	70.3	56	●
4.3.3	Domestic market scale, bn PPP$	201.3	66	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**22.5**	**83**	
5.1	**Knowledge workers**	**24.3**	**[85]**	
5.1.1	Knowledge-intensive employment, %	16.4	89	
5.1.2	Firms offering formal training, % ⊙	23.4	65	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, %	9.1	73	
5.2	**Innovation linkages**	**19.7**	**69**	
5.2.1	University/industry research collaboration†	35.2	98	
5.2.2	State of cluster development†	50.2	48	●
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	119	○ ◇
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	86	
5.3	**Knowledge absorption**	**23.5**	**87**	
5.3.1	Intellectual property payments, % total trade	0.6	59	
5.3.2	High-tech imports, % total trade ⊙	6.7	78	
5.3.3	ICT services imports, % total trade	0.4	106	
5.3.4	FDI net inflows, % GDP	3.7	42	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**13.0**	**99**	
6.1	**Knowledge creation**	**1.3**	**130**	○ ◇
6.1.1	Patents by origin/bn PPP$ GDP	0.1	115	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	73	
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	60	
6.1.4	Scientific & technical articles/bn PPP$ GDP	0.4	130	○ ◇
6.1.5	Citable documents H-index	2.9	123	○
6.2	**Knowledge impact**	**15.3**	**98**	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.5	38	●
6.2.2	New businesses/th pop. 15-64	1.5	69	
6.2.3	Computer software spending, % GDP	0.0	116	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.9	111	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**22.5**	**68**	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade ⊙	2.2	52	●
6.3.3	ICT services exports, % total trade	0.5	97	
6.3.4	FDI net outflows, % GDP	0.1	100	
	CREATIVE OUTPUTS	**17.8**	**82**	
7.1	**Intangible assets**	**19.7**	**91**	
7.1.1	Trademarks by origin/bn PPP$ GDP	44.6	58	
7.1.2	Global brand value, top 5,000, % GDP	2.3	77	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.0	117	○
7.1.4	ICTs & organizational model creation†	48.9	85	
7.2	**Creative goods and services**	**22.7**	**[46]**	
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15-69	3.5	53	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade ⊙	2.2	26	●
7.3	**Online creativity**	**9.2**	**88**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	2.5	71	
7.3.2	Country-code TLDs/th pop. 15-69	1.3	80	
7.3.3	Wikipedia edits/mn pop. 15-69	36.7	85	◇
7.3.4	Mobile app creation/bn PPP$ GDP	0.0	96	○

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

ECUADOR

GII 2020 rank

99

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
97	96	Upper middle	LCN	17.4	202.8	10,251.7	99

		Score/Value	Rank	
	INSTITUTIONS	**44.6**	**126**	○ ◇
1.1	**Political environment**	**48.0**	**94**	
1.1.1	Political and operational stability*	55.4	116	◇
1.1.2	Government effectiveness*	44.3	87	
1.2	**Regulatory environment**	**38.6**	**121**	◇
1.2.1	Regulatory quality*	18.3	123	○ ◇
1.2.2	Rule of law*	30.2	103	
1.2.3	Cost of redundancy dismissal, salary weeks	31.8	121	○ ◇
1.3	**Business environment**	**47.3**	**128**	○ ◇
1.3.1	Ease of starting a business*	69.1	127	○ ◇
1.3.2	Ease of resolving insolvency*	25.5	126	○ ◇

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**21.0**	**91**	
2.1	**Education**	**35.8**	**93**	
2.1.1	Expenditure on education, % GDP ⊙	5.0	41	●
2.1.2	Government funding/pupil, secondary, % GDP/cap	5.3	104	○ ◇
2.1.3	School life expectancy, years ⊙	15.2	47	●
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	20.6	99	◇
2.2	**Tertiary education**	**20.5**	**95**	
2.2.1	Tertiary enrolment, % gross ⊙	44.9	66	
2.2.2	Graduates in science & engineering, % ⊙	15.8	90	
2.2.3	Tertiary inbound mobility, % ⊙	0.8	92	
2.3	**Research & development (R&D)**	**6.8**	**70**	
2.3.1	Researchers, FTE/mn pop. ⊙	399.5	72	
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.4	70	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	13.9	58	●

		Score/Value	Rank	
	INFRASTRUCTURE	**37.3**	**82**	
3.1	**Information & communication technologies (ICTs)**	**57.9**	**84**	
3.1.1	ICT access*	47.6	94	◇
3.1.2	ICT use*	43.7	90	◇
3.1.3	Government's online service*	72.9	64	
3.1.4	E-participation*	67.4	80	
3.2	**General infrastructure**	**23.3**	**80**	
3.2.1	Electricity output, kWh/mn pop.	1,763.4	84	
3.2.2	Logistics performance*	38.1	61	
3.2.3	Gross capital formation, % GDP	24.7	54	●
3.3	**Ecological sustainability**	**30.8**	**58**	●
3.3.1	GDP/unit of energy use	11.9	34	●
3.3.2	Environmental performance*	51.0	54	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.6	73	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**47.8**	**64**	
4.1	**Credit**	**40.4**	**69**	
4.1.1	Ease of getting credit*	45.0	101	◇
4.1.2	Domestic credit to private sector, % GDP	35.7	85	
4.1.3	Microfinance gross loans, % GDP	6.1	2	● ◆
4.2	**Investment**	**44.0**	**[37]**	
4.2.1	Ease of protecting minority investors*	44.0	98	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**59.0**	**78**	
4.3.1	Applied tariff rate, weighted avg., %	7.4	99	
4.3.2	Intensity of local competition†	69.8	62	
4.3.3	Domestic market scale, bn PPP$	202.8	65	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**20.6**	**97**	
5.1	**Knowledge workers**	**28.2**	**74**	
5.1.1	Knowledge-intensive employment, %	13.1	98	◇
5.1.2	Firms offering formal training, % ⊙	73.7	2	● ◆
5.1.3	GERD performed by business, % GDP ⊙	0.2	53	
5.1.4	GERD financed by business, % ⊙	0.1	100	○ ◇
5.1.5	Females employed w/advanced degrees, %	8.7	77	
5.2	**Innovation linkages**	**13.4**	**119**	◇
5.2.1	University/industry research collaboration†	34.7	99	
5.2.2	State of cluster development†	39.0	100	
5.2.3	GERD financed by abroad, % GDP ⊙	0.0	78	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	112	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	90	
5.3	**Knowledge absorption**	**20.1**	**97**	
5.3.1	Intellectual property payments, % total trade	0.2	95	
5.3.2	High-tech imports, % total trade	8.2	54	●
5.3.3	ICT services imports, % total trade	0.0	128	○ ◇
5.3.4	FDI net inflows, % GDP	0.9	115	◇
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**12.3**	**105**	
6.1	**Knowledge creation**	**7.2**	**86**	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	107	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	63	
6.1.3	Utility models by origin/bn PPP$ GDP	0.2	47	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.5	71	
6.1.5	Citable documents H-index	9.1	80	
6.2	**Knowledge impact**	**18.2**	**89**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-0.5	103	
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	65	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.3	59	
6.2.5	High- and medium-high-tech manufacturing, %	12.8	75	
6.3	**Knowledge diffusion**	**11.4**	**116**	◇
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade	0.3	92	
6.3.3	ICT services exports, % total trade	0.1	121	○
6.3.4	FDI net outflows, % GDP	0.9	59	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**15.6**	**92**	
7.1	**Intangible assets**	**23.1**	**81**	
7.1.1	Trademarks by origin/bn PPP$ GDP	57.1	39	●
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.2	62	
7.1.4	ICTs & organizational model creation†	52.9	66	
7.2	**Creative goods and services**	**5.2**	**103**	
7.2.1	Cultural & creative services exports, % total trade	0.0	93	
7.2.2	National feature films/mn pop. 15–69 ⊙	2.1	64	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	1.0	59	
7.2.5	Creative goods exports, % total trade	0.1	109	
7.3	**Online creativity**	**11.0**	**81**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.0	79	
7.3.2	Country-code TLDs/th pop. 15–69	1.1	82	
7.3.3	Wikipedia edits/mn pop. 15–69	43.9	73	
7.3.4	Mobile app creation/bn PPP$ GDP	0.3	78	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

EGYPT

GII 2020 rank

96

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
82	104	Lower middle	NAWA	100.4	1,391.3	12,242.7	92

		Score/Value	Rank	
1	**INSTITUTIONS**	**48.6**	**115**	○
1.1	**Political environment**	**45.6**	**104**	
1.1.1	Political and operational stability*	62.5	92	
1.1.2	Government effectiveness*	37.1	106	
1.2	**Regulatory environment**	**35.2**	**124**	○
1.2.1	Regulatory quality*	18.9	121	○ ◇
1.2.2	Rule of law*	35.9	89	
1.2.3	Cost of redundancy dismissal, salary weeks	36.8	124	○ ◇
1.3	**Business environment**	**65.0**	**84**	
1.3.1	Ease of starting a business*	87.8	72	
1.3.2	Ease of resolving insolvency*	42.2	93	

		Score/Value	Rank	
2	**HUMAN CAPITAL & RESEARCH**	**21.5**	**90**	
2.1	**Education**	**40.0**	**[80]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap	13.8	85	
2.1.3	School life expectancy, years	13.3	77	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	15.2	74	
2.2	**Tertiary education**	**13.5**	**109**	
2.2.1	Tertiary enrolment, % gross	35.2	76	
2.2.2	Graduates in science & engineering, % ◷	11.2	102	○ ◇
2.2.3	Tertiary inbound mobility, % ◷	1.8	78	
2.3	**Research & development (R&D)**	**11.0**	**55**	
2.3.1	Researchers, FTE/mn pop.	686.7	61	
2.3.2	Gross expenditure on R&D, % GDP	0.7	49	◆
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	21.5	48	● ◆

		Score/Value	Rank	
3	**INFRASTRUCTURE**	**31.5**	**99**	
3.1	**Information & communication technologies (ICTs)**	**50.3**	**96**	
3.1.1	ICT access*	56.3	81	◆
3.1.2	ICT use*	37.3	100	
3.1.3	Government's online service*	53.5	102	
3.1.4	E-participation*	53.9	101	
3.2	**General infrastructure**	**17.4**	**116**	○
3.2.1	Electricity output, kWh/mn pop.	1,928.8	79	◆
3.2.2	Logistics performance*	35.4	66	
3.2.3	Gross capital formation, % GDP	17.3	114	○ ◇
3.3	**Ecological sustainability**	**26.8**	**74**	◆
3.3.1	GDP/unit of energy use	10.9	45	●
3.3.2	Environmental performance*	43.3	81	◆
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.6	76	

		Score/Value	Rank	
4	**MARKET SOPHISTICATION**	**39.3**	**106**	
4.1	**Credit**	**30.0**	**108**	
4.1.1	Ease of getting credit*	65.0	61	
4.1.2	Domestic credit to private sector, % GDP	25.5	103	
4.1.3	Microfinance gross loans, % GDP	0.1	62	
4.2	**Investment**	**24.0**	**119**	○
4.2.1	Ease of protecting minority investors*	64.0	56	
4.2.2	Market capitalization, % GDP	15.5	61	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	70	○
4.3	**Trade, competition, and market scale**	**63.9**	**62**	
4.3.1	Applied tariff rate, weighted avg., %	8.2	105	
4.3.2	Intensity of local competition†	65.7	77	
4.3.3	Domestic market scale, bn PPP$	1,391.3	19	● ◆

		Score/Value	Rank	
5	**BUSINESS SOPHISTICATION**	**18.7**	**103**	
5.1	**Knowledge workers**	**15.2**	**108**	
5.1.1	Knowledge-intensive employment, % ◷	30.3	45	● ◆
5.1.2	Firms offering formal training, % ◷	10.0	93	○ ◇
5.1.3	GERD performed by business, % GDP	0.0	79	
5.1.4	GERD financed by business, %	3.9	87	
5.1.5	Females employed w/advanced degrees, % ◷	5.5	88	
5.2	**Innovation linkages**	**19.3**	**74**	
5.2.1	University/industry research collaboration†	38.5	79	
5.2.2	State of cluster development†	63.6	22	● ◆
5.2.3	GERD financed by abroad, % GDP	0.0	86	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	96	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	94	
5.3	**Knowledge absorption**	**21.6**	**94**	
5.3.1	Intellectual property payments, % total trade	0.4	71	
5.3.2	High-tech imports, % total trade	9.0	45	●
5.3.3	ICT services imports, % total trade	1.0	70	
5.3.4	FDI net inflows, % GDP	2.8	61	
5.3.5	Research talent, % in business enterprise	6.3	69	

		Score/Value	Rank	
6	**KNOWLEDGE & TECHNOLOGY OUTPUTS**	**19.7**	**65**	
6.1	**Knowledge creation**	**12.7**	**69**	
6.1.1	Patents by origin/bn PPP$ GDP	0.8	72	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	86	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	8.4	59	
6.1.5	Citable documents H-index	17.4	47	● ◆
6.2	**Knowledge impact**	**31.7**	**36**	● ◆
6.2.1	Growth rate of PPP$ GDP/worker, %	3.9	20	●
6.2.2	New businesses/th pop. 15-64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	21	● ◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.5	92	
6.2.5	High- and medium-high-tech manufacturing, % ◷	21.9	50	
6.3	**Knowledge diffusion**	**14.6**	**99**	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade	0.2	99	
6.3.3	ICT services exports, % total trade	1.2	77	
6.3.4	FDI net outflows, % GDP	0.1	103	

		Score/Value	Rank	
7	**CREATIVE OUTPUTS**	**13.4**	**101**	
7.1	**Intangible assets**	**19.2**	**95**	
7.1.1	Trademarks by origin/bn PPP$ GDP	16.3	98	
7.1.2	Global brand value, top 5,000, % GDP	4.2	71	
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.3	59	
7.1.4	ICTs & organizational model creation†	56.0	57	
7.2	**Creative goods and services**	**6.9**	**94**	
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15-69 ◷	0.6	96	○
7.2.3	Entertainment & Media market/th pop. 15-69	0.4	61	○ ◇
7.2.4	Printing and other media, % manufacturing ◷	0.5	85	
7.2.5	Creative goods exports, % total trade	0.9	45	●
7.3	**Online creativity**	**8.4**	**92**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	1.2	92	
7.3.2	Country-code TLDs/th pop. 15-69	0.0	123	○
7.3.3	Wikipedia edits/mn pop. 15-69	35.8	87	
7.3.4	Mobile app creation/bn PPP$ GDP	0.2	81	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

EL SALVADOR

GII 2020 rank

92

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
87	95	Lower middle	LCN	6.5	55.7	7,257.4	108

		Score/Value	Rank	
	INSTITUTIONS	**54.0**	**100**	
1.1	**Political environment**	**48.2**	**93**	
1.1.1	Political and operational stability*	64.3	83	
1.1.2	Government effectiveness*	40.2	96	
1.2	**Regulatory environment**	**51.8**	**100**	
1.2.1	Regulatory quality*	40.8	72	◆
1.2.2	Rule of law*	25.2	115	
1.2.3	Cost of redundancy dismissal, salary weeks	22.9	96	
1.3	**Business environment**	**62.1**	**96**	
1.3.1	Ease of starting a business*	78.6	111	
1.3.2	Ease of resolving insolvency*	45.6	83	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**16.4**	**105**	
2.1	**Education**	**26.5**	**115**	
2.1.1	Expenditure on education, % GDP	3.6	87	
2.1.2	Government funding/pupil, secondary, % GDP/cap	14.3	84	
2.1.3	School life expectancy, years	11.6	95	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	27.6	114	◇
2.2	**Tertiary education**	**21.8**	**89**	
2.2.1	Tertiary enrolment, % gross	29.4	82	
2.2.2	Graduates in science & engineering, %	21.4	59	
2.2.3	Tertiary inbound mobility, %	0.5	97	
2.3	**Research & development (R&D)**	**1.0**	**107**	
2.3.1	Researchers, FTE/mn pop. ⊙	63.7	91	
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.2	93	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**31.4**	**101**	
3.1	**Information & communication technologies (ICTs)**	**52.5**	**93**	
3.1.1	ICT access*	48.5	92	
3.1.2	ICT use*	33.7	103	
3.1.3	Government's online service*	62.5	90	
3.1.4	E-participation*	65.2	81	
3.2	**General infrastructure**	**15.4**	**118**	
3.2.1	Electricity output, kWh/mn pop.	857.1	99	
3.2.2	Logistics performance*	23.7	97	
3.2.3	Gross capital formation, % GDP	20.0	98	
3.3	**Ecological sustainability**	**26.3**	**77**	◆
3.3.1	GDP/unit of energy use	11.1	43	●
3.3.2	Environmental performance*	43.1	82	◆
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	97	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**46.7**	**71**	
4.1	**Credit**	**42.1**	**62**	
4.1.1	Ease of getting credit*	80.0	23	●
4.1.2	Domestic credit to private sector, % GDP	52.5	65	
4.1.3	Microfinance gross loans, % GDP	0.4	38	
4.2	**Investment**	**36.0**	**[69]**	
4.2.1	Ease of protecting minority investors*	36.0	116	◇
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**62.1**	**68**	
4.3.1	Applied tariff rate, weighted avg., %	1.9	55	◆
4.3.2	Intensity of local competition†	72.8	40	● ◆
4.3.3	Domestic market scale, bn PPP$	55.7	98	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**23.7**	**76**	
5.1	**Knowledge workers**	**28.7**	**71**	
5.1.1	Knowledge-intensive employment, %	12.8	100	
5.1.2	Firms offering formal training, % ⊙	53.8	12	● ◆
5.1.3	GERD performed by business, % GDP ⊙	0.1	69	
5.1.4	GERD financed by business, %	31.2	56	
5.1.5	Females employed w/advanced degrees, %	4.8	91	
5.2	**Innovation linkages**	**10.8**	**125**	○ ◇
5.2.1	University/industry research collaboration†	27.2	120	○ ◇
5.2.2	State of cluster development†	32.1	117	◇
5.2.3	GERD financed by abroad, % GDP	0.0	74	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	121	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**31.5**	**56**	
5.3.1	Intellectual property payments, % total trade	1.3	24	● ◆
5.3.2	High-tech imports, % total trade	9.0	46	●
5.3.3	ICT services imports, % total trade	0.5	102	
5.3.4	FDI net inflows, % GDP	1.9	86	
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**11.3**	**110**	
6.1	**Knowledge creation**	**1.1**	**131**	○ ◇
6.1.1	Patents by origin/bn PPP$ GDP	0.1	125	○
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	85	
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	61	
6.1.4	Scientific & technical articles/bn PPP$ GDP	0.5	128	○
6.1.5	Citable documents H-index	2.5	126	○
6.2	**Knowledge impact**	**5.0**	**[124]**	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	0.6	93	
6.2.3	Computer software spending, % GDP	0.0	103	◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.1	71	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**27.8**	**50**	●
6.3.1	Intellectual property receipts, % total trade	0.5	27	● ◆
6.3.2	High-tech net exports, % total trade	2.8	49	●
6.3.3	ICT services exports, % total trade	2.2	51	●
6.3.4	FDI net outflows, % GDP	-0.9	126	○ ◇

		Score/Value	Rank	
	CREATIVE OUTPUTS	**19.2**	**74**	
7.1	**Intangible assets**	**30.8**	**48**	●
7.1.1	Trademarks by origin/bn PPP$ GDP	75.6	25	●
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.4	90	
7.1.4	ICTs & organizational model creation†	42.7	103	
7.2	**Creative goods and services**	**5.6**	**[102]**	
7.2.1	Cultural & creative services exports, % total trade	0.0	107	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.7	57	
7.3	**Online creativity**	**9.6**	**85**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.4	73	◆
7.3.2	Country-code TLDs/th pop. 15–69	0.6	96	
7.3.3	Wikipedia edits/mn pop. 15–69	38.9	80	
7.3.4	Mobile app creation/bn PPP$ GDP ⊙	0.0	99	○

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

ESTONIA

GII 2020 rank

25

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
20	25	High	EUR	1.3	47.3	31,300.6	24

		Score/Value	Rank	
	INSTITUTIONS	**80.8**	**23**	
1.1	**Political environment**	**79.2**	**23**	
1.1.1	Political and operational stability*	83.9	21	
1.1.2	Government effectiveness*	76.8	25	
1.2	**Regulatory environment**	**85.7**	**18**	
1.2.1	Regulatory quality*	83.0	17	
1.2.2	Rule of law*	79.0	22	
1.2.3	Cost of redundancy dismissal, salary weeks	12.9	39	
1.3	**Business environment**	**77.7**	**41**	
1.3.1	Ease of starting a business*	95.4	13	
1.3.2	Ease of resolving insolvency*	60.1	49	
	HUMAN CAPITAL & RESEARCH	**42.3**	**34**	
2.1	**Education**	**54.6**	**39**	
2.1.1	Expenditure on education, % GDP 🕓	5.2	38	
2.1.2	Government funding/pupil, secondary, % GDP/cap	19.1	54	
2.1.3	School life expectancy, years	16.0	36	
2.1.4	PISA scales in reading, maths, & science	525.5	4	● ◆
2.1.5	Pupil-teacher ratio, secondary 🕓	9.2	24	
2.2	**Tertiary education**	**48.4**	**19**	
2.2.1	Tertiary enrolment, % gross	69.6	29	
2.2.2	Graduates in science & engineering, %	28.8	20	
2.2.3	Tertiary inbound mobility, %	8.2	27	
2.3	**Research & development (R&D)**	**23.9**	**43**	
2.3.1	Researchers, FTE/mn pop.	3,755.3	27	
2.3.2	Gross expenditure on R&D, % GDP	1.4	25	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	22.0	46	
	INFRASTRUCTURE	**61.2**	**5**	● ◆
3.1	**Information & communication technologies (ICTs)**	**86.0**	**20**	
3.1.1	ICT access*	81.2	24	
3.1.2	ICT use*	81.6	16	
3.1.3	Government's online service*	90.3	26	
3.1.4	E-participation*	91.0	27	
3.2	**General infrastructure**	**36.7**	**30**	
3.2.1	Electricity output, kWh/mn pop.	9,318.8	16	
3.2.2	Logistics performance*	58.3	35	
3.2.3	Gross capital formation, % GDP	26.9	38	
3.3	**Ecological sustainability**	**60.9**	**1**	● ◆
3.3.1	GDP/unit of energy use	6.9	90	○
3.3.2	Environmental performance*	65.3	30	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	12.5	1	● ◆
	MARKET SOPHISTICATION	**58.0**	**21**	
4.1	**Credit**	**48.3**	**41**	
4.1.1	Ease of getting credit*	70.0	44	
4.1.2	Domestic credit to private sector, % GDP	62.6	53	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**61.2**	**15**	◆
4.2.1	Ease of protecting minority investors*	58.0	77	○
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.4	8	◆
4.3	**Trade, competition, and market scale**	**64.5**	**52**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	79.7	10	
4.3.3	Domestic market scale, bn PPP$	47.3	101	○ ◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**38.1**	**30**	
5.1	**Knowledge workers**	**51.8**	**26**	
5.1.1	Knowledge-intensive employment, %	47.0	14	
5.1.2	Firms offering formal training, %	40.7	26	
5.1.3	GERD performed by business, % GDP	0.6	34	
5.1.4	GERD financed by business, %	43.6	38	
5.1.5	Females employed w/advanced degrees, %	26.4	7	● ◆
5.2	**Innovation linkages**	**29.9**	**34**	
5.2.1	University/industry research collaboration†	47.6	48	
5.2.2	State of cluster development†	43.9	82	○ ◇
5.2.3	GERD financed by abroad, % GDP	0.2	19	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	22	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.5	32	
5.3	**Knowledge absorption**	**32.7**	**50**	
5.3.1	Intellectual property payments, % total trade	0.3	79	○
5.3.2	High-tech imports, % total trade	9.7	37	
5.3.3	ICT services imports, % total trade	2.6	13	
5.3.4	FDI net inflows, % GDP	4.7	32	
5.3.5	Research talent, % in business enterprise	33.3	39	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**37.9**	**23**	
6.1	**Knowledge creation**	**29.6**	**33**	
6.1.1	Patents by origin/bn PPP$ GDP	1.6	50	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.8	29	
6.1.3	Utility models by origin/bn PPP$ GDP	0.6	33	
6.1.4	Scientific & technical articles/bn PPP$ GDP	30.7	9	◆
6.1.5	Citable documents H-index	17.0	49	
6.2	**Knowledge impact**	**42.4**	**13**	
6.2.1	Growth rate of PPP$ GDP/worker, %	3.2	24	◆
6.2.2	New businesses/th pop. 15–64	23.6	2	● ◆
6.2.3	Computer software spending, % GDP	0.0	80	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	23.4	6	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	17.8	60	○
6.3	**Knowledge diffusion**	**41.8**	**26**	
6.3.1	Intellectual property receipts, % total trade	0.1	63	○
6.3.2	High-tech net exports, % total trade	9.3	16	
6.3.3	ICT services exports, % total trade	4.0	21	
6.3.4	FDI net outflows, % GDP	1.0	54	
	CREATIVE OUTPUTS	**43.0**	**15**	
7.1	**Intangible assets**	**39.4**	**29**	
7.1.1	Trademarks by origin/bn PPP$ GDP	100.6	10	◆
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	5.4	24	
7.1.4	ICTs & organizational model creation†	79.3	5	● ◆
7.2	**Creative goods and services**	**36.5**	**18**	
7.2.1	Cultural & creative services exports, % total trade	1.8	8	●
7.2.2	National feature films/mn pop. 15–69	19.5	5	● ◆
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	2.0	16	
7.2.5	Creative goods exports, % total trade	1.1	41	
7.3	**Online creativity**	**56.6**	**14**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	9.9	40	
7.3.2	Country-code TLDs/th pop. 15–69	42.0	17	
7.3.3	Wikipedia edits/mn pop. 15–69	99.5	2	● ◆
7.3.4	Mobile app creation/bn PPP$ GDP	75.0	6	● ◆

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. 🕓 indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

ETHIOPIA

GII 2020 rank

127

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
110	130	Low	SSF	112.1	240.2	2,192.2	111

		Score/Value	Rank	
	INSTITUTIONS	**48.6**	**116**	
1.1	**Political environment**	**42.8**	**113**	
1.1.1	Political and operational stability*	55.4	116	
1.1.2	Government effectiveness*	36.6	108	
1.2	**Regulatory environment**	**51.9**	**99**	
1.2.1	Regulatory quality*	16.1	125	
1.2.2	Rule of law*	35.5	91	
1.2.3	Cost of redundancy dismissal, salary weeks	19.1	80	
1.3	**Business environment**	**51.0**	**126**	◇
1.3.1	Ease of starting a business*	71.7	121	◇
1.3.2	Ease of resolving insolvency*	30.3	119	◇

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**9.3**	**128**	
2.1	**Education**	**20.9**	**125**	
2.1.1	Expenditure on education, % GDP ⊙	4.7	52	●
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	16.8	69	
2.1.3	School life expectancy, years ⊙	8.4	116	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⊙	40.4	124	○ ◇
2.2	**Tertiary education**	**5.4**	**[124]**	
2.2.1	Tertiary enrolment, % gross ⊙	8.1	114	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**1.6**	**101**	
2.3.1	Researchers, FTE/mn pop. ⊙	90.5	89	◆
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.3	83	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**27.3**	**108**	
3.1	**Information & communication technologies (ICTs)**	**38.3**	**113**	
3.1.1	ICT access* ⊙	21.7	130	◇
3.1.2	ICT use* ⊙	10.9	128	
3.1.3	Government's online service*	63.2	88	◆
3.1.4	E-participation*	57.3	96	
3.2	**General infrastructure**	**29.8**	**52**	●
3.2.1	Electricity output, kWh/mn pop.	132.8	119	
3.2.2	Logistics performance*	n/a	n/a	
3.2.3	Gross capital formation, % GDP	38.5	11	●
3.3	**Ecological sustainability**	**13.9**	**127**	
3.3.1	GDP/unit of energy use	4.2	116	
3.3.2	Environmental performance*	34.4	105	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.0	131	○ ◇

		Score/Value	Rank	
	MARKET SOPHISTICATION	**19.6**	**131**	○ ◇
4.1	**Credit**	**10.1**	**128**	◇
4.1.1	Ease of getting credit*	15.0	127	◇
4.1.2	Domestic credit to private sector, % GDP	n/a	n/a	
4.1.3	Microfinance gross loans, % GDP	0.0	66	
4.2	**Investment**	**5.1**	**131**	○ ◇
4.2.1	Ease of protecting minority investors*	10.0	131	○ ◇
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	79	
4.3	**Trade, competition, and market scale**	**43.7**	**127**	
4.3.1	Applied tariff rate, weighted avg., %	12.1	125	◇
4.3.2	Intensity of local competition†	45.6	127	○ ◇
4.3.3	Domestic market scale, bn PPP$	240.2	61	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**17.1**	**120**	
5.1	**Knowledge workers**	**5.5**	**128**	◇
5.1.1	Knowledge-intensive employment, % ⊙	4.5	115	
5.1.2	Firms offering formal training, % ⊙	20.8	72	
5.1.3	GERD performed by business, % GDP ⊙	0.0	87	
5.1.4	GERD financed by business, %	1.5	95	
5.1.5	Females employed w/advanced degrees, % ⊙	0.3	119	
5.2	**Innovation linkages**	**15.3**	**110**	
5.2.1	University/industry research collaboration†	39.6	76	
5.2.2	State of cluster development†	37.7	105	
5.2.3	GERD financed by abroad, % GDP	0.1	49	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	103	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**30.5**	**60**	●
5.3.1	Intellectual property payments, % total trade ⊙	0.0	113	
5.3.2	High-tech imports, % total trade ⊙	22.2	6	● ◆
5.3.3	ICT services imports, % total trade ⊙	0.7	91	
5.3.4	FDI net inflows, % GDP	4.8	28	●
5.3.5	Research talent, % in business enterprise ⊙	2.2	76	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**14.7**	**87**	◆
6.1	**Knowledge creation**	**14.2**	**66**	◆
6.1.1	Patents by origin/bn PPP$ GDP	0.1	124	
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	1.8	12	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.5	82	
6.1.5	Citable documents H-index	8.2	84	◆
6.2	**Knowledge impact**	**18.3**	**88**	◆
6.2.1	Growth rate of PPP$ GDP/worker, %	4.9	10	● ◆
6.2.2	New businesses/th pop. 15–64	0.5	97	
6.2.3	Computer software spending, % GDP	0.0	125	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.2	128	◇
6.2.5	High- and medium-high-tech manufacturing, % ⊙	13.5	72	◆
6.3	**Knowledge diffusion**	**11.7**	**112**	
6.3.1	Intellectual property receipts, % total trade ⊙	0.0	105	
6.3.2	High-tech net exports, % total trade ⊙	0.1	115	
6.3.3	ICT services exports, % total trade ⊙	0.6	93	
6.3.4	FDI net outflows, % GDP	4.7	10	● ◆

		Score/Value	Rank	
	CREATIVE OUTPUTS	**8.8**	**119**	
7.1	**Intangible assets**	**13.2**	**119**	
7.1.1	Trademarks by origin/bn PPP$ GDP	2.5	126	○ ◇
7.1.2	Global brand value, top 5,000, % GDP	4.2	70	
7.1.3	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.4	ICTs & organizational model creation†	38.2	117	
7.2	**Creative goods and services**	**8.7**	**[83]**	
7.2.1	Cultural & creative services exports, % total trade	0.0	100	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing ⊙	1.8	20	● ◆
7.2.5	Creative goods exports, % total trade ⊙	0.0	116	
7.3	**Online creativity**	**0.0**	**131**	○ ◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.0	130	
7.3.2	Country-code TLDs/th pop. 15–69	0.0	131	○ ◇
7.3.3	Wikipedia edits/mn pop. 15–69	n/a	n/a	
7.3.4	Mobile app creation/bn PPP$ GDP	0.0	102	○ ◇

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

FINLAND

GII 2020 rank

7

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
8	**8**	**High**	**EUR**	**5.5**	**264.7**	**41,883.3**	**6**

		Score/Value	Rank	
	INSTITUTIONS	**93.5**	**2**	● ◆
1.1	**Political environment**	**92.2**	**3**	●
1.1.1	Political and operational stability*	87.5	11	
1.1.2	Government effectiveness*	94.5	3	● ◆
1.2	**Regulatory environment**	**95.1**	**5**	●
1.2.1	Regulatory quality*	88.9	7	
1.2.2	Rule of law*	100.0	1	● ◆
1.2.3	Cost of redundancy dismissal, salary weeks	10.1	31	
1.3	**Business environment**	**93.1**	**1**	● ◆
1.3.1	Ease of starting a business*	93.5	29	
1.3.2	Ease of resolving insolvency*	92.7	1	● ◆

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**61.5**	**4**	●
2.1	**Education**	**66.5**	**8**	◆
2.1.1	Expenditure on education, % GDP ◷	6.9	7	◆
2.1.2	Government funding/pupil, secondary, % GDP/cap	24.8	21	
2.1.3	School life expectancy, years	19.4	4	● ◆
2.1.4	PISA scales in reading, maths, & science	516.4	8	
2.1.5	Pupil-teacher ratio, secondary ◷	13.6	65	○
2.2	**Tertiary education**	**52.2**	**14**	
2.2.1	Tertiary enrolment, % gross	88.2	7	
2.2.2	Graduates in science & engineering, %	27.3	27	
2.2.3	Tertiary inbound mobility, %	8.2	28	
2.3	**Research & development (R&D)**	**65.7**	**10**	
2.3.1	Researchers, FTE/mn pop.	6,861.1	5	
2.3.2	Gross expenditure on R&D, % GDP	2.8	11	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	76.0	12	
2.3.4	QS university ranking, average score top 3*	48.6	19	

		Score/Value	Rank	
	INFRASTRUCTURE	**59.9**	**9**	
3.1	**Information & communication technologies (ICTs)**	**87.7**	**18**	
3.1.1	ICT access*	73.7	48	◇
3.1.2	ICT use*	80.4	19	
3.1.3	Government's online service*	96.5	8	
3.1.4	E-participation*	100.0	1	●
3.2	**General infrastructure**	**45.3**	**9**	
3.2.1	Electricity output, kWh/mn pop.	12,683.7	10	
3.2.2	Logistics performance*	89.1	10	
3.2.3	Gross capital formation, % GDP	23.8	61	
3.3	**Ecological sustainability**	**46.9**	**25**	
3.3.1	GDP/unit of energy use	6.6	95	○
3.3.2	Environmental performance*	78.9	7	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	5.7	17	◆

		Score/Value	Rank	
	MARKET SOPHISTICATION	**53.1**	**33**	
4.1	**Credit**	**50.9**	**31**	
4.1.1	Ease of getting credit*	60.0	74	○
4.1.2	Domestic credit to private sector, % GDP	94.8	27	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**44.1**	**36**	
4.2.1	Ease of protecting minority investors*	62.0	60	○
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	18	
4.3	**Trade, competition, and market scale**	**64.3**	**56**	◇
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	61.7	100	○ ◇
4.3.3	Domestic market scale, bn PPP$	264.7	60	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**59.9**	**8**	
5.1	**Knowledge workers**	**66.9**	**8**	
5.1.1	Knowledge-intensive employment, %	47.8	10	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	1.8	11	
5.1.4	GERD financed by business, %	58.0	14	
5.1.5	Females employed w/advanced degrees, %	27.6	5	◆
5.2	**Innovation linkages**	**68.5**	**3**	● ◆
5.2.1	University/industry research collaboration†	75.8	3	● ◆
5.2.2	State of cluster development†	64.0	20	
5.2.3	GERD financed by abroad, % GDP	0.3	8	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.2	9	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	6.0	7	
5.3	**Knowledge absorption**	**44.2**	**24**	
5.3.1	Intellectual property payments, % total trade	1.0	35	
5.3.2	High-tech imports, % total trade	7.7	64	○
5.3.3	ICT services imports, % total trade	4.1	2	● ◆
5.3.4	FDI net inflows, % GDP	2.2	76	○
5.3.5	Research talent, % in business enterprise	56.3	17	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**55.1**	**6**	
6.1	**Knowledge creation**	**64.2**	**9**	
6.1.1	Patents by origin/bn PPP$ GDP	12.1	7	
6.1.2	PCT patents by origin/bn PPP$ GDP	6.3	5	◆
6.1.3	Utility models by origin/bn PPP$ GDP	1.4	17	
6.1.4	Scientific & technical articles/bn PPP$ GDP	33.5	5	● ◆
6.1.5	Citable documents H-index	43.3	19	
6.2	**Knowledge impact**	**35.2**	**25**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.4	81	○
6.2.2	New businesses/th pop. 15-64	4.3	35	
6.2.3	Computer software spending, % GDP	0.0	17	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	9.8	27	
6.2.5	High- and medium-high-tech manufacturing, %	34.2	32	
6.3	**Knowledge diffusion**	**65.9**	**3**	● ◆
6.3.1	Intellectual property receipts, % total trade	3.4	1	● ◆
6.3.2	High-tech net exports, % total trade	4.2	39	
6.3.3	ICT services exports, % total trade	7.6	5	● ◆
6.3.4	FDI net outflows, % GDP	4.6	12	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**41.8**	**16**	
7.1	**Intangible assets**	**38.9**	**30**	
7.1.1	Trademarks by origin/bn PPP$ GDP	40.8	66	○
7.1.2	Global brand value, top 5,000, % GDP	81.8	25	
7.1.3	Industrial designs by origin/bn PPP$ GDP	3.5	36	
7.1.4	ICTs & organizational model creation†	80.4	3	● ◆
7.2	**Creative goods and services**	**24.4**	**37**	
7.2.1	Cultural & creative services exports, % total trade	0.8	35	
7.2.2	National feature films/mn pop. 15-69	10.7	17	
7.2.3	Entertainment & Media market/th pop. 15-69	58.8	11	
7.2.4	Printing and other media, % manufacturing	1.0	57	○
7.2.5	Creative goods exports, % total trade	0.5	62	
7.3	**Online creativity**	**65.2**	**8**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	28.9	21	
7.3.2	Country-code TLDs/th pop. 15-69	38.8	18	
7.3.3	Wikipedia edits/mn pop. 15-69	93.3	6	◆
7.3.4	Mobile app creation/bn PPP$ GDP	100.0	1	● ◆

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

FRANCE

GII 2020 rank

12

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
12	16	High	EUR	65.1	3,061.1	41,226.7	16

		Score/Value	Rank	
	INSTITUTIONS	**83.7**	**19**	
1.1	**Political environment**	**82.9**	**20**	
1.1.1	Political and operational stability*	82.1	29	
1.1.2	Government effectiveness*	83.2	16	
1.2	**Regulatory environment**	**84.3**	**20**	
1.2.1	Regulatory quality*	72.7	27	
1.2.2	Rule of law*	84.2	20	
1.2.3	Cost of redundancy dismissal, salary weeks	13.0	40	
1.3	**Business environment**	**83.9**	**22**	
1.3.1	Ease of starting a business*	93.1	35	
1.3.2	Ease of resolving insolvency*	74.6	24	
	HUMAN CAPITAL & RESEARCH	**56.2**	**13**	
2.1	**Education**	**58.7**	**15**	
2.1.1	Expenditure on education, % GDP	5.3	30	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	15.6	39	
2.1.4	PISA scales in reading, maths, & science	493.7	25	
2.1.5	Pupil-teacher ratio, secondary ⊙	12.9	60	○
2.2	**Tertiary education**	**45.4**	**24**	
2.2.1	Tertiary enrolment, % gross	65.6	37	
2.2.2	Graduates in science & engineering, % ⊙	25.6	33	
2.2.3	Tertiary inbound mobility, %	10.2	19	
2.3	**Research & development (R&D)**	**64.4**	**12**	
2.3.1	Researchers, FTE/mn pop	4,715.3	19	
2.3.2	Gross expenditure on R&D, % GDP	2.2	12	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	87.2	7	●
2.3.4	QS university ranking, average score top 3*	69.6	11	●
	INFRASTRUCTURE	**57.7**	**16**	
3.1	**Information & communication technologies (ICTs)**	**90.8**	**6**	●
3.1.1	ICT access*	85.7	10	●
3.1.2	ICT use*	82.8	14	
3.1.3	Government's online service*	97.9	4	●
3.1.4	E-participation*	96.6	13	
3.2	**General infrastructure**	**39.7**	**23**	
3.2.1	Electricity output, kWh/mn pop	8,558.1	19	
3.2.2	Logistics performance*	83.3	16	
3.2.3	Gross capital formation, % GDP	23.3	66	○
3.3	**Ecological sustainability**	**42.5**	**33**	
3.3.1	GDP/unit of energy use	10.5	48	○
3.3.2	Environmental performance*	80.0	5	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.0	42	
	MARKET SOPHISTICATION	**59.4**	**18**	
4.1	**Credit**	**48.2**	**42**	
4.1.1	Ease of getting credit*	50.0	94	○
4.1.2	Domestic credit to private sector, % GDP	104.7	23	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**48.8**	**27**	
4.2.1	Ease of protecting minority investors*	68.0	44	○
4.2.2	Market capitalization, % GDP	93.0	13	
4.2.3	Venture capital deals/bn PPP$ GDP	0.2	15	
4.3	**Trade, competition, and market scale**	**81.2**	**5**	●
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	○
4.3.2	Intensity of local competition†	80.0	8	●
4.3.3	Domestic market scale, bn PPP$	3,061.1	10	●

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**50.2**	**21**	
5.1	**Knowledge workers**	**60.6**	**14**	
5.1.1	Knowledge-intensive employment, %	45.6	16	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	1.4	15	
5.1.4	GERD financed by business, %	56.1	17	
5.1.5	Females employed w/advanced degrees, %	22.5	21	
5.2	**Innovation linkages**	**42.0**	**24**	
5.2.1	University/industry research collaboration†	58.5	26	◇
5.2.2	State of cluster development†	62.1	23	
5.2.3	GERD financed by abroad, % GDP	0.2	23	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	26	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	3.2	16	
5.3	**Knowledge absorption**	**48.1**	**19**	
5.3.1	Intellectual property payments, % total trade	1.8	15	
5.3.2	High-tech imports, % total trade	9.4	41	
5.3.3	ICT services imports, % total trade	2.2	22	
5.3.4	FDI net inflows, % GDP	1.6	93	○
5.3.5	Research talent, % in business enterprise	62.3	10	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**45.1**	**16**	
6.1	**Knowledge creation**	**46.8**	**18**	
6.1.1	Patents by origin/bn PPP$ GDP	8.3	13	
6.1.2	PCT patents by origin/bn PPP$ GDP	2.6	13	
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	57	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	16.4	36	
6.1.5	Citable documents H-index	79.3	5	● ◆
6.2	**Knowledge impact**	**39.4**	**20**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.7	68	○
6.2.2	New businesses/th pop. 15–64	4.8	31	
6.2.3	Computer software spending, % GDP	0.0	11	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.1	37	
6.2.5	High- and medium-high-tech manufacturing, %	47.2	12	
6.3	**Knowledge diffusion**	**49.1**	**13**	
6.3.1	Intellectual property receipts, % total trade	1.9	11	
6.3.2	High-tech net exports, % total trade	12.9	11	
6.3.3	ICT services exports, % total trade	2.3	48	
6.3.4	FDI net outflows, % GDP	3.2	20	
	CREATIVE OUTPUTS	**46.7**	**13**	
7.1	**Intangible assets**	**56.4**	**6**	●
7.1.1	Trademarks by origin/bn PPP$ GDP	103.9	9	●
7.1.2	Global brand value, top 5,000, % GDP	178.0	5	●
7.1.3	Industrial designs by origin/bn PPP$ GDP	6.3	21	
7.1.4	ICTs & organizational model creation†	70.9	19	
7.2	**Creative goods and services**	**28.4**	**31**	
7.2.1	Cultural & creative services exports, % total trade	1.3	19	
7.2.2	National feature films/mn pop. 15–69	6.8	33	
7.2.3	Entertainment & Media market/th pop. 15–69	53.3	15	
7.2.4	Printing and other media, % manufacturing	1.0	61	○
7.2.5	Creative goods exports, % total trade	1.7	32	
7.3	**Online creativity**	**45.6**	**25**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	40.5	18	
7.3.2	Country-code TLDs/th pop. 15–69	23.7	27	
7.3.3	Wikipedia edits/mn pop. 15–69	86.1	12	
7.3.4	Mobile app creation/bn PPP$ GDP	32.9	16	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

GEORGIA

GII 2020 rank

63

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
71	54	Upper middle	NAWA	4.0	45.4	10,674.9	48

		Score/Value	Rank	
	INSTITUTIONS	**75.1**	**36**	◆
1.1	**Political environment**	**66.4**	**44**	◆
1.1.1	Political and operational stability*	71.4	59	
1.1.2	Government effectiveness*	63.9	41	◆
1.2	**Regulatory environment**	**81.0**	**26**	◆
1.2.1	Regulatory quality*	71.4	28	◆
1.2.2	Rule of law*	55.2	48	◆
1.2.3	Cost of redundancy dismissal, salary weeks	8.6	16	●
1.3	**Business environment**	**77.9**	**40**	
1.3.1	Ease of starting a business*	99.6	2	● ◆
1.3.2	Ease of resolving insolvency*	56.2	59	
	HUMAN CAPITAL & RESEARCH	**31.6**	**61**	
2.1	**Education**	**47.0**	**62**	
2.1.1	Expenditure on education, % GDP ⊙	3.8	78	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	15.3	44	
2.1.4	PISA scales in reading, maths, & science	386.7	70	○
2.1.5	Pupil-teacher ratio, secondary	7.6	4	● ◆
2.2	**Tertiary education**	**42.0**	**38**	
2.2.1	Tertiary enrolment, % gross	63.9	41	
2.2.2	Graduates in science & engineering, %	24.6	40	
2.2.3	Tertiary inbound mobility, %	8.1	29	◆
2.3	**Research & development (R&D)**	**5.8**	**75**	
2.3.1	Researchers, FTE/mn pop.	1,463.8	45	
2.3.2	Gross expenditure on R&D, % GDP	0.3	80	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**37.4**	**81**	
3.1	**Information & communication technologies (ICTs)**	**64.8**	**71**	
3.1.1	ICT access*	70.4	60	
3.1.2	ICT use*	57.1	62	
3.1.3	Government's online service*	69.4	71	
3.1.4	E-participation*	62.4	85	
3.2	**General infrastructure**	**26.3**	**71**	
3.2.1	Electricity output, kWh/mn pop.	3,099.8	63	
3.2.2	Logistics performance*	17.5	111	○ ◇
3.2.3	Gross capital formation, % GDP	34.3	18	● ◆
3.3	**Ecological sustainability**	**21.2**	**93**	◇
3.3.1	GDP/unit of energy use	7.4	86	
3.3.2	Environmental performance*	41.3	86	◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.4	90	
	MARKET SOPHISTICATION	**51.8**	**39**	
4.1	**Credit**	**50.9**	**30**	◆
4.1.1	Ease of getting credit*	85.0	14	●
4.1.2	Domestic credit to private sector, % GDP	68.0	48	
4.1.3	Microfinance gross loans, % GDP	1.8	17	
4.2	**Investment**	**45.7**	**32**	
4.2.1	Ease of protecting minority investors*	84.0	7	● ◆
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	38	
4.3	**Trade, competition, and market scale**	**58.8**	**81**	
4.3.1	Applied tariff rate, weighted avg., % ⊙	0.7	6	●
4.3.2	Intensity of local competition†	62.7	95	
4.3.3	Domestic market scale, bn PPP$	45.4	105	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**23.5**	**79**	
5.1	**Knowledge workers**	**30.0**	**65**	
5.1.1	Knowledge-intensive employment, %	25.6	56	
5.1.2	Firms offering formal training, %	32.0	44	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	1.7	92	○ ◇
5.1.5	Females employed w/advanced degrees, %	18.5	33	
5.2	**Innovation linkages**	**16.2**	**102**	
5.2.1	University/industry research collaboration† ⊙	32.0	104	○
5.2.2	State of cluster development† ⊙	34.8	113	○ ◇
5.2.3	GERD financed by abroad, % GDP	0.0	61	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	39	◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	59	
5.3	**Knowledge absorption**	**24.3**	**82**	
5.3.1	Intellectual property payments, % total trade	0.3	84	
5.3.2	High-tech imports, % total trade	7.6	67	
5.3.3	ICT services imports, % total trade	0.9	84	
5.3.4	FDI net inflows, % GDP	9.9	10	● ◆
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**19.0**	**67**	
6.1	**Knowledge creation**	**19.5**	**52**	
6.1.1	Patents by origin/bn PPP$ GDP	2.4	34	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	56	
6.1.3	Utility models by origin/bn PPP$ GDP	1.2	19	
6.1.4	Scientific & technical articles/bn PPP$ GDP	13.3	42	
6.1.5	Citable documents H-index	10.8	72	
6.2	**Knowledge impact**	**25.0**	**63**	
6.2.1	Growth rate of PPP$ GDP/worker, %	5.2	7	● ◆
6.2.2	New businesses/th pop. 15-64	10.4	11	● ◆
6.2.3	Computer software spending, % GDP	0.0	88	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.1	60	
6.2.5	High- and medium-high-tech manufacturing, %	7.6	90	○
6.3	**Knowledge diffusion**	**12.5**	**105**	
6.3.1	Intellectual property receipts, % total trade	0.0	93	○
6.3.2	High-tech net exports, % total trade	0.3	93	
6.3.3	ICT services exports, % total trade	0.9	85	
6.3.4	FDI net outflows, % GDP	1.9	38	
	CREATIVE OUTPUTS	**20.3**	**68**	
7.1	**Intangible assets**	**25.1**	**73**	
7.1.1	Trademarks by origin/bn PPP$ GDP	65.1	31	
7.1.2	Global brand value, top 5,000, % GDP	9.1	62	
7.1.3	Industrial designs by origin/bn PPP$ GDP	4.8	25	
7.1.4	ICTs & organizational model creation†	43.6	101	○ ◇
7.2	**Creative goods and services**	**11.7**	**72**	
7.2.1	Cultural & creative services exports, % total trade	0.2	70	
7.2.2	National feature films/mn pop. 15-69	6.7	34	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	1.5	28	
7.2.5	Creative goods exports, % total trade	0.1	98	
7.3	**Online creativity**	**19.4**	**54**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	1.7	86	
7.3.2	Country-code TLDs/th pop. 15-69	3.9	58	
7.3.3	Wikipedia edits/mn pop. 15-69	70.7	37	◆
7.3.4	Mobile app creation/bn PPP$ GDP	3.0	62	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

GERMANY

GII 2020 rank

9

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
7	14	High	EUR	83.5	4,444.4	46,765.5	9

		Score/Value	Rank	
	INSTITUTIONS	**84.6**	**18**	
1.1	**Political environment**	**86.1**	**14**	
1.1.1	Political and operational stability*	85.7	17	
1.1.2	Government effectiveness*	86.3	13	
1.2	**Regulatory environment**	**80.9**	**28**	
1.2.1	Regulatory quality*	87.9	12	
1.2.2	Rule of law*	89.2	16	
1.2.3	Cost of redundancy dismissal, salary weeks	21.6	90	○ ◇
1.3	**Business environment**	**86.7**	**14**	
1.3.1	Ease of starting a business*	83.7	96	○ ◇
1.3.2	Ease of resolving insolvency*	89.8	4	● ◆
	HUMAN CAPITAL & RESEARCH	**61.1**	**5**	●
2.1	**Education**	**54.6**	**38**	
2.1.1	Expenditure on education, % GDP ◷	4.8	50	
2.1.2	Government funding/pupil, secondary, % GDP/cap	23.0	28	
2.1.3	School life expectancy, years	17.0	17	
2.1.4	PISA scales in reading, maths, & science	500.4	18	
2.1.5	Pupil-teacher ratio, secondary ◷	12.0	54	
2.2	**Tertiary education**	**56.1**	**6**	●
2.2.1	Tertiary enrolment, % gross	70.2	28	
2.2.2	Graduates in science & engineering, %	35.6	6	● ◆
2.2.3	Tertiary inbound mobility, %	8.4	25	
2.3	**Research & development (R&D)**	**72.7**	**7**	●
2.3.1	Researchers, FTE/mn pop.	5,211.9	15	
2.3.2	Gross expenditure on R&D, % GDP	3.1	7	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	95.6	2	● ◆
2.3.4	QS university ranking, average score top 3*	70.1	10	
	INFRASTRUCTURE	**58.0**	**12**	
3.1	**Information & communication technologies (ICTs)**	**88.5**	**15**	
3.1.1	ICT access*	88.5	7	●
3.1.2	ICT use*	80.3	20	
3.1.3	Government's online service*	93.1	17	
3.1.4	E-participation*	92.1	23	
3.2	**General infrastructure**	**42.1**	**19**	
3.2.1	Electricity output, kWh/mn pop.	7,764.6	27	
3.2.2	Logistics performance*	100.0	1	● ◆
3.2.3	Gross capital formation, % GDP	21.8	79	○
3.3	**Ecological sustainability**	**43.5**	**31**	
3.3.1	GDP/unit of energy use	12.3	32	
3.3.2	Environmental performance*	77.2	10	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.9	48	
	MARKET SOPHISTICATION	**56.1**	**24**	
4.1	**Credit**	**51.9**	**29**	
4.1.1	Ease of getting credit*	70.0	44	○
4.1.2	Domestic credit to private sector, % GDP	77.7	38	◇
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**35.1**	**75**	○ ◇
4.2.1	Ease of protecting minority investors*	62.0	60	○
4.2.2	Market capitalization, % GDP	51.9	31	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	23	
4.3	**Trade, competition, and market scale**	**81.2**	**6**	●
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	76.3	18	
4.3.3	Domestic market scale, bn PPP$	4,444.4	5	●

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**53.7**	**12**	
5.1	**Knowledge workers**	**65.0**	**11**	
5.1.1	Knowledge-intensive employment, %	45.2	17	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	2.2	7	
5.1.4	GERD financed by business, %	66.2	7	
5.1.5	Females employed w/advanced degrees, %	13.5	51	◇
5.2	**Innovation linkages**	**53.7**	**13**	
5.2.1	University/industry research collaboration†	70.7	8	
5.2.2	State of cluster development†	73.5	3	● ◆
5.2.3	GERD financed by abroad, % GDP	0.2	21	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	30	◇
5.2.5	Patent families 2+ offices/bn PPP$ GDP	5.6	9	
5.3	**Knowledge absorption**	**42.5**	**26**	
5.3.1	Intellectual property payments, % total trade	0.8	49	
5.3.2	High-tech imports, % total trade	9.9	34	
5.3.3	ICT services imports, % total trade	2.1	25	
5.3.4	FDI net inflows, % GDP	2.3	74	○
5.3.5	Research talent, % in business enterprise	60.4	15	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**51.7**	**10**	
6.1	**Knowledge creation**	**68.0**	**5**	●
6.1.1	Patents by origin/bn PPP$ GDP	16.9	1	● ◆
6.1.2	PCT patents by origin/bn PPP$ GDP	4.4	9	
6.1.3	Utility models by origin/bn PPP$ GDP	2.0	11	
6.1.4	Scientific & technical articles/bn PPP$ GDP	16.8	34	
6.1.5	Citable documents H-index	87.4	3	● ◆
6.2	**Knowledge impact**	**41.3**	**15**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.3	84	○
6.2.2	New businesses/th pop. 15–64	1.4	73	○
6.2.3	Computer software spending, % GDP	0.0	18	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	11.5	25	
6.2.5	High- and medium-high-tech manufacturing, %	56.5	7	
6.3	**Knowledge diffusion**	**45.8**	**17**	
6.3.1	Intellectual property receipts, % total trade	1.3	17	
6.3.2	High-tech net exports, % total trade	12.1	12	
6.3.3	ICT services exports, % total trade	2.3	44	
6.3.4	FDI net outflows, % GDP	3.6	16	
	CREATIVE OUTPUTS	**49.1**	**9**	
7.1	**Intangible assets**	**54.8**	**7**	●
7.1.1	Trademarks by origin/bn PPP$ GDP	61.1	33	
7.1.2	Global brand value, top 5,000, % GDP	143.4	11	
7.1.3	Industrial designs by origin/bn PPP$ GDP	13.7	7	◆
7.1.4	ICTs & organizational model creation†	78.0	8	
7.2	**Creative goods and services**	**27.6**	**33**	
7.2.1	Cultural & creative services exports, % total trade	0.9	31	
7.2.2	National feature films/mn pop. 15–69	4.0	49	○
7.2.3	Entertainment & Media market/th pop. 15–69	57.1	12	
7.2.4	Printing and other media, % manufacturing	1.0	56	○
7.2.5	Creative goods exports, % total trade	2.1	28	
7.3	**Online creativity**	**59.1**	**11**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	52.5	14	
7.3.2	Country-code TLDs/th pop. 15–69	84.5	6	● ◆
7.3.3	Wikipedia edits/mn pop. 15–69	86.4	11	
7.3.4	Mobile app creation/bn PPP$ GDP	13.7	35	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

GHANA

GII 2020 rank

108

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
93	**113**	**Lower middle**	**SSF**	**30.4**	**209.8**	**6,072.6**	**106**

		Score/Value	Rank	
	INSTITUTIONS	**46.3**	**121**	
1.1	**Political environment**	**52.9**	**83**	
1.1.1	Political and operational stability*	67.9	73	
1.1.2	Government effectiveness*	45.4	82	
1.2	**Regulatory environment**	**30.7**	**127**	◇
1.2.1	Regulatory quality*	39.7	79	
1.2.2	Rule of law*	48.5	59	◆
1.2.3	Cost of redundancy dismissal, salary weeks	49.8	126	○ ◇
1.3	**Business environment**	**55.2**	**118**	
1.3.1	Ease of starting a business*	85.0	89	
1.3.2	Ease of resolving insolvency*	25.4	127	
	HUMAN CAPITAL & RESEARCH	**17.2**	**104**	
2.1	**Education**	**36.0**	**92**	
2.1.1	Expenditure on education, % GDP	4.0	73	
2.1.2	Government funding/pupil, secondary, % GDP/cap ⏱	19.3	53	
2.1.3	School life expectancy, years	11.5	97	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	15.2	75	
2.2	**Tertiary education**	**13.7**	**108**	
2.2.1	Tertiary enrolment, % gross	15.7	98	
2.2.2	Graduates in science & engineering, %	16.4	86	
2.2.3	Tertiary inbound mobility, %	2.2	74	
2.3	**Research & development (R&D)**	**1.9**	**97**	
2.3.1	Researchers, FTE/mn pop. ⏱	38.0	98	
2.3.2	Gross expenditure on R&D, % GDP ⏱	0.4	72	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**32.5**	**96**	
3.1	**Information & communication technologies (ICTs)**	**55.6**	**87**	
3.1.1	ICT access*	46.2	97	
3.1.2	ICT use*	43.7	87	
3.1.3	Government's online service*	69.4	71	
3.1.4	E-participation*	62.9	83	
3.2	**General infrastructure**	**19.2**	**103**	
3.2.1	Electricity output, kWh/mn pop.	488.0	106	
3.2.2	Logistics performance*	23.2	101	
3.2.3	Gross capital formation, % GDP	25.8	44	●
3.3	**Ecological sustainability**	**22.7**	**87**	
3.3.1	GDP/unit of energy use	12.5	29	● ◆
3.3.2	Environmental performance*	27.6	124	◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	105	
	MARKET SOPHISTICATION	**37.1**	**111**	
4.1	**Credit**	**26.9**	**115**	
4.1.1	Ease of getting credit*	60.0	74	
4.1.2	Domestic credit to private sector, % GDP	11.7	124	◇
4.1.3	Microfinance gross loans, % GDP	0.6	32	●
4.2	**Investment**	**31.9**	**89**	
4.2.1	Ease of protecting minority investors*	60.0	71	
4.2.2	Market capitalization, % GDP ⏱	8.5	67	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**52.7**	**104**	
4.3.1	Applied tariff rate, weighted avg., %	10.3	117	◇
4.3.2	Intensity of local competition†	63.4	88	
4.3.3	Domestic market scale, bn PPP$	209.8	62	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**17.9**	**113**	
5.1	**Knowledge workers**	**15.1**	**109**	
5.1.1	Knowledge-intensive employment, % ⏱	12.2	102	
5.1.2	Firms offering formal training, % ⏱	40.1	29	●
5.1.3	GERD performed by business, % GDP ⏱	0.0	88	○ ◇
5.1.4	GERD financed by business, % ⏱	0.1	101	○ ◇
5.1.5	Females employed w/advanced degrees, % ⏱	3.5	96	
5.2	**Innovation linkages**	**21.5**	**61**	
5.2.1	University/industry research collaboration†	48.2	44	● ◆
5.2.2	State of cluster development†	49.5	50	
5.2.3	GERD financed by abroad, % GDP ⏱	0.1	33	●
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	90	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**17.1**	**[117]**	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports, % total trade	3.4	125	
5.3.3	ICT services imports, % total trade	n/a	n/a	
5.3.4	FDI net inflows, % GDP	5.5	22	●
5.3.5	Research talent, % in business enterprise ⏱	1.0	80	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**12.6**	**104**	
6.1	**Knowledge creation**	**4.4**	**112**	
6.1.1	Patents by origin/bn PPP$ GDP	0.1	122	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	0.0	70	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	4.4	94	
6.1.5	Citable documents H-index	8.6	83	
6.2	**Knowledge impact**	**16.8**	**93**	
6.2.1	Growth rate of PPP$ GDP/worker, %	4.3	17	●
6.2.2	New businesses/th pop. 15-64 ⏱	0.9	85	
6.2.3	Computer software spending, % GDP	0.0	123	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.4	123	◇
6.2.5	High- and medium-high-tech manufacturing, % ⏱	10.6	78	
6.3	**Knowledge diffusion**	**16.7**	**[86]**	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade	0.2	97	
6.3.3	ICT services exports, % total trade	n/a	n/a	
6.3.4	FDI net outflows, % GDP	0.1	110	
	CREATIVE OUTPUTS	**16.1**	**90**	
7.1	**Intangible assets**	**24.5**	**75**	
7.1.1	Trademarks by origin/bn PPP$ GDP	4.3	122	
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	4.1	29	●
7.1.4	ICTs & organizational model creation†	49.7	84	
7.2	**Creative goods and services**	**10.0**	**[77]**	
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15-69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing ⏱	1.6	25	●
7.2.5	Creative goods exports, % total trade	0.0	127	○
7.3	**Online creativity**	**5.2**	**108**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	0.6	104	
7.3.2	Country-code TLDs/th pop. 15-69	0.1	121	
7.3.3	Wikipedia edits/mn pop. 15-69	19.3	109	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⏱ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

GREECE

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
52	40	High	EUR	10.5	324.1	26,410.8	41

		Score/Value	Rank	
	INSTITUTIONS	**68.0**	**52**	◇
1.1	**Political environment**	**62.3**	**53**	◇
1.1.1	Political and operational stability*	71.4	59	◇
1.1.2	Government effectiveness*	57.7	51	◇
1.2	**Regulatory environment**	**67.2**	**59**	◇
1.2.1	Regulatory quality*	49.6	57	◇
1.2.2	Rule of law*	50.7	55	◇
1.2.3	Cost of redundancy dismissal, salary weeks	15.9	64	
1.3	**Business environment**	**74.6**	**53**	
1.3.1	Ease of starting a business*	96.0	11	● ◆
1.3.2	Ease of resolving insolvency*	53.1	66	
	HUMAN CAPITAL & RESEARCH	**49.9**	**20**	●
2.1	**Education**	**53.7**	**42**	
2.1.1	Expenditure on education, % GDP	3.9	77	
2.1.2	Government funding/pupil, secondary, % GDP/cap	22.4	32	
2.1.3	School life expectancy, years	19.1	5	● ◆
2.1.4	PISA scales in reading, maths, & science	453.5	43	
2.1.5	Pupil-teacher ratio, secondary ⊙	8.6	15	●
2.2	**Tertiary education**	**64.6**	**3**	● ◆
2.2.1	Tertiary enrolment, % gross	136.6	1	● ◆
2.2.2	Graduates in science & engineering, %	29.4	17	●
2.2.3	Tertiary inbound mobility, %	3.4	61	
2.3	**Research & development (R&D)**	**31.3**	**37**	
2.3.1	Researchers, FTE/mn pop	3,482.7	28	
2.3.2	Gross expenditure on R&D, % GDP	1.2	34	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	38.4	40	
2.3.4	QS university ranking, average score top 3*	21.6	47	
	INFRASTRUCTURE	**49.9**	**41**	
3.1	**Information & communication technologies (ICTs)**	**80.6**	**32**	
3.1.1	ICT access*	80.6	26	
3.1.2	ICT use*	72.4	36	
3.1.3	Government's online service*	81.9	41	
3.1.4	E-participation*	87.6	34	
3.2	**General infrastructure**	**22.0**	**87**	◇
3.2.1	Electricity output, kWh/mn pop	4,898.0	43	
3.2.2	Logistics performance*	53.2	41	
3.2.3	Gross capital formation, % GDP	13.9	122	○ ◇
3.3	**Ecological sustainability**	**46.9**	**26**	
3.3.1	GDP/unit of energy use	11.6	37	
3.3.2	Environmental performance*	69.1	25	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	4.5	21	●
	MARKET SOPHISTICATION	**46.0**	**75**	
4.1	**Credit**	**42.1**	**63**	
4.1.1	Ease of getting credit*	45.0	101	○ ◇
4.1.2	Domestic credit to private sector, % GDP	89.2	29	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**28.5**	**101**	○
4.2.1	Ease of protecting minority investors*	70.0	36	
4.2.2	Market capitalization, % GDP	20.5	58	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	41	
4.3	**Trade, competition, and market scale**	**67.6**	**43**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	67.9	69	
4.3.3	Domestic market scale, bn PPP$	324.1	55	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**26.4**	**62**	◇
5.1	**Knowledge workers**	**36.0**	**56**	
5.1.1	Knowledge-intensive employment, %	30.0	46	
5.1.2	Firms offering formal training, % ⊙	21.6	71	
5.1.3	GERD performed by business, % GDP	0.6	35	
5.1.4	GERD financed by business, %	42.6	41	
5.1.5	Females employed w/advanced degrees, %	18.0	35	
5.2	**Innovation linkages**	**18.8**	**80**	◇
5.2.1	University/industry research collaboration†	27.9	119	○ ◇
5.2.2	State of cluster development†	31.8	118	○ ◇
5.2.3	GERD financed by abroad, % GDP	0.2	24	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	62	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.3	38	
5.3	**Knowledge absorption**	**24.5**	**80**	◇
5.3.1	Intellectual property payments, % total trade	0.5	68	
5.3.2	High-tech imports, % total trade	5.5	104	○
5.3.3	ICT services imports, % total trade	1.1	66	
5.3.4	FDI net inflows, % GDP	1.6	94	
5.3.5	Research talent, % in business enterprise	27.4	45	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**27.3**	**47**	
6.1	**Knowledge creation**	**24.5**	**42**	
6.1.1	Patents by origin/bn PPP$ GDP	1.8	43	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.4	37	
6.1.3	Utility models by origin/bn PPP$ GDP	0.0	62	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	22.2	23	●
6.1.5	Citable documents H-index	32.7	29	
6.2	**Knowledge impact**	**35.0**	**26**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.0	91	○
6.2.2	New businesses/th pop. 15–64	1.4	71	
6.2.3	Computer software spending, % GDP	0.0	13	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	20.7	13	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	13.3	73	◇
6.3	**Knowledge diffusion**	**22.3**	**69**	
6.3.1	Intellectual property receipts, % total trade	0.1	53	
6.3.2	High-tech net exports, % total trade	2.1	53	
6.3.3	ICT services exports, % total trade	1.5	69	
6.3.4	FDI net outflows, % GDP	-0.2	122	○
	CREATIVE OUTPUTS	**23.8**	**59**	◇
7.1	**Intangible assets**	**22.1**	**87**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Global brand value, top 5,000, % GDP	3.3	73	◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	3.7	34	
7.1.4	ICTs & organizational model creation†	44.6	97	○ ◇
7.2	**Creative goods and services**	**23.4**	**43**	
7.2.1	Cultural & creative services exports, % total trade	0.8	32	
7.2.2	National feature films/mn pop. 15–69	11.5	14	●
7.2.3	Entertainment & Media market/th pop. 15–69	23.9	28	
7.2.4	Printing and other media, % manufacturing	1.2	39	
7.2.5	Creative goods exports, % total trade	1.3	39	
7.3	**Online creativity**	**27.4**	**38**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	12.8	35	
7.3.2	Country-code TLDs/th pop. 15–69	19.2	30	
7.3.3	Wikipedia edits/mn pop. 15–69	74.8	31	
7.3.4	Mobile app creation/bn PPP$ GDP	4.4	57	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

GUATEMALA

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
96	110	Upper middle	LCN	17.6	153.3	7,599.6	107

		Score/Value	Rank	
	INSTITUTIONS	**48.0**	**117**	◇
1.1	**Political environment**	**41.7**	**115**	◇
1.1.1	Political and operational stability*	55.4	116	◇
1.1.2	Government effectiveness*	34.9	115	◇
1.2	**Regulatory environment**	**45.2**	**114**	◇
1.2.1	Regulatory quality*	36.6	86	
1.2.2	Rule of law*	19.3	123	◇
1.2.3	Cost of redundancy dismissal, salary weeks	27.0	106	
1.3	**Business environment**	**57.2**	**113**	◇
1.3.1	Ease of starting a business*	86.8	77	
1.3.2	Ease of resolving insolvency*	27.6	124	◇
	HUMAN CAPITAL & RESEARCH	**10.8**	**123**	◇
2.1	**Education**	**24.3**	**118**	◇
2.1.1	Expenditure on education, % GDP	2.9	100	
2.1.2	Government funding/pupil, secondary, % GDP/cap	5.4	103	○ ◇
2.1.3	School life expectancy, years ⊙	10.8	102	◇
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	10.5	39	●
2.2	**Tertiary education**	**8.0**	**116**	◇
2.2.1	Tertiary enrolment, % gross ⊙	21.8	92	◇
2.2.2	Graduates in science & engineering, % ⊙	9.8	105	○ ◇
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**0.1**	**119**	
2.3.1	Researchers, FTE/mn pop. ⊙	14.1	106	○ ◇
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.0	114	○ ◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**25.9**	**113**	◇
3.1	**Information & communication technologies (ICTs)**	**50.8**	**95**	
3.1.1	ICT access*	47.8	93	◇
3.1.2	ICT use*	28.9	105	◇
3.1.3	Government's online service*	64.6	84	
3.1.4	E-participation*	61.8	89	
3.2	**General infrastructure**	**7.6**	**129**	◇
3.2.1	Electricity output, kWh/mn pop.	766.4	101	◇
3.2.2	Logistics performance*	16.2	114	◇
3.2.3	Gross capital formation, % GDP	11.9	124	○ ◇
3.3	**Ecological sustainability**	**19.3**	**107**	◇
3.3.1	GDP/unit of energy use	9.0	69	
3.3.2	Environmental performance*	31.8	115	◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	124	
	MARKET SOPHISTICATION	**45.5**	**79**	
4.1	**Credit**	**39.6**	**72**	
4.1.1	Ease of getting credit*	85.0	14	●
4.1.2	Domestic credit to private sector, % GDP	32.8	91	
4.1.3	Microfinance gross loans, % GDP	0.2	52	
4.2	**Investment**	**30.0**	**[94]**	
4.2.1	Ease of protecting minority investors*	30.0	121	◇
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**66.9**	**47**	●
4.3.1	Applied tariff rate, weighted avg., % ⊙	1.4	16	●
4.3.2	Intensity of local competition†	72.8	41	●
4.3.3	Domestic market scale, bn PPP$	153.3	73	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**22.6**	**82**	
5.1	**Knowledge workers**	**20.9**	**99**	
5.1.1	Knowledge-intensive employment, % ⊙	9.1	107	◇
5.1.2	Firms offering formal training, % ⊙	55.7	9	● ◆
5.1.3	GERD performed by business, % GDP ⊙	0.0	88	○ ◇
5.1.4	GERD financed by business, %	10.3	76	
5.1.5	Females employed w/advanced degrees, % ⊙	2.2	100	◇
5.2	**Innovation linkages**	**14.7**	**113**	
5.2.1	University/industry research collaboration†	37.7	85	
5.2.2	State of cluster development†	44.3	79	
5.2.3	GERD financed by abroad, % GDP ⊙	0.0	72	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	120	◇
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	91	
5.3	**Knowledge absorption**	**32.0**	**54**	●
5.3.1	Intellectual property payments, % total trade	1.1	33	●
5.3.2	High-tech imports, % total trade ⊙	10.0	30	●
5.3.3	ICT services imports, % total trade	0.9	79	
5.3.4	FDI net inflows, % GDP	1.5	102	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**10.2**	**116**	◇
6.1	**Knowledge creation**	**1.4**	**129**	◇
6.1.1	Patents by origin/bn PPP$ GDP	0.0	128	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	58	
6.1.4	Scientific & technical articles/bn PPP$ GDP	0.4	129	○ ◇
6.1.5	Citable documents H-index	4.6	111	
6.2	**Knowledge impact**	**9.8**	**118**	◇
6.2.1	Growth rate of PPP$ GDP/worker, %	-0.1	94	
6.2.2	New businesses/th pop. 15-64	0.5	96	
6.2.3	Computer software spending, % GDP	0.0	120	◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.3	95	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**19.3**	**82**	
6.3.1	Intellectual property receipts, % total trade	0.0	97	◇
6.3.2	High-tech net exports, % total trade ⊙	1.4	63	
6.3.3	ICT services exports, % total trade	1.4	72	
6.3.4	FDI net outflows, % GDP	0.1	109	
	CREATIVE OUTPUTS	**18.1**	**81**	
7.1	**Intangible assets**	**30.7**	**49**	●
7.1.1	Trademarks by origin/bn PPP$ GDP	44.7	57	●
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.2	98	
7.1.4	ICTs & organizational model creation†	57.0	56	●
7.2	**Creative goods and services**	**3.2**	**[111]**	
7.2.1	Cultural & creative services exports, % total trade	0.1	88	
7.2.2	National feature films/mn pop. 15-69 ⊙	1.2	82	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade ⊙	0.3	74	
7.3	**Online creativity**	**7.7**	**97**	◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	4.1	58	●
7.3.2	Country-code TLDs/th pop. 15-69	0.5	97	
7.3.3	Wikipedia edits/mn pop. 15-69	30.1	93	◇
7.3.4	Mobile app creation/bn PPP$ GDP	0.0	101	○

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

GUINEA

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
122	128	Low	SSF	12.8	33.3	2,131.2	125

		Score/Value	Rank	
	INSTITUTIONS	**52.2**	**105**	
1.1	**Political environment**	**38.0**	**124**	
1.1.1	Political and operational stability*	57.1	110	
1.1.2	Government effectiveness*	28.5	123	
1.2	**Regulatory environment**	**57.0**	**88**	
1.2.1	Regulatory quality*	21.3	117	
1.2.2	Rule of law*	15.1	128	◇
1.2.3	Cost of redundancy dismissal, salary weeks	10.1	30	●
1.3	**Business environment**	**61.5**	**102**	
1.3.1	Ease of starting a business*	84.5	94	
1.3.2	Ease of resolving insolvency*	38.6	103	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**6.1**	**131**	○ ◇
2.1	**Education**	**11.9**	**130**	○ ◇
2.1.1	Expenditure on education, % GDP	2.6	107	◇
2.1.2	Government funding/pupil, secondary, % GDP/cap 🕘	8.2	99	◇
2.1.3	School life expectancy, years 🕘	9.0	113	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary 🕘	33.1	120	
2.2	**Tertiary education**	**6.6**	**121**	
2.2.1	Tertiary enrolment, % gross 🕘	11.6	106	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, % 🕘	0.9	90	
2.3	**Research & development (R&D)**	**0.0**	**[121]**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**16.9**	**130**	○ ◇
3.1	**Information & communication technologies (ICTs)**	**27.9**	**124**	
3.1.1	ICT access*	31.0	121	
3.1.2	ICT use*	13.9	122	
3.1.3	Government's online service*	31.3	119	
3.1.4	E-participation*	35.4	116	
3.2	**General infrastructure**	**9.2**	**128**	◇
3.2.1	Electricity output, kWh/mn pop.	n/a	n/a	
3.2.2	Logistics performance*	6.1	122	○ ◇
3.2.3	Gross capital formation, % GDP	15.4	120	
3.3	**Ecological sustainability**	**13.6**	**128**	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	26.4	127	○ ◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	122	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**29.4**	**126**	
4.1	**Credit**	**13.3**	**127**	
4.1.1	Ease of getting credit*	30.0	122	
4.1.2	Domestic credit to private sector, % GDP 🕘	9.7	127	○
4.1.3	Microfinance gross loans, % GDP 🕘	0.2	50	●
4.2	**Investment**	**26.0**	**[110]**	
4.2.1	Ease of protecting minority investors*	26.0	125	◇
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**48.9**	**119**	
4.3.1	Applied tariff rate, weighted avg., %	11.3	122	
4.3.2	Intensity of local competition†	75.9	21	● ◆
4.3.3	Domestic market scale, bn PPP$	33.3	117	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**20.9**	**[93]**	
5.1	**Knowledge workers**	**13.8**	**[112]**	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % 🕘	16.0	85	◇
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, %	n/a	n/a	
5.2	**Innovation linkages**	**34.9**	**[30]**	
5.2.1	University/industry research collaboration†	68.5	13	● ◆
5.2.2	State of cluster development†	52.5	43	● ◆
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	74	● ◆
5.3	**Knowledge absorption**	**14.0**	**131**	○ ◇
5.3.1	Intellectual property payments, % total trade 🕘	0.0	111	
5.3.2	High-tech imports, % total trade 🕘	2.1	128	○ ◇
5.3.3	ICT services imports, % total trade 🕘	0.2	121	
5.3.4	FDI net inflows, % GDP	9.2	11	● ◆
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**4.0**	**131**	○ ◇
6.1	**Knowledge creation**	**1.4**	**128**	◇
6.1.1	Patents by origin/bn PPP$ GDP	0.0	129	○
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	1.3	121	◇
6.1.5	Citable documents H-index	2.5	126	◇
6.2	**Knowledge impact**	**1.6**	**[130]**	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15-64	0.4	102	
6.2.3	Computer software spending, % GDP	0.0	107	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.3	125	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**9.0**	**126**	◇
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade 🕘	0.1	108	
6.3.3	ICT services exports, % total trade 🕘	0.0	128	○ ◇
6.3.4	FDI net outflows, % GDP	0.1	106	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**15.0**	**95**	
7.1	**Intangible assets**	**25.8**	**72**	●
7.1.1	Trademarks by origin/bn PPP$ GDP	5.1	118	
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.3	60	●
7.1.4	ICTs & organizational model creation†	60.0	45	● ◆
7.2	**Creative goods and services**	**2.7**	**[112]**	
7.2.1	Cultural & creative services exports, % total trade 🕘	0.3	62	●
7.2.2	National feature films/mn pop. 15-69 🕘	0.9	88	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade 🕘	0.0	122	
7.3	**Online creativity**	**5.8**	**105**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	0.1	126	
7.3.2	Country-code TLDs/th pop. 15-69	0.0	129	○
7.3.3	Wikipedia edits/mn pop. 15-69	21.7	104	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. 🕘 indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

HONDURAS

GII 2020 rank

103

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
102	100	Lower middle	LCN	9.7	51.8	4,709.8	104

		Score/Value	Rank	
	INSTITUTIONS	**45.3**	**125**	○ ◇
1.1	**Political environment**	**43.8**	**108**	
1.1.1	Political and operational stability*	58.9	104	
1.1.2	Government effectiveness*	36.3	111	
1.2	**Regulatory environment**	**40.2**	**119**	
1.2.1	Regulatory quality*	29.4	103	
1.2.2	Rule of law*	20.0	120	◇
1.2.3	Cost of redundancy dismissal, salary weeks	30.3	118	
1.3	**Business environment**	**52.0**	**123**	○
1.3.1	Ease of starting a business*	71.4	123	○ ◇
1.3.2	Ease of resolving insolvency*	32.6	116	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**18.6**	**99**	
2.1	**Education**	**41.2**	**77**	
2.1.1	Expenditure on education, % GDP	6.1	14	● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap ◷	20.3	48	
2.1.3	School life expectancy, years	10.1	108	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ◷	16.7	80	
2.2	**Tertiary education**	**14.4**	**107**	
2.2.1	Tertiary enrolment, % gross	26.2	87	
2.2.2	Graduates in science & engineering, %	15.2	95	
2.2.3	Tertiary inbound mobility, %	0.9	88	
2.3	**Research & development (R&D)**	**0.2**	**116**	
2.3.1	Researchers, FTE/mn pop. ◷	34.7	99	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.0	112	○ ◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**27.2**	**109**	
3.1	**Information & communication technologies (ICTs)**	**42.2**	**104**	
3.1.1	ICT access*	39.5	105	
3.1.2	ICT use*	23.3	111	◇
3.1.3	Government's online service*	51.4	105	
3.1.4	E-participation*	54.5	99	
3.2	**General infrastructure**	**19.9**	**99**	
3.2.1	Electricity output, kWh/mn pop.	1,008.1	94	
3.2.2	Logistics performance*	25.1	89	
3.2.3	Gross capital formation, % GDP	25.5	49	●
3.3	**Ecological sustainability**	**19.4**	**106**	
3.3.1	GDP/unit of energy use	6.8	92	
3.3.2	Environmental performance*	37.8	96	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.4	87	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**49.6**	**56**	
4.1	**Credit**	**48.2**	**43**	●
4.1.1	Ease of getting credit*	80.0	23	●
4.1.2	Domestic credit to private sector, % GDP	62.7	52	●
4.1.3	Microfinance gross loans, % GDP	1.9	15	●
4.2	**Investment**	**42.0**	**[47]**	
4.2.1	Ease of protecting minority investors*	42.0	102	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**58.5**	**84**	
4.3.1	Applied tariff rate, weighted avg., %	3.4	70	
4.3.2	Intensity of local competition†	69.5	63	
4.3.3	Domestic market scale, bn PPP$	51.8	99	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**23.9**	**74**	
5.1	**Knowledge workers**	**26.6**	**80**	
5.1.1	Knowledge-intensive employment, %	13.0	99	
5.1.2	Firms offering formal training, % ◷	47.7	19	● ◆
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	10.4	75	
5.1.5	Females employed w/advanced degrees, %	4.0	94	
5.2	**Innovation linkages**	**16.8**	**96**	
5.2.1	University/industry research collaboration† ◷	37.9	84	
5.2.2	State of cluster development† ◷	46.0	72	
5.2.3	GERD financed by abroad, % GDP	0.0	94	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	53	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**28.3**	**65**	
5.3.1	Intellectual property payments, % total trade	0.7	58	
5.3.2	High-tech imports, % total trade ◷	7.6	68	
5.3.3	ICT services imports, % total trade	1.6	39	● ◆
5.3.4	FDI net inflows, % GDP	5.1	26	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**13.1**	**97**	
6.1	**Knowledge creation**	**1.5**	**127**	○
6.1.1	Patents by origin/bn PPP$ GDP	0.2	108	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	0.0	63	
6.1.4	Scientific & technical articles/bn PPP$ GDP	1.3	122	○
6.1.5	Citable documents H-index	2.6	125	○
6.2	**Knowledge impact**	**15.0**	**[101]**	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	60	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.4	68	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**22.7**	**67**	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade ◷	0.5	79	
6.3.3	ICT services exports, % total trade	2.5	43	●
6.3.4	FDI net outflows, % GDP	1.0	55	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**12.9**	**104**	
7.1	**Intangible assets**	**22.3**	**86**	
7.1.1	Trademarks by origin/bn PPP$ GDP	51.9	44	●
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.1	112	○
7.1.4	ICTs & organizational model creation†	55.3	59	
7.2	**Creative goods and services**	**2.0**	**[119]**	
7.2.1	Cultural & creative services exports, % total trade	0.0	102	
7.2.2	National feature films/mn pop. 15–69	2.0	68	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade ◷	0.1	107	
7.3	**Online creativity**	**4.9**	**110**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.5	107	
7.3.2	Country-code TLDs/th pop. 15–69	0.4	102	
7.3.3	Wikipedia edits/mn pop. 15–69	22.9	102	
7.3.4	Mobile app creation/bn PPP$ GDP	0.1	85	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

HONG KONG, CHINA

GII 2020 rank

11

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
16	7	High	SEAO	7.4	490.9	56,683.7	13

		Score/Value	Rank	
	INSTITUTIONS	**90.4**	**5**	
1.1	**Political environment**	**90.9**	**7**	
1.1.1	Political and operational stability*	87.5	11	
1.1.2	Government effectiveness*	92.7	4	
1.2	**Regulatory environment**	**98.2**	**1**	● ◆
1.2.1	Regulatory quality*	100.0	1	● ◆
1.2.2	Rule of law*	92.8	11	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	**Business environment**	**81.9**	**28**	
1.3.1	Ease of starting a business*	98.2	5	◆
1.3.2	Ease of resolving insolvency*	65.7	41	◇

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**47.6**	**23**	◇
2.1	**Education**	**51.1**	**48**	
2.1.1	Expenditure on education, % GDP	3.3	91	○ ◇
2.1.2	Government funding/pupil, secondary, % GDP/cap	22.0	37	
2.1.3	School life expectancy, years	16.9	18	
2.1.4	PISA scales in reading, maths, & science	530.7	3	● ◆
2.1.5	Pupil-teacher ratio, secondary	11.2	47	
2.2	**Tertiary education**	**55.4**	**9**	
2.2.1	Tertiary enrolment, % gross	76.9	22	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	12.5	15	
2.3	**Research & development (R&D)**	**36.4**	**30**	◇
2.3.1	Researchers, FTE/mn pop.	4,026.5	25	◇
2.3.2	Gross expenditure on R&D, % GDP	0.9	42	◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	80.1	5	

		Score/Value	Rank	
	INFRASTRUCTURE	**59.1**	**11**	
3.1	**Information & communication technologies (ICTs)**	**88.2**	**[17]**	
3.1.1	ICT access*	92.5	2	● ◆
3.1.2	ICT use*	84.0	11	
3.1.3	Government's online service*	n/a	n/a	
3.1.4	E-participation*	n/a	n/a	
3.2	**General infrastructure**	**34.2**	**36**	◇
3.2.1	Electricity output, kWh/mn pop.	5,010.4	41	
3.2.2	Logistics performance*	86.8	12	
3.2.3	Gross capital formation, % GDP	18.9	103	○ ◇
3.3	**Ecological sustainability**	**54.9**	**13**	◆
3.3.1	GDP/unit of energy use	28.6	1	● ◆
3.3.2	Environmental performance*	n/a	n/a	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.2	55	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**86.5**	**1**	● ◆
4.1	**Credit**	**87.5**	**2**	● ◆
4.1.1	Ease of getting credit*	75.0	34	
4.1.2	Domestic credit to private sector, % GDP	219.1	1	● ◆
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**93.6**	**1**	● ◆
4.2.1	Ease of protecting minority investors*	84.0	7	◆
4.2.2	Market capitalization, % GDP	1,107.2	1	● ◆
4.2.3	Venture capital deals/bn PPP$ GDP	0.5	4	◆
4.3	**Trade, competition, and market scale**	**78.5**	**10**	
4.3.1	Applied tariff rate, weighted avg., %	0.0	1	● ◆
4.3.2	Intensity of local competition†	85.6	2	● ◆
4.3.3	Domestic market scale, bn PPP$	490.9	42	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**45.4**	**24**	◇
5.1	**Knowledge workers**	**45.2**	**34**	◇
5.1.1	Knowledge-intensive employment, % ⓘ	39.0	30	◇
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	0.4	41	◇
5.1.4	GERD financed by business, %	49.3	29	
5.1.5	Females employed w/advanced degrees, % ⓘ	15.9	42	◇
5.2	**Innovation linkages**	**41.4**	**25**	◇
5.2.1	University/industry research collaboration†	65.8	18	
5.2.2	State of cluster development†	72.1	4	◆
5.2.3	GERD financed by abroad, % GDP	0.0	60	○ ◇
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.2	10	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.9	28	◇
5.3	**Knowledge absorption**	**49.6**	**14**	
5.3.1	Intellectual property payments, % total trade ⓘ	0.3	77	○ ◇
5.3.2	High-tech imports, % total trade	52.1	1	● ◆
5.3.3	ICT services imports, % total trade ⓘ	0.3	115	○ ◇
5.3.4	FDI net inflows, % GDP	34.1	2	● ◆
5.3.5	Research talent, % in business enterprise	35.6	36	◇

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**23.8**	**54**	◇
6.1	**Knowledge creation**	**20.9**	**[47]**	
6.1.1	Patents by origin/bn PPP$ GDP	0.7	77	○ ◇
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	1.1	21	
6.1.4	Scientific & technical articles/bn PPP$ GDP	n/a	n/a	
6.1.5	Citable documents H-index	36.5	26	
6.2	**Knowledge impact**	**31.0**	**38**	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.1	59	
6.2.2	New businesses/th pop. 15–64	28.6	1	● ◆
6.2.3	Computer software spending, % GDP	0.0	27	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.7	65	
6.2.5	High- and medium-high-tech manufacturing, %	8.6	87	○ ◇
6.3	**Knowledge diffusion**	**19.5**	**80**	○ ◇
6.3.1	Intellectual property receipts, % total trade ⓘ	0.1	56	◇
6.3.2	High-tech net exports, % total trade	0.1	111	○ ◇
6.3.3	ICT services exports, % total trade ⓘ	0.4	101	○ ◇
6.3.4	FDI net outflows, % GDP	24.7	1	● ◆

		Score/Value	Rank	
	CREATIVE OUTPUTS	**61.6**	**1**	● ◆
7.1	**Intangible assets**	**58.1**	**5**	◆
7.1.1	Trademarks by origin/bn PPP$ GDP	66.0	30	
7.1.2	Global brand value, top 5,000, % GDP	278.5	1	● ◆
7.1.3	Industrial designs by origin/bn PPP$ GDP	2.6	44	
7.1.4	ICTs & organizational model creation†	67.6	23	◇
7.2	**Creative goods and services**	**64.4**	**1**	● ◆
7.2.1	Cultural & creative services exports, % total trade	0.1	77	○ ◇
7.2.2	National feature films/mn pop. 15–69	9.3	22	
7.2.3	Entertainment & Media market/th pop. 15–69	51.7	16	
7.2.4	Printing and other media, % manufacturing	5.0	1	● ◆
7.2.5	Creative goods exports, % total trade	11.1	1	● ◆
7.3	**Online creativity**	**65.7**	**7**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	72.1	8	
7.3.2	Country-code TLDs/th pop. 15–69	12.6	37	◇
7.3.3	Wikipedia edits/mn pop. 15–69	87.6	10	
7.3.4	Mobile app creation/bn PPP$ GDP	91.0	5	◆

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⓘ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

HUNGARY

GII 2020 rank

35

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
32	37	High	EUR	9.7	332.2	29,723.4	33

		Score/Value	Rank	
	INSTITUTIONS	**71.3**	**43**	
1.1	**Political environment**	**68.1**	**41**	
1.1.1	Political and operational stability*	82.1	29	
1.1.2	Government effectiveness*	61.0	44	◇
1.2	**Regulatory environment**	**74.3**	**38**	
1.2.1	Regulatory quality*	57.7	42	
1.2.2	Rule of law*	61.1	40	
1.2.3	Cost of redundancy dismissal, salary weeks	13.4	48	
1.3	**Business environment**	**71.6**	**63**	
1.3.1	Ease of starting a business*	88.2	70	
1.3.2	Ease of resolving insolvency*	55.0	61	
	HUMAN CAPITAL & RESEARCH	**41.4**	**36**	
2.1	**Education**	**51.2**	**47**	
2.1.1	Expenditure on education, % GDP ⊙	4.7	55	
2.1.2	Government funding/pupil, secondary, % GDP/cap	23.1	27	
2.1.3	School life expectancy, years	15.2	46	
2.1.4	PISA scales in reading, maths, & science	479.3	33	
2.1.5	Pupil-teacher ratio, secondary ⊙	10.0	35	
2.2	**Tertiary education**	**37.7**	**52**	
2.2.1	Tertiary enrolment, % gross	48.5	62	◇
2.2.2	Graduates in science & engineering, %	23.3	50	
2.2.3	Tertiary inbound mobility, %	10.0	20	
2.3	**Research & development (R&D)**	**35.3**	**32**	
2.3.1	Researchers, FTE/mn pop.	3,237.7	29	
2.3.2	Gross expenditure on R&D, % GDP	1.6	22	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	50.9	29	
2.3.4	QS university ranking, average score top 3*	20.4	52	
	INFRASTRUCTURE	**52.4**	**34**	
3.1	**Information & communication technologies (ICTs)**	**71.5**	**54**	◇
3.1.1	ICT access*	75.8	40	
3.1.2	ICT use*	65.6	51	◇
3.1.3	Government's online service*	73.6	58	◇
3.1.4	E-participation*	70.8	68	◇
3.2	**General infrastructure**	**34.3**	**33**	
3.2.1	Electricity output, kWh/mn pop.	3,265.6	61	
3.2.2	Logistics performance*	63.3	30	
3.2.3	Gross capital formation, % GDP	29.4	28	
3.3	**Ecological sustainability**	**51.5**	**19**	●
3.3.1	GDP/unit of energy use	10.1	53	
3.3.2	Environmental performance*	63.7	33	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	7.7	10	● ◆
	MARKET SOPHISTICATION	**43.3**	**89**	◇
4.1	**Credit**	**44.0**	**55**	
4.1.1	Ease of getting credit*	75.0	34	
4.1.2	Domestic credit to private sector, % GDP	33.4	89	○ ◇
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**21.6**	**125**	○ ◇
4.2.1	Ease of protecting minority investors*	54.0	88	○ ◇
4.2.2	Market capitalization, % GDP	19.4	60	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	58	○
4.3	**Trade, competition, and market scale**	**64.2**	**57**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	59.3	110	○ ◇
4.3.3	Domestic market scale, bn PPP$	332.2	53	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**37.8**	**33**	
5.1	**Knowledge workers**	**40.9**	**44**	
5.1.1	Knowledge-intensive employment, %	34.4	38	
5.1.2	Firms offering formal training, % ⊙	15.8	86	○ ◇
5.1.3	GERD performed by business, % GDP	1.2	20	
5.1.4	GERD financed by business, %	52.7	21	
5.1.5	Females employed w/advanced degrees, %	15.1	44	
5.2	**Innovation linkages**	**24.5**	**51**	
5.2.1	University/industry research collaboration†	44.2	57	
5.2.2	State of cluster development†	47.2	65	
5.2.3	GERD financed by abroad, % GDP	0.2	18	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	86	○ ◇
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.3	36	
5.3	**Knowledge absorption**	**48.1**	**20**	
5.3.1	Intellectual property payments, % total trade	1.3	26	
5.3.2	High-tech imports, % total trade	13.7	15	●
5.3.3	ICT services imports, % total trade	1.3	56	
5.3.4	FDI net inflows, % GDP	1.6	96	○
5.3.5	Research talent, % in business enterprise	63.7	8	●
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**38.2**	**22**	
6.1	**Knowledge creation**	**23.2**	**44**	
6.1.1	Patents by origin/bn PPP$ GDP	1.7	46	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.5	33	
6.1.3	Utility models by origin/bn PPP$ GDP	0.7	32	
6.1.4	Scientific & technical articles/bn PPP$ GDP	16.4	35	
6.1.5	Citable documents H-index	29.2	33	
6.2	**Knowledge impact**	**46.8**	**8**	● ◆
6.2.1	Growth rate of PPP$ GDP/worker, %	2.7	32	◆
6.2.2	New businesses/th pop. 15–64	3.7	38	
6.2.3	Computer software spending, % GDP	0.0	38	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	21.3	11	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	54.7	9	● ◆
6.3	**Knowledge diffusion**	**44.6**	**20**	
6.3.1	Intellectual property receipts, % total trade	1.5	15	●
6.3.2	High-tech net exports, % total trade	13.8	10	● ◆
6.3.3	ICT services exports, % total trade	1.9	59	
6.3.4	FDI net outflows, % GDP	-0.5	124	○
	CREATIVE OUTPUTS	**29.4**	**46**	
7.1	**Intangible assets**	**23.6**	**80**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP	28.1	81	
7.1.2	Global brand value, top 5,000, % GDP	10.5	59	
7.1.3	Industrial designs by origin/bn PPP$ GDP	2.7	42	
7.1.4	ICTs & organizational model creation†	60.3	42	
7.2	**Creative goods and services**	**37.6**	**15**	●
7.2.1	Cultural & creative services exports, % total trade	0.6	40	
7.2.2	National feature films/mn pop. 15–69	5.2	43	
7.2.3	Entertainment & Media market/th pop. 15–69	14.5	33	◇
7.2.4	Printing and other media, % manufacturing	0.8	71	○
7.2.5	Creative goods exports, % total trade	6.4	9	● ◆
7.3	**Online creativity**	**32.7**	**33**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	10.2	39	
7.3.2	Country-code TLDs/th pop. 15–69	33.2	19	●
7.3.3	Wikipedia edits/mn pop. 15–69	82.9	18	●
7.3.4	Mobile app creation/bn PPP$ GDP	5.3	54	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

ICELAND

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
19	23	High	EUR	0.3	20.0	48,947.5	20

		Score/Value	Rank	
1	**INSTITUTIONS**	**86.6**	**14**	
1.1	**Political environment**	**85.6**	**15**	
1.1.1	Political and operational stability*	91.1	5	
1.1.2	Government effectiveness*	82.9	17	
1.2	**Regulatory environment**	**87.7**	**16**	
1.2.1	Regulatory quality*	79.2	19	
1.2.2	Rule of law*	91.5	13	
1.2.3	Cost of redundancy dismissal, salary weeks	13.0	41	
1.3	**Business environment**	**86.3**	**15**	
1.3.1	Ease of starting a business*	90.6	54	
1.3.2	Ease of resolving insolvency*	82.0	11	
2	**HUMAN CAPITAL & RESEARCH**	**46.1**	**28**	◇
2.1	**Education**	**64.6**	**11**	
2.1.1	Expenditure on education, % GDP ⊙	7.5	5	● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap	19.4	52	
2.1.3	School life expectancy, years	19.1	6	
2.1.4	PISA scales in reading, maths, & science	481.4	30	◇
2.1.5	Pupil-teacher ratio, secondary ⊙	9.9	33	
2.2	**Tertiary education**	**33.6**	**63**	◇
2.2.1	Tertiary enrolment, % gross	71.8	25	
2.2.2	Graduates in science & engineering, % ⊙	15.7	91	○ ◇
2.2.3	Tertiary inbound mobility, %	6.9	36	
2.3	**Research & development (R&D)**	**40.1**	**24**	◇
2.3.1	Researchers, FTE/mn pop.	6,088.3	8	
2.3.2	Gross expenditure on R&D, % GDP	2.0	16	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	46.3	32	◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
3	**INFRASTRUCTURE**	**52.8**	**31**	◇
3.1	**Information & communication technologies (ICTs)**	**80.5**	**33**	◇
3.1.1	ICT access*	91.6	3	● ◆
3.1.2	ICT use*	88.9	2	● ◆
3.1.3	Government's online service*	72.9	64	◇
3.1.4	E-participation*	68.5	74	◇
3.2	**General infrastructure**	**47.8**	**7**	
3.2.1	Electricity output, kWh/mn pop.	56,656.6	1	● ◆
3.2.2	Logistics performance*	54.2	39	◇
3.2.3	Gross capital formation, % GDP	20.7	91	○
3.3	**Ecological sustainability**	**30.0**	**62**	◇
3.3.1	GDP/unit of energy use	2.9	121	○ ◇
3.3.2	Environmental performance*	72.3	17	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.9	46	
4	**MARKET SOPHISTICATION**	**49.8**	**54**	◇
4.1	**Credit**	**47.8**	**45**	
4.1.1	Ease of getting credit*	55.0	88	○
4.1.2	Domestic credit to private sector, % GDP	92.2	28	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**44.8**	**34**	
4.2.1	Ease of protecting minority investors*	72.0	27	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	28	
4.3	**Trade, competition, and market scale**	**57.0**	**90**	◇
4.3.1	Applied tariff rate, weighted avg., % ⊙	1.6	19	
4.3.2	Intensity of local competition†	70.0	61	◇
4.3.3	Domestic market scale, bn PPP$	20.0	128	○ ◇

		Score/Value	Rank	
5	**BUSINESS SOPHISTICATION**	**51.1**	**18**	
5.1	**Knowledge workers**	**58.0**	**20**	
5.1.1	Knowledge-intensive employment, %	50.0	6	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	1.3	16	
5.1.4	GERD financed by business, %	40.2	45	◇
5.1.5	Females employed w/advanced degrees, %	26.2	9	
5.2	**Innovation linkages**	**67.2**	**4**	● ◆
5.2.1	University/industry research collaboration†	59.1	25	◇
5.2.2	State of cluster development†	52.2	44	◇
5.2.3	GERD financed by abroad, % GDP	0.4	4	● ◆
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.3	6	● ◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	5.2	10	
5.3	**Knowledge absorption**	**28.2**	**66**	◇
5.3.1	Intellectual property payments, % total trade	1.1	31	
5.3.2	High-tech imports, % total trade	6.1	96	○
5.3.3	ICT services imports, % total trade	2.5	16	
5.3.4	FDI net inflows, % GDP	-11.8	131	○ ◇
5.3.5	Research talent, % in business enterprise	42.7	32	◇
6	**KNOWLEDGE & TECHNOLOGY OUTPUTS**	**33.0**	**34**	◇
6.1	**Knowledge creation**	**48.0**	**16**	
6.1.1	Patents by origin/bn PPP$ GDP	4.6	24	
6.1.2	PCT patents by origin/bn PPP$ GDP	2.1	16	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	35.1	4	● ◆
6.1.5	Citable documents H-index	19.6	41	◇
6.2	**Knowledge impact**	**24.8**	**64**	◇
6.2.1	Growth rate of PPP$ GDP/worker, %	1.1	61	
6.2.2	New businesses/th pop. 15–64	9.9	17	
6.2.3	Computer software spending, % GDP	0.0	35	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.0	62	
6.2.5	High- and medium-high-tech manufacturing, %	15.4	65	◇
6.3	**Knowledge diffusion**	**26.2**	**54**	◇
6.3.1	Intellectual property receipts, % total trade	2.1	10	
6.3.2	High-tech net exports, % total trade	1.2	65	◇
6.3.3	ICT services exports, % total trade	2.6	39	
6.3.4	FDI net outflows, % GDP	-12.7	130	○ ◇
7	**CREATIVE OUTPUTS**	**49.3**	**8**	
7.1	**Intangible assets**	**48.9**	**14**	
7.1.1	Trademarks by origin/bn PPP$ GDP	100.1	12	
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP ⊙	0.8	76	
7.1.4	ICTs & organizational model creation†	75.5	13	
7.2	**Creative goods and services**	**29.5**	**28**	
7.2.1	Cultural & creative services exports, % total trade	0.6	42	
7.2.2	National feature films/mn pop. 15–69	55.3	1	● ◆
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	1.6	27	
7.2.5	Creative goods exports, % total trade	0.1	101	○ ◇
7.3	**Online creativity**	**70.1**	**3**	● ◆
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	100.0	1	● ◆
7.3.2	Country-code TLDs/th pop. 15–69	91.0	5	● ◆
7.3.3	Wikipedia edits/mn pop. 15–69	89.0	8	
7.3.4	Mobile app creation/bn PPP$ GDP	1.0	68	◇

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

INDIA

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
45	57	Lower middle	CSA	1,366.4	11,325.7	7,314.6	52

		Score/Value	Rank	
	INSTITUTIONS	**64.7**	**61**	◆
1.1	**Political environment**	**59.1**	**63**	◆
1.1.1	Political and operational stability*	64.3	83	
1.1.2	Government effectiveness*	56.5	55	◆
1.2	**Regulatory environment**	**63.4**	**70**	◆
1.2.1	Regulatory quality*	36.9	84	
1.2.2	Rule of law*	47.3	62	◆
1.2.3	Cost of redundancy dismissal, salary weeks	15.8	61	
1.3	**Business environment**	**71.8**	**62**	
1.3.1	Ease of starting a business*	81.6	105	
1.3.2	Ease of resolving insolvency*	62.0	47	◆
	HUMAN CAPITAL & RESEARCH	**31.6**	**60**	◆
2.1	**Education**	**29.6**	**107**	○
2.1.1	Expenditure on education, % GDP ⊙	3.8	79	
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	16.9	68	
2.1.3	School life expectancy, years	12.2	90	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	28.5	118	○ ◇
2.2	**Tertiary education**	**32.4**	**66**	
2.2.1	Tertiary enrolment, % gross	28.1	84	
2.2.2	Graduates in science & engineering, %	31.7	12	● ◆
2.2.3	Tertiary inbound mobility, %	0.1	108	○
2.3	**Research & development (R&D)**	**32.9**	**35**	◆
2.3.1	Researchers, FTE/mn pop	252.7	78	
2.3.2	Gross expenditure on R&D, % GDP	0.6	57	◆
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	69.7	16	● ◆
2.3.4	QS university ranking, average score top 3*	47.2	22	● ◆
	INFRASTRUCTURE	**38.1**	**75**	◆
3.1	**Information & communication technologies (ICTs)**	**63.3**	**74**	◆
3.1.1	ICT access*	37.9	108	○
3.1.2	ICT use*	24.7	108	○
3.1.3	Government's online service*	95.1	9	● ◆
3.1.4	E-participation*	95.5	15	● ◆
3.2	**General infrastructure**	**30.9**	**46**	◆
3.2.1	Electricity output, kWh/mn pop	1,144.2	92	
3.2.2	Logistics performance*	51.9	43	◆
3.2.3	Gross capital formation, % GDP	31.3	24	
3.3	**Ecological sustainability**	**20.2**	**98**	
3.3.1	GDP/unit of energy use	9.5	63	
3.3.2	Environmental performance*	27.6	124	○ ◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.7	70	
	MARKET SOPHISTICATION	**53.7**	**31**	◆
4.1	**Credit**	**43.0**	**60**	
4.1.1	Ease of getting credit*	80.0	23	
4.1.2	Domestic credit to private sector, % GDP	49.9	70	
4.1.3	Microfinance gross loans, % GDP	0.9	25	
4.2	**Investment**	**40.8**	**59**	
4.2.1	Ease of protecting minority investors*	80.0	13	● ◆
4.2.2	Market capitalization, % GDP	77.6	19	◆
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	39	◆
4.3	**Trade, competition, and market scale**	**77.2**	**15**	● ◆
4.3.1	Applied tariff rate, weighted avg., %	4.9	90	
4.3.2	Intensity of local competition†	67.6	70	
4.3.3	Domestic market scale, bn PPP$	11,325.7	3	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**29.4**	**55**	◆
5.1	**Knowledge workers**	**25.9**	**83**	
5.1.1	Knowledge-intensive employment, %	15.7	90	
5.1.2	Firms offering formal training, % ⊙	35.9	37	
5.1.3	GERD performed by business, % GDP	0.2	52	
5.1.4	GERD financed by business, %	36.8	48	◆
5.1.5	Females employed w/advanced degrees, %	2.2	101	○
5.2	**Innovation linkages**	**26.6**	**41**	◆
5.2.1	University/industry research collaboration†	47.7	45	◆
5.2.2	State of cluster development†	54.3	37	◆
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	47	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	47	◆
5.3	**Knowledge absorption**	**35.7**	**39**	◆
5.3.1	Intellectual property payments, % total trade	1.3	27	◆
5.3.2	High-tech imports, % total trade	10.1	29	
5.3.3	ICT services imports, % total trade	1.2	60	
5.3.4	FDI net inflows, % GDP	1.7	92	
5.3.5	Research talent, % in business enterprise	34.0	38	◆
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**34.7**	**27**	◆
6.1	**Knowledge creation**	**19.8**	**51**	
6.1.1	Patents by origin/bn PPP$ GDP	1.6	51	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.2	51	◆
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.8	76	
6.1.5	Citable documents H-index	40.4	21	● ◆
6.2	**Knowledge impact**	**30.4**	**41**	◆
6.2.1	Growth rate of PPP$ GDP/worker, %	5.0	9	●
6.2.2	New businesses/th pop. 15-64	0.1	115	○
6.2.3	Computer software spending, % GDP	0.0	64	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.0	72	
6.2.5	High- and medium-high-tech manufacturing, % ⊙	34.1	34	◆
6.3	**Knowledge diffusion**	**54.0**	**10**	● ◆
6.3.1	Intellectual property receipts, % total trade	0.1	50	
6.3.2	High-tech net exports, % total trade	3.4	42	
6.3.3	ICT services exports, % total trade	9.9	1	● ◆
6.3.4	FDI net outflows, % GDP	0.4	82	
	CREATIVE OUTPUTS	**20.6**	**64**	
7.1	**Intangible assets**	**27.3**	**67**	
7.1.1	Trademarks by origin/bn PPP$ GDP	28.4	80	
7.1.2	Global brand value, top 5,000, % GDP	61.5	31	◆
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.9	75	
7.1.4	ICTs & organizational model creation†	59.6	47	◆
7.2	**Creative goods and services**	**18.7**	**58**	
7.2.1	Cultural & creative services exports, % total trade	1.3	21	◆
7.2.2	National feature films/mn pop. 15-69 ⊙	2.2	63	
7.2.3	Entertainment & Media market/th pop. 15-69	0.8	60	○
7.2.4	Printing and other media, % manufacturing ⊙	0.6	81	○
7.2.5	Creative goods exports, % total trade	2.4	23	
7.3	**Online creativity**	**9.1**	**90**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	0.9	99	
7.3.2	Country-code TLDs/th pop. 15-69	0.7	94	
7.3.3	Wikipedia edits/mn pop. 15-69	28.1	98	○
7.3.4	Mobile app creation/bn PPP$ GDP	10.5	45	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

INDONESIA

GII 2020 rank

85

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
76	91	Lower middle	SEAO	270.6	3,737.5	12,220.8	85

		Score/Value	Rank	
1	**INSTITUTIONS**	**51.0**	**111**	
1.1	**Political environment**	**58.1**	**66**	◆
1.1.1	Political and operational stability*	66.1	76	
1.1.2	Government effectiveness*	54.2	61	◆
1.2	**Regulatory environment**	**20.3**	**130**	○ ◇
1.2.1	Regulatory quality*	39.9	77	◆
1.2.2	Rule of law*	38.5	81	
1.2.3	Cost of redundancy dismissal, salary weeks	57.8	128	○ ◇
1.3	**Business environment**	**74.6**	**52**	◆
1.3.1	Ease of starting a business*	81.2	108	
1.3.2	Ease of resolving insolvency*	68.1	35	● ◆

		Score/Value	Rank	
2	**HUMAN CAPITAL & RESEARCH**	**21.0**	**92**	
2.1	**Education**	**31.4**	**102**	
2.1.1	Expenditure on education, % GDP ◷	3.6	89	
2.1.2	Government funding/pupil, secondary, % GDP/cap ◷	10.5	93	○
2.1.3	School life expectancy, years	13.6	75	
2.1.4	PISA scales in reading, maths, & science	381.9	72	○
2.1.5	Pupil-teacher ratio, secondary	15.2	76	
2.2	**Tertiary education**	**21.3**	**92**	
2.2.1	Tertiary enrolment, % gross	36.3	73	
2.2.2	Graduates in science & engineering, %	19.4	75	
2.2.3	Tertiary inbound mobility, %	0.1	110	○
2.3	**Research & development (R&D)**	**10.2**	**58**	
2.3.1	Researchers, FTE/mn pop.	216.0	81	
2.3.2	Gross expenditure on R&D, % GDP	0.3	85	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	33.4	34	● ◆

		Score/Value	Rank	
3	**INFRASTRUCTURE**	**37.7**	**80**	◆
3.1	**Information & communication technologies (ICTs)**	**54.2**	**89**	
3.1.1	ICT access*	53.7	85	
3.1.2	ICT use*	44.2	85	
3.1.3	Government's online service*	56.9	93	
3.1.4	E-participation*	61.8	89	
3.2	**General infrastructure**	**32.8**	**40**	◆
3.2.1	Electricity output, kWh/mn pop.	965.4	95	
3.2.2	Logistics performance*	50.7	45	◆
3.2.3	Gross capital formation, % GDP	34.5	17	●
3.3	**Ecological sustainability**	**26.2**	**78**	◆
3.3.1	GDP/unit of energy use	11.9	34	◆
3.3.2	Environmental performance*	37.8	96	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.6	79	

		Score/Value	Rank	
4	**MARKET SOPHISTICATION**	**48.1**	**62**	
4.1	**Credit**	**34.3**	**93**	
4.1.1	Ease of getting credit*	70.0	44	
4.1.2	Domestic credit to private sector, % GDP	38.8	82	
4.1.3	Microfinance gross loans, % GDP	0.0	67	
4.2	**Investment**	**31.3**	**93**	
4.2.1	Ease of protecting minority investors*	70.0	36	
4.2.2	Market capitalization, % GDP	47.9	33	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	59	
4.3	**Trade, competition, and market scale**	**78.8**	**8**	● ◆
4.3.1	Applied tariff rate, weighted avg., %	2.0	57	◆
4.3.2	Intensity of local competition†	73.2	37	◆
4.3.3	Domestic market scale, bn PPP$	3,737.5	7	● ◆

		Score/Value	Rank	
5	**BUSINESS SOPHISTICATION**	**17.8**	**114**	
5.1	**Knowledge workers**	**8.9**	**125**	○ ◇
5.1.1	Knowledge-intensive employment, %	14.5	92	
5.1.2	Firms offering formal training, % ◷	7.7	94	○ ◇
5.1.3	GERD performed by business, % GDP	0.0	81	
5.1.4	GERD financed by business, %	6.8	81	
5.1.5	Females employed w/advanced degrees, %	5.9	85	
5.2	**Innovation linkages**	**19.6**	**71**	
5.2.1	University/industry research collaboration†	53.5	33	● ◆
5.2.2	State of cluster development†	59.4	26	● ◆
5.2.3	GERD financed by abroad, % GDP	0.0	97	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	108	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	100	
5.3	**Knowledge absorption**	**24.9**	**78**	
5.3.1	Intellectual property payments, % total trade	0.9	38	◆
5.3.2	High-tech imports, % total trade	8.9	47	
5.3.3	ICT services imports, % total trade	1.4	50	
5.3.4	FDI net inflows, % GDP	1.5	101	
5.3.5	Research talent, % in business enterprise	7.5	66	

		Score/Value	Rank	
6	**KNOWLEDGE & TECHNOLOGY OUTPUTS**	**17.9**	**71**	
6.1	**Knowledge creation**	**5.7**	**101**	
6.1.1	Patents by origin/bn PPP$ GDP	0.4	85	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	98	
6.1.3	Utility models by origin/bn PPP$ GDP	0.4	38	
6.1.4	Scientific & technical articles/bn PPP$ GDP	0.7	126	○
6.1.5	Citable documents H-index	14.0	56	
6.2	**Knowledge impact**	**27.0**	**55**	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.9	30	●
6.2.2	New businesses/th pop. 15–64 ◷	0.3	106	
6.2.3	Computer software spending, % GDP	0.0	32	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.6	88	
6.2.5	High- and medium-high-tech manufacturing, % ◷	29.6	38	◆
6.3	**Knowledge diffusion**	**21.1**	**72**	
6.3.1	Intellectual property receipts, % total trade	0.0	76	
6.3.2	High-tech net exports, % total trade	3.0	45	
6.3.3	ICT services exports, % total trade	0.6	94	
6.3.4	FDI net outflows, % GDP	-0.1	121	○

		Score/Value	Rank	
7	**CREATIVE OUTPUTS**	**17.8**	**83**	
7.1	**Intangible assets**	**24.7**	**74**	
7.1.1	Trademarks by origin/bn PPP$ GDP	16.8	97	
7.1.2	Global brand value, top 5,000, % GDP	35.8	42	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.7	78	
7.1.4	ICTs & organizational model creation†	65.4	27	● ◆
7.2	**Creative goods and services**	**12.9**	**69**	
7.2.1	Cultural & creative services exports, % total trade ◷	0.0	98	
7.2.2	National feature films/mn pop. 15–69	0.6	97	○
7.2.3	Entertainment & Media market/th pop. 15–69	2.4	51	◆
7.2.4	Printing and other media, % manufacturing ◷	0.8	74	
7.2.5	Creative goods exports, % total trade	2.3	25	●
7.3	**Online creativity**	**8.6**	**91**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.5	89	
7.3.2	Country-code TLDs/th pop. 15–69	0.6	95	
7.3.3	Wikipedia edits/mn pop. 15–69	31.7	92	
7.3.4	Mobile app creation/bn PPP$ GDP	4.6	56	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

IRAN (ISLAMIC REPUBLIC OF)

GII 2020 rank

67

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
50	90	Upper middle	CSA	82.9	1,470.7	15,419.0	61

		Score/Value	Rank	
	INSTITUTIONS	**46.6**	**120**	○ ◇
1.1	**Political environment**	**44.3**	**106**	◇
1.1.1	Political and operational stability*	51.8	123	○ ◇
1.1.2	Government effectiveness*	40.5	94	◇
1.2	**Regulatory environment**	**44.1**	**117**	◇
1.2.1	Regulatory quality*	7.6	129	○ ◇
1.2.2	Rule of law*	28.6	108	◇
1.2.3	Cost of redundancy dismissal, salary weeks	23.1	97	
1.3	**Business environment**	**51.4**	**125**	○ ◇
1.3.1	Ease of starting a business*	67.8	128	○ ◇
1.3.2	Ease of resolving insolvency*	35.1	111	◇
	HUMAN CAPITAL & RESEARCH	**36.6**	**46**	
2.1	**Education**	**39.3**	**83**	
2.1.1	Expenditure on education, % GDP	4.0	74	
2.1.2	Government funding/pupil, secondary, % GDP/cap	17.5	65	
2.1.3	School life expectancy, years	14.8	55	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ◷	19.0	94	
2.2	**Tertiary education**	**55.9**	**7**	● ◆
2.2.1	Tertiary enrolment, % gross	68.1	31	●
2.2.2	Graduates in science & engineering, %	42.1	3	● ◆
2.2.3	Tertiary inbound mobility, %	0.5	96	◇
2.3	**Research & development (R&D)**	**14.5**	**48**	
2.3.1	Researchers, FTE/mn pop. ◷	1,474.9	44	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.8	44	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	24.0	44	
	INFRASTRUCTURE	**39.7**	**69**	
3.1	**Information & communication technologies (ICTs)**	**61.1**	**80**	
3.1.1	ICT access*	75.9	39	● ◆
3.1.2	ICT use*	52.7	73	
3.1.3	Government's online service*	63.2	88	
3.1.4	E-participation*	52.8	103	
3.2	**General infrastructure**	**36.5**	**31**	● ◆
3.2.1	Electricity output, kWh/mn pop.	3,794.6	53	
3.2.2	Logistics performance*	36.7	63	
3.2.3	Gross capital formation, % GDP	40.8	10	● ◆
3.3	**Ecological sustainability**	**21.3**	**92**	◇
3.3.1	GDP/unit of energy use	5.8	104	◇
3.3.2	Environmental performance*	48.0	61	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.4	92	
	MARKET SOPHISTICATION	**38.8**	**108**	◇
4.1	**Credit**	**39.2**	**77**	
4.1.1	Ease of getting credit*	50.0	94	
4.1.2	Domestic credit to private sector, % GDP ◷	66.1	50	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**25.5**	**115**	
4.2.1	Ease of protecting minority investors*	40.0	110	◇
4.2.2	Market capitalization, % GDP ◷	24.6	52	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**51.8**	**107**	◇
4.3.1	Applied tariff rate, weighted avg., % ◷	15.2	129	○ ◇
4.3.2	Intensity of local competition†	58.0	113	◇
4.3.3	Domestic market scale, bn PPP$	1,470.7	18	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**17.9**	**112**	◇
5.1	**Knowledge workers**	**17.5**	**[103]**	
5.1.1	Knowledge-intensive employment, %	19.8	77	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP ◷	0.2	50	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, %	n/a	n/a	
5.2	**Innovation linkages**	**16.4**	**100**	
5.2.1	University/industry research collaboration†	28.7	117	○ ◇
5.2.2	State of cluster development†	42.1	88	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	122	○ ◇
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	64	
5.3	**Knowledge absorption**	**19.8**	**99**	
5.3.1	Intellectual property payments, % total trade ◷	0.2	94	
5.3.2	High-tech imports, % total trade ◷	6.2	92	
5.3.3	ICT services imports, % total trade ◷	0.5	101	
5.3.4	FDI net inflows, % GDP ◷	0.8	119	◇
5.3.5	Research talent, % in business enterprise ◷	19.2	56	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**23.0**	**59**	
6.1	**Knowledge creation**	**39.3**	**25**	● ◆
6.1.1	Patents by origin/bn PPP$ GDP	7.5	14	● ◆
6.1.2	PCT patents by origin/bn PPP$ GDP	0.2	53	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	23.5	21	● ◆
6.1.5	Citable documents H-index	19.7	40	
6.2	**Knowledge impact**	**18.3**	**86**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-3.0	115	○ ◇
6.2.2	New businesses/th pop. 15–64	0.4	101	
6.2.3	Computer software spending, % GDP	0.0	58	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.3	96	
6.2.5	High- and medium-high-tech manufacturing, % ◷	38.5	26	● ◆
6.3	**Knowledge diffusion**	**11.4**	**117**	◇
6.3.1	Intellectual property receipts, % total trade ◷	0.0	86	
6.3.2	High-tech net exports, % total trade ◷	0.3	90	
6.3.3	ICT services exports, % total trade ◷	0.6	92	
6.3.4	FDI net outflows, % GDP ◷	0.8	60	
	CREATIVE OUTPUTS	**28.7**	**48**	
7.1	**Intangible assets**	**49.1**	**13**	● ◆
7.1.1	Trademarks by origin/bn PPP$ GDP	222.0	1	● ◆
7.1.2	Global brand value, top 5,000, % GDP	1.9	78	
7.1.3	Industrial designs by origin/bn PPP$ GDP	9.2	14	● ◆
7.1.4	ICTs & organizational model creation†	47.4	92	
7.2	**Creative goods and services**	**2.5**	**114**	◇
7.2.1	Cultural & creative services exports, % total trade ◷	0.1	74	
7.2.2	National feature films/mn pop. 15–69	1.7	74	
7.2.3	Entertainment & Media market/th pop. 15–69	2.1	53	◇
7.2.4	Printing and other media, % manufacturing ◷	0.3	96	○ ◇
7.2.5	Creative goods exports, % total trade ◷	0.0	119	○
7.3	**Online creativity**	**14.1**	**71**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.8	80	
7.3.2	Country-code TLDs/th pop. 15–69	6.1	46	
7.3.3	Wikipedia edits/mn pop. 15–69	50.8	59	
7.3.4	Mobile app creation/bn PPP$ GDP	0.5	72	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

IRELAND

GII 2020 rank

15

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
11	20	High	EUR	4.9	412.8	72,810.0	12

		Score/Value	Rank	
	INSTITUTIONS	**85.3**	**17**	
1.1	**Political environment**	**83.2**	**19**	
1.1.1	Political and operational stability*	85.7	17	
1.1.2	Government effectiveness*	81.9	20	
1.2	**Regulatory environment**	**85.9**	**17**	
1.2.1	Regulatory quality*	83.9	15	
1.2.2	Rule of law*	84.8	18	
1.2.3	Cost of redundancy dismissal, salary weeks	14.3	54	
1.3	**Business environment**	**86.8**	**13**	
1.3.1	Ease of starting a business*	94.4	21	
1.3.2	Ease of resolving insolvency*	79.2	18	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**48.5**	**22**	◇
2.1	**Education**	**45.5**	**67**	○ ◇
2.1.1	Expenditure on education, % GDP ⊙	3.7	84	○ ◇
2.1.2	Government funding/pupil, secondary, % GDP/cap	15.8	73	○ ◇
2.1.3	School life expectancy, years	18.7	9	●
2.1.4	PISA scales in reading, maths, & science	504.6	10	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	**Tertiary education**	**47.5**	**22**	
2.2.1	Tertiary enrolment, % gross	77.8	21	
2.2.2	Graduates in science & engineering, % ⊙	25.2	37	
2.2.3	Tertiary inbound mobility, %	8.9	23	
2.3	**Research & development (R&D)**	**52.5**	**20**	
2.3.1	Researchers, FTE/mn pop.	5,243.1	14	
2.3.2	Gross expenditure on R&D, % GDP	1.1	35	◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	77.2	11	
2.3.4	QS university ranking, average score top 3*	47.0	23	

		Score/Value	Rank	
	INFRASTRUCTURE	**59.2**	**10**	
3.1	**Information & communication technologies (ICTs)**	**83.8**	**23**	
3.1.1	ICT access*	81.2	25	
3.1.2	ICT use*	78.0	24	
3.1.3	Government's online service*	82.6	39	◇
3.1.4	E-participation*	93.3	22	
3.2	**General infrastructure**	**34.3**	**34**	◇
3.2.1	Electricity output, kWh/mn pop.	6,314.5	33	
3.2.2	Logistics performance*	67.6	28	◇
3.2.3	Gross capital formation, % GDP	24.1	58	○
3.3	**Ecological sustainability**	**59.6**	**5**	● ◆
3.3.1	GDP/unit of energy use	25.0	2	● ◆
3.3.2	Environmental performance*	72.8	16	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.5	32	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**52.5**	**35**	◇
4.1	**Credit**	**43.3**	**58**	◇
4.1.1	Ease of getting credit*	70.0	44	
4.1.2	Domestic credit to private sector, % GDP	41.1	79	○ ◇
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**45.1**	**33**	
4.2.1	Ease of protecting minority investors*	80.0	13	
4.2.2	Market capitalization, % GDP	37.5	40	○ ◇
4.2.3	Venture capital deals/bn PPP$ GDP	0.2	13	
4.3	**Trade, competition, and market scale**	**69.1**	**34**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	69.4	64	○ ◇
4.3.3	Domestic market scale, bn PPP$	412.8	46	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**53.1**	**14**	
5.1	**Knowledge workers**	**55.8**	**23**	
5.1.1	Knowledge-intensive employment, %	43.4	21	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	0.9	24	
5.1.4	GERD financed by business, %	52.2	24	
5.1.5	Females employed w/advanced degrees, %	26.3	8	●
5.2	**Innovation linkages**	**43.2**	**21**	
5.2.1	University/industry research collaboration†	67.3	15	
5.2.2	State of cluster development†	58.3	28	◇
5.2.3	GERD financed by abroad, % GDP	0.3	9	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	20	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	1.5	24	◇
5.3	**Knowledge absorption**	**60.3**	**3**	● ◆
5.3.1	Intellectual property payments, % total trade	21.9	1	● ◆
5.3.2	High-tech imports, % total trade	9.2	42	
5.3.3	ICT services imports, % total trade	1.6	38	
5.3.4	FDI net inflows, % GDP	20.2	6	● ◆
5.3.5	Research talent, % in business enterprise	48.3	27	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**55.1**	**5**	●
6.1	**Knowledge creation**	**24.6**	**41**	◇
6.1.1	Patents by origin/bn PPP$ GDP	2.3	37	◇
6.1.2	PCT patents by origin/bn PPP$ GDP	1.6	21	◇
6.1.3	Utility models by origin/bn PPP$ GDP	0.3	40	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	13.4	41	◇
6.1.5	Citable documents H-index	34.3	28	
6.2	**Knowledge impact**	**54.3**	**1**	● ◆
6.2.1	Growth rate of PPP$ GDP/worker, %	4.1	19	◆
6.2.2	New businesses/th pop. 15-64	7.1	23	
6.2.3	Computer software spending, % GDP	0.0	2	● ◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	6.4	42	
6.2.5	High- and medium-high-tech manufacturing, % ⊙	65.3	2	● ◆
6.3	**Knowledge diffusion**	**86.4**	**1**	● ◆
6.3.1	Intellectual property receipts, % total trade	3.1	7	● ◆
6.3.2	High-tech net exports, % total trade	9.3	17	
6.3.3	ICT services exports, % total trade	25.8	1	● ◆
6.3.4	FDI net outflows, % GDP	19.9	1	● ◆

		Score/Value	Rank	
	CREATIVE OUTPUTS	**37.6**	**21**	◇
7.1	**Intangible assets**	**39.7**	**27**	
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Global brand value, top 5,000, % GDP	70.0	27	◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.3	58	○
7.1.4	ICTs & organizational model creation†	70.8	20	
7.2	**Creative goods and services**	**21.2**	**49**	◇
7.2.1	Cultural & creative services exports, % total trade	0.1	79	○ ◇
7.2.2	National feature films/mn pop. 15-69 ⊙	8.9	23	
7.2.3	Entertainment & Media market/th pop. 15-69	50.7	19	
7.2.4	Printing and other media, % manufacturing	0.5	88	○
7.2.5	Creative goods exports, % total trade	1.4	37	
7.3	**Online creativity**	**49.9**	**20**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	59.5	12	
7.3.2	Country-code TLDs/th pop. 15-69	25.7	26	
7.3.3	Wikipedia edits/mn pop. 15-69	79.1	28	
7.3.4	Mobile app creation/bn PPP$ GDP	36.4	14	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

ISRAEL

GII 2020 rank

13

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
13	17	High	NAWA	8.5	354.2	34,153.8	10

		Score/Value	Rank	
	INSTITUTIONS	**75.6**	**35**	◇
1.1	**Political environment**	**75.8**	**32**	◇
1.1.1	Political and operational stability*	73.2	49	◇
1.1.2	Government effectiveness*	77.1	24	◇
1.2	**Regulatory environment**	**67.6**	**57**	◇
1.2.1	Regulatory quality*	74.7	24	
1.2.2	Rule of law*	72.6	29	◇
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	113	○ ◇
1.3	**Business environment**	**83.4**	**24**	
1.3.1	Ease of starting a business*	94.1	26	
1.3.2	Ease of resolving insolvency*	72.7	27	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**55.1**	**15**	
2.1	**Education**	**53.5**	**43**	
2.1.1	Expenditure on education, % GDP ⊙	5.8	17	
2.1.2	Government funding/pupil, secondary, % GDP/cap	18.7	57	○
2.1.3	School life expectancy, years	16.2	30	
2.1.4	PISA scales in reading, maths, & science	465.2	39	○ ◇
2.1.5	Pupil-teacher ratio, secondary ⊙	9.8	30	
2.2	**Tertiary education**	**34.7**	**59**	○
2.2.1	Tertiary enrolment, % gross	63.4	42	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, % ⊙	2.8	68	○ ◇
2.3	**Research & development (R&D)**	**77.0**	**3**	● ◆
2.3.1	Researchers, FTE/mn pop. ⊙	8,341.7	1	● ◆
2.3.2	Gross expenditure on R&D, % GDP	4.9	1	● ◆
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	65.8	21	
2.3.4	QS university ranking, average score top 3*	42.2	29	

		Score/Value	Rank	
	INFRASTRUCTURE	**51.1**	**40**	◇
3.1	**Information & communication technologies (ICTs)**	**80.7**	**31**	◇
3.1.1	ICT access*	79.7	28	
3.1.2	ICT use*	77.4	26	
3.1.3	Government's online service*	82.6	39	◇
3.1.4	E-participation*	83.2	43	◇
3.2	**General infrastructure**	**31.5**	**43**	◇
3.2.1	Electricity output, kWh/mn pop.	7,768.4	26	
3.2.2	Logistics performance*	58.1	36	◇
3.2.3	Gross capital formation, % GDP	21.7	81	○
3.3	**Ecological sustainability**	**41.0**	**36**	
3.3.1	GDP/unit of energy use	12.8	26	
3.3.2	Environmental performance*	65.8	29	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.2	38	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**61.4**	**14**	
4.1	**Credit**	**49.3**	**38**	
4.1.1	Ease of getting credit*	70.0	44	○
4.1.2	Domestic credit to private sector, % GDP	66.7	49	◇
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**64.1**	**12**	
4.2.1	Ease of protecting minority investors*	78.0	18	
4.2.2	Market capitalization, % GDP	61.0	25	
4.2.3	Venture capital deals/bn PPP$ GDP	0.5	5	◆
4.3	**Trade, competition, and market scale**	**70.7**	**33**	
4.3.1	Applied tariff rate, weighted avg., % ⊙	1.9	54	
4.3.2	Intensity of local competition†	75.4	24	
4.3.3	Domestic market scale, bn PPP$	354.2	51	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**63.7**	**3**	● ◆
5.1	**Knowledge workers**	**61.4**	**12**	
5.1.1	Knowledge-intensive employment, % ⊙	48.4	8	
5.1.2	Firms offering formal training, % ⊙	18.6	76	○ ◇
5.1.3	GERD performed by business, % GDP	4.4	1	● ◆
5.1.4	GERD financed by business, %	35.8	49	○ ◇
5.1.5	Females employed w/advanced degrees, % ⊙	22.3	23	
5.2	**Innovation linkages**	**81.6**	**1**	● ◆
5.2.1	University/industry research collaboration†	78.5	1	● ◆
5.2.2	State of cluster development†	56.8	31	◇
5.2.3	GERD financed by abroad, % GDP	2.5	1	● ◆
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.3	5	◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	5.9	8	
5.3	**Knowledge absorption**	**48.2**	**18**	
5.3.1	Intellectual property payments, % total trade	0.5	65	○ ◇
5.3.2	High-tech imports, % total trade	9.9	35	
5.3.3	ICT services imports, % total trade	2.0	29	
5.3.4	FDI net inflows, % GDP	4.8	27	
5.3.5	Research talent, % in business enterprise ⊙	83.7	1	● ◆

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**55.6**	**4**	●
6.1	**Knowledge creation**	**52.9**	**12**	
6.1.1	Patents by origin/bn PPP$ GDP	4.5	25	
6.1.2	PCT patents by origin/bn PPP$ GDP	5.7	6	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	24.9	16	
6.1.5	Citable documents H-index	47.4	16	
6.2	**Knowledge impact**	**40.9**	**17**	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.6	53	
6.2.2	New businesses/th pop. 15-64	3.3	42	
6.2.3	Computer software spending, % GDP	0.0	57	◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	23.3	7	◆
6.2.5	High- and medium-high-tech manufacturing, % ⊙	41.3	22	
6.3	**Knowledge diffusion**	**72.9**	**2**	● ◆
6.3.1	Intellectual property receipts, % total trade	1.8	14	
6.3.2	High-tech net exports, % total trade	11.9	14	
6.3.3	ICT services exports, % total trade	13.2	1	● ◆
6.3.4	FDI net outflows, % GDP	2.7	25	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**35.9**	**26**	◇
7.1	**Intangible assets**	**27.6**	**65**	○ ◇
7.1.1	Trademarks by origin/bn PPP$ GDP	12.3	105	○ ◇
7.1.2	Global brand value, top 5,000, % GDP	21.2	46	◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	2.9	38	
7.1.4	ICTs & organizational model creation†	77.0	12	
7.2	**Creative goods and services**	**30.8**	**24**	
7.2.1	Cultural & creative services exports, % total trade	2.6	4	● ◆
7.2.2	National feature films/mn pop. 15-69	5.3	41	
7.2.3	Entertainment & Media market/th pop. 15-69	35.0	21	◇
7.2.4	Printing and other media, % manufacturing ⊙	1.2	41	
7.2.5	Creative goods exports, % total trade	1.6	34	
7.3	**Online creativity**	**57.6**	**13**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	21.9	26	◇
7.3.2	Country-code TLDs/th pop. 15-69	13.8	34	◇
7.3.3	Wikipedia edits/mn pop. 15-69	94.9	3	● ◆
7.3.4	Mobile app creation/bn PPP$ GDP	100.0	1	● ◆

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

ITALY

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
24	33	High	EUR	60.6	2,442.8	35,331.7	30

		Score/Value	Rank	
	INSTITUTIONS	**74.6**	**37**	
1.1	**Political environment**	**63.4**	**49**	◇
1.1.1	Political and operational stability*	71.4	59	◇
1.1.2	Government effectiveness*	59.4	47	◇
1.2	**Regulatory environment**	**78.2**	**31**	
1.2.1	Regulatory quality*	59.5	41	
1.2.2	Rule of law*	53.1	51	◇
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	● ◆
1.3	**Business environment**	**82.1**	**27**	
1.3.1	Ease of starting a business*	86.8	76	○ ◇
1.3.2	Ease of resolving insolvency*	77.5	20	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**43.7**	**32**	
2.1	**Education**	**49.6**	**53**	
2.1.1	Expenditure on education, % GDP ⊙	3.8	80	○
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	22.9	30	
2.1.3	School life expectancy, years	16.1	34	
2.1.4	PISA scales in reading, maths, & science	477.0	34	
2.1.5	Pupil-teacher ratio, secondary ⊙	10.0	34	
2.2	**Tertiary education**	**37.6**	**53**	
2.2.1	Tertiary enrolment, % gross	61.9	44	
2.2.2	Graduates in science & engineering, % ⊙	23.3	49	
2.2.3	Tertiary inbound mobility, %	5.3	42	
2.3	**Research & development (R&D)**	**44.1**	**23**	
2.3.1	Researchers, FTE/mn pop.	2,306.8	38	
2.3.2	Gross expenditure on R&D, % GDP	1.4	26	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	72.8	14	●
2.3.4	QS university ranking, average score top 3*	47.9	20	

		Score/Value	Rank	
	INFRASTRUCTURE	**56.6**	**19**	
3.1	**Information & communication technologies (ICTs)**	**83.7**	**25**	
3.1.1	ICT access*	73.6	49	◇
3.1.2	ICT use*	70.4	40	
3.1.3	Government's online service*	95.1	9	●
3.1.4	E-participation*	95.5	15	
3.2	**General infrastructure**	**30.9**	**48**	
3.2.1	Electricity output, kWh/mn pop.	4,780.6	44	
3.2.2	Logistics performance*	78.3	19	
3.2.3	Gross capital formation, % GDP	17.6	113	○ ◇
3.3	**Ecological sustainability**	**55.1**	**12**	● ◆
3.3.1	GDP/unit of energy use	13.9	16	
3.3.2	Environmental performance*	71.0	20	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	6.3	14	●

		Score/Value	Rank	
	MARKET SOPHISTICATION	**50.5**	**50**	
4.1	**Credit**	**39.3**	**74**	○
4.1.1	Ease of getting credit*	45.0	101	○ ◇
4.1.2	Domestic credit to private sector, % GDP	77.4	39	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**35.3**	**74**	○
4.2.1	Ease of protecting minority investors*	66.0	50	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	46	○
4.3	**Trade, competition, and market scale**	**76.9**	**17**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	71.4	47	
4.3.3	Domestic market scale, bn PPP$	2,442.8	12	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**36.7**	**34**	
5.1	**Knowledge workers**	**38.8**	**48**	
5.1.1	Knowledge-intensive employment, %	36.4	35	
5.1.2	Firms offering formal training, %	12.6	90	○ ◇
5.1.3	GERD performed by business, % GDP	0.9	23	
5.1.4	GERD financed by business, %	53.7	20	
5.1.5	Females employed w/advanced degrees, %	13.0	53	
5.2	**Innovation linkages**	**37.4**	**27**	
5.2.1	University/industry research collaboration†	50.0	40	
5.2.2	State of cluster development†	74.9	1	● ◆
5.2.3	GERD financed by abroad, % GDP	0.2	25	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	50	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	2.0	18	
5.3	**Knowledge absorption**	**33.9**	**46**	
5.3.1	Intellectual property payments, % total trade	0.8	44	
5.3.2	High-tech imports, % total trade	7.1	73	○
5.3.3	ICT services imports, % total trade	1.6	40	
5.3.4	FDI net inflows, % GDP	1.3	105	○
5.3.5	Research talent, % in business enterprise	43.6	31	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**42.3**	**18**	
6.1	**Knowledge creation**	**41.9**	**22**	
6.1.1	Patents by origin/bn PPP$ GDP	5.6	19	
6.1.2	PCT patents by origin/bn PPP$ GDP	1.4	23	
6.1.3	Utility models by origin/bn PPP$ GDP	0.7	28	
6.1.4	Scientific & technical articles/bn PPP$ GDP	18.3	30	
6.1.5	Citable documents H-index	68.8	8	● ◆
6.2	**Knowledge impact**	**52.7**	**2**	● ◆
6.2.1	Growth rate of PPP$ GDP/worker, %	0.1	90	○
6.2.2	New businesses/th pop. 15–64	3.0	49	
6.2.3	Computer software spending, % GDP	0.0	14	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	36.6	2	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	39.0	24	
6.3	**Knowledge diffusion**	**32.1**	**39**	
6.3.1	Intellectual property receipts, % total trade	0.7	22	
6.3.2	High-tech net exports, % total trade	5.2	32	
6.3.3	ICT services exports, % total trade	1.5	67	
6.3.4	FDI net outflows, % GDP	1.1	52	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**35.9**	**27**	
7.1	**Intangible assets**	**44.9**	**20**	
7.1.1	Trademarks by origin/bn PPP$ GDP	48.8	50	
7.1.2	Global brand value, top 5,000, % GDP	87.3	23	
7.1.3	Industrial designs by origin/bn PPP$ GDP	19.2	1	● ◆
7.1.4	ICTs & organizational model creation†	54.6	61	◇
7.2	**Creative goods and services**	**22.1**	**47**	
7.2.1	Cultural & creative services exports, % total trade	0.4	58	
7.2.2	National feature films/mn pop. 15–69	4.1	48	
7.2.3	Entertainment & Media market/th pop. 15–69	33.0	23	
7.2.4	Printing and other media, % manufacturing	1.1	44	
7.2.5	Creative goods exports, % total trade	2.2	27	
7.3	**Online creativity**	**31.6**	**34**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	22.7	25	
7.3.2	Country-code TLDs/th pop. 15–69	23.4	28	
7.3.3	Wikipedia edits/mn pop. 15–69	78.2	30	
7.3.4	Mobile app creation/bn PPP$ GDP	3.4	60	○

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

JAMAICA

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
62	86	Upper middle	LCN	2.9	27.9	8,461.3	81

		Score/Value	Rank	
	INSTITUTIONS	**71.8**	**42**	◆
1.1	**Political environment**	**65.2**	**46**	◆
1.1.1	Political and operational stability*	73.2	49	
1.1.2	Government effectiveness*	61.2	43	◆
1.2	**Regulatory environment**	**66.5**	**61**	
1.2.1	Regulatory quality*	49.1	59	
1.2.2	Rule of law*	40.5	75	
1.2.3	Cost of redundancy dismissal, salary weeks	14.0	52	
1.3	**Business environment**	**83.7**	**23**	● ◆
1.3.1	Ease of starting a business*	97.4	6	● ◆
1.3.2	Ease of resolving insolvency*	70.1	32	◆
	HUMAN CAPITAL & RESEARCH	**22.6**	**[88]**	
2.1	**Education**	**48.5**	**59**	
2.1.1	Expenditure on education, % GDP	5.4	27	●
2.1.2	Government funding/pupil, secondary, % GDP/cap	29.6	13	● ◆
2.1.3	School life expectancy, years ◷	12.3	88	◇
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	16.7	81	
2.2	**Tertiary education**	**19.4**	**[97]**	
2.2.1	Tertiary enrolment, % gross ◷	27.1	86	◇
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**0.0**	**[121]**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**26.4**	**110**	◇
3.1	**Information & communication technologies (ICTs)**	**39.7**	**109**	◇
3.1.1	ICT access*	54.6	82	
3.1.2	ICT use*	40.8	99	◇
3.1.3	Government's online service*	31.9	118	○ ◇
3.1.4	E-participation*	31.5	119	○ ◇
3.2	**General infrastructure**	**14.5**	**121**	○ ◇
3.2.1	Electricity output, kWh/mn pop.	1,515.2	89	
3.2.2	Logistics performance*	21.1	106	○ ◇
3.2.3	Gross capital formation, % GDP	18.8	104	
3.3	**Ecological sustainability**	**25.1**	**80**	
3.3.1	GDP/unit of energy use	8.6	71	
3.3.2	Environmental performance*	48.2	60	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.4	89	
	MARKET SOPHISTICATION	**38.0**	**110**	◇
4.1	**Credit**	**39.5**	**73**	
4.1.1	Ease of getting credit*	85.0	14	●
4.1.2	Domestic credit to private sector, % GDP ◷	32.0	92	
4.1.3	Microfinance gross loans, % GDP	0.2	53	
4.2	**Investment**	**27.5**	**105**	
4.2.1	Ease of protecting minority investors*	62.0	60	
4.2.2	Market capitalization, % GDP ◷	32.0	43	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	42	
4.3	**Trade, competition, and market scale**	**47.1**	**123**	○ ◇
4.3.1	Applied tariff rate, weighted avg., % ◷	10.8	119	○ ◇
4.3.2	Intensity of local competition†	72.1	45	
4.3.3	Domestic market scale, bn PPP$	27.9	121	○ ◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**27.0**	**60**	
5.1	**Knowledge workers**	**30.5**	**[64]**	
5.1.1	Knowledge-intensive employment, % ◷	21.6	72	
5.1.2	Firms offering formal training, % ◷	25.9	60	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, %	n/a	n/a	
5.2	**Innovation linkages**	**25.8**	**44**	◆
5.2.1	University/industry research collaboration†	44.8	53	
5.2.2	State of cluster development†	46.5	69	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	27	● ◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	60	
5.3	**Knowledge absorption**	**24.8**	**79**	
5.3.1	Intellectual property payments, % total trade	0.8	45	
5.3.2	High-tech imports, % total trade ◷	4.5	114	○
5.3.3	ICT services imports, % total trade	1.2	59	
5.3.4	FDI net inflows, % GDP	5.8	21	● ◆
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**12.0**	**107**	
6.1	**Knowledge creation**	**6.4**	**[94]**	
6.1.1	Patents by origin/bn PPP$ GDP	1.0	65	
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.1	104	
6.1.5	Citable documents H-index	5.2	102	
6.2	**Knowledge impact**	**15.6**	**96**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-1.8	112	○ ◇
6.2.2	New businesses/th pop. 15-64	1.6	64	
6.2.3	Computer software spending, % GDP	0.0	26	● ◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.1	104	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**14.1**	**101**	
6.3.1	Intellectual property receipts, % total trade	0.1	59	
6.3.2	High-tech net exports, % total trade ◷	0.0	123	○ ◇
6.3.3	ICT services exports, % total trade	1.9	58	
6.3.4	FDI net outflows, % GDP	0.7	65	
	CREATIVE OUTPUTS	**30.0**	**42**	◆
7.1	**Intangible assets**	**52.5**	**10**	● ◆
7.1.1	Trademarks by origin/bn PPP$ GDP	185.8	4	● ◆
7.1.2	Global brand value, top 5,000, % GDP	95.0	20	● ◆
7.1.3	Industrial designs by origin/bn PPP$ GDP	4.2	27	●
7.1.4	ICTs & organizational model creation†	55.2	60	
7.2	**Creative goods and services**	**2.2**	**[116]**	
7.2.1	Cultural & creative services exports, % total trade	0.1	90	
7.2.2	National feature films/mn pop. 15-69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade ◷	0.2	78	
7.3	**Online creativity**	**12.7**	**74**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	1.7	83	
7.3.2	Country-code TLDs/th pop. 15-69	1.0	83	
7.3.3	Wikipedia edits/mn pop. 15-69	38.5	81	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

JAPAN

GII 2020 rank

16

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
18	12	High	SEAO	126.9	5,747.5	39,763.1	15

		Score/Value	Rank	
	INSTITUTIONS	**89.3**	**8**	
1.1	**Political environment**	**88.7**	**11**	
1.1.1	Political and operational stability*	91.1	5	
1.1.2	Government effectiveness*	87.6	11	
1.2	**Regulatory environment**	**90.9**	**12**	
1.2.1	Regulatory quality*	76.9	22	
1.2.2	Rule of law*	86.7	17	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	**Business environment**	**88.2**	**9**	
1.3.1	Ease of starting a business*	86.1	82	○ ◇
1.3.2	Ease of resolving insolvency*	90.2	3	● ◆

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**47.3**	**[24]**	
2.1	**Education**	**48.6**	**[57]**	
2.1.1	Expenditure on education, % GDP ⊙	3.2	93	○ ◇
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	520.0	5	
2.1.5	Pupil-teacher ratio, secondary ⊙	11.1	45	
2.2	**Tertiary education**	**18.4**	**[99]**	
2.2.1	Tertiary enrolment, % gross	n/a	n/a	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	4.3	54	
2.3	**Research & development (R&D)**	**74.9**	**5**	●
2.3.1	Researchers, FTE/mn pop.	5,331.2	13	
2.3.2	Gross expenditure on R&D, % GDP	3.3	5	●
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	91.1	6	
2.3.4	QS university ranking, average score top 3*	78.6	8	

		Score/Value	Rank	
	INFRASTRUCTURE	**60.0**	**8**	
3.1	**Information & communication technologies (ICTs)**	**90.2**	**10**	
3.1.1	ICT access*	85.6	11	
3.1.2	ICT use*	81.9	15	
3.1.3	Government's online service*	95.1	9	
3.1.4	E-participation*	98.3	5	
3.2	**General infrastructure**	**42.3**	**18**	
3.2.1	Electricity output, kWh/mn pop.	8,054.7	21	
3.2.2	Logistics performance*	91.8	5	●
3.2.3	Gross capital formation, % GDP	24.6	55	
3.3	**Ecological sustainability**	**47.5**	**23**	
3.3.1	GDP/unit of energy use	11.4	40	
3.3.2	Environmental performance*	75.1	12	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	4.1	25	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**64.3**	**9**	
4.1	**Credit**	**65.7**	**12**	
4.1.1	Ease of getting credit*	55.0	88	○
4.1.2	Domestic credit to private sector, % GDP	168.8	4	● ◆
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**41.5**	**56**	
4.2.1	Ease of protecting minority investors*	64.0	56	
4.2.2	Market capitalization, % GDP	111.7	8	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	35	◇
4.3	**Trade, competition, and market scale**	**85.6**	**2**	● ◆
4.3.1	Applied tariff rate, weighted avg., %	2.5	61	
4.3.2	Intensity of local competition†	87.2	1	● ◆
4.3.3	Domestic market scale, bn PPP$	5,747.5	4	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**57.1**	**10**	
5.1	**Knowledge workers**	**65.1**	**10**	
5.1.1	Knowledge-intensive employment, %	24.8	60	○ ◇
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	2.6	3	●
5.1.4	GERD financed by business, %	79.1	2	● ◆
5.1.5	Females employed w/advanced degrees, %	21.8	24	
5.2	**Innovation linkages**	**47.7**	**17**	
5.2.1	University/industry research collaboration†	62.4	20	
5.2.2	State of cluster development†	67.7	11	
5.2.3	GERD financed by abroad, % GDP	0.0	66	○ ◇
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	43	◇
5.2.5	Patent families 2+ offices/bn PPP$ GDP	13.2	1	● ◆
5.3	**Knowledge absorption**	**58.6**	**4**	●
5.3.1	Intellectual property payments, % total trade	2.5	9	
5.3.2	High-tech imports, % total trade	13.6	16	
5.3.3	ICT services imports, % total trade	1.7	36	
5.3.4	FDI net inflows, % GDP	0.6	121	○
5.3.5	Research talent, % in business enterprise	74.4	4	● ◆

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**46.4**	**13**	
6.1	**Knowledge creation**	**57.2**	**11**	
6.1.1	Patents by origin/bn PPP$ GDP	45.3	1	● ◆
6.1.2	PCT patents by origin/bn PPP$ GDP	9.2	1	● ◆
6.1.3	Utility models by origin/bn PPP$ GDP	0.7	31	
6.1.4	Scientific & technical articles/bn PPP$ GDP	9.7	53	◇
6.1.5	Citable documents H-index	69.9	6	
6.2	**Knowledge impact**	**32.1**	**35**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-0.1	95	○
6.2.2	New businesses/th pop. 15–64	0.4	103	○ ◇
6.2.3	Computer software spending, % GDP	0.0	46	◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.4	35	
6.2.5	High- and medium-high-tech manufacturing, % ⊙	55.1	8	
6.3	**Knowledge diffusion**	**49.8**	**12**	
6.3.1	Intellectual property receipts, % total trade	4.9	1	● ◆
6.3.2	High-tech net exports, % total trade	12.0	13	
6.3.3	ICT services exports, % total trade	0.5	99	○ ◇
6.3.4	FDI net outflows, % GDP	3.5	17	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**37.2**	**24**	◇
7.1	**Intangible assets**	**47.3**	**17**	
7.1.1	Trademarks by origin/bn PPP$ GDP	78.3	24	
7.1.2	Global brand value, top 5,000, % GDP	146.2	10	
7.1.3	Industrial designs by origin/bn PPP$ GDP	4.2	28	
7.1.4	ICTs & organizational model creation†	67.8	22	
7.2	**Creative goods and services**	**30.0**	**27**	
7.2.1	Cultural & creative services exports, % total trade	0.3	60	○
7.2.2	National feature films/mn pop. 15–69	6.9	31	
7.2.3	Entertainment & Media market/th pop. 15–69	68.9	5	
7.2.4	Printing and other media, % manufacturing ⊙	1.7	24	
7.2.5	Creative goods exports, % total trade	1.9	30	
7.3	**Online creativity**	**24.2**	**48**	◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	14.9	31	◇
7.3.2	Country-code TLDs/th pop. 15–69	5.7	50	◇
7.3.3	Wikipedia edits/mn pop. 15–69	65.3	49	◇
7.3.4	Mobile app creation/bn PPP$ GDP	13.0	37	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

JORDAN

GII 2020 rank

81

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
81	77	Upper middle	NAWA	10.1	97.2	8,423.6	86

		Score/Value	Rank	
	INSTITUTIONS	**64.3**	**63**	
1.1	**Political environment**	**56.5**	**69**	
1.1.1	Political and operational stability*	64.3	83	
1.1.2	Government effectiveness*	52.7	64	
1.2	**Regulatory environment**	**74.2**	**39**	◆
1.2.1	Regulatory quality*	44.0	66	
1.2.2	Rule of law*	52.8	53	◆
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	● ◆
1.3	**Business environment**	**62.1**	**97**	
1.3.1	Ease of starting a business*	84.5	92	
1.3.2	Ease of resolving insolvency*	39.7	98	
	HUMAN CAPITAL & RESEARCH	**27.2**	**78**	
2.1	**Education**	**31.8**	**99**	
2.1.1	Expenditure on education, % GDP	3.6	88	
2.1.2	Government funding/pupil, secondary, % GDP/cap	15.6	74	
2.1.3	School life expectancy, years	10.4	105	○ ◇
2.1.4	PISA scales in reading, maths, & science	416.0	58	
2.1.5	Pupil-teacher ratio, secondary	12.3	56	
2.2	**Tertiary education**	**40.4**	**41**	
2.2.1	Tertiary enrolment, % gross	34.4	78	
2.2.2	Graduates in science & engineering, %	26.4	30	●
2.2.3	Tertiary inbound mobility, %	14.0	11	● ◆
2.3	**Research & development (R&D)**	**9.5**	**60**	
2.3.1	Researchers, FTE/mn pop.	596.0	63	
2.3.2	Gross expenditure on R&D, % GDP	0.7	51	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	16.8	54	
	INFRASTRUCTURE	**32.8**	**95**	
3.1	**Information & communication technologies (ICTs)**	**52.7**	**92**	
3.1.1	ICT access*	59.3	75	
3.1.2	ICT use*	53.7	66	
3.1.3	Government's online service*	49.3	106	◇
3.1.4	E-participation*	48.3	106	
3.2	**General infrastructure**	**17.5**	**115**	○
3.2.1	Electricity output, kWh/mn pop.	2,140.2	75	
3.2.2	Logistics performance*	29.0	83	
3.2.3	Gross capital formation, % GDP	19.5	100	
3.3	**Ecological sustainability**	**28.3**	**68**	
3.3.1	GDP/unit of energy use	8.5	73	
3.3.2	Environmental performance*	53.4	46	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.0	62	
	MARKET SOPHISTICATION	**50.1**	**52**	
4.1	**Credit**	**53.2**	**24**	● ◆
4.1.1	Ease of getting credit*	95.0	4	● ◆
4.1.2	Domestic credit to private sector, % GDP	80.4	35	●
4.1.3	Microfinance gross loans, % GDP	0.4	40	
4.2	**Investment**	**34.6**	**77**	
4.2.1	Ease of protecting minority investors*	50.0	92	
4.2.2	Market capitalization, % GDP	58.5	29	
4.2.3	Venture capital deals/bn PPP$ GDP	0.2	17	●
4.3	**Trade, competition, and market scale**	**62.4**	**67**	
4.3.1	Applied tariff rate, weighted avg., %	4.4	84	
4.3.2	Intensity of local competition†	76.0	19	● ◆
4.3.3	Domestic market scale, bn PPP$	97.2	83	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**20.7**	**94**	
5.1	**Knowledge workers**	**15.0**	**[110]**	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, %	16.9	82	○ ◇
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, %	n/a	n/a	
5.2	**Innovation linkages**	**27.5**	**38**	◆
5.2.1	University/industry research collaboration†	44.5	55	
5.2.2	State of cluster development†	57.5	30	● ◆
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	38	◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	83	
5.3	**Knowledge absorption**	**19.5**	**104**	
5.3.1	Intellectual property payments, % total trade	0.1	100	○
5.3.2	High-tech imports, % total trade	6.8	76	
5.3.3	ICT services imports, % total trade	0.3	113	○ ◇
5.3.4	FDI net inflows, % GDP	3.7	41	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**15.6**	**82**	
6.1	**Knowledge creation**	**16.8**	**60**	
6.1.1	Patents by origin/bn PPP$ GDP	0.3	91	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.2	48	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	17.0	33	● ◆
6.1.5	Citable documents H-index	9.7	78	
6.2	**Knowledge impact**	**19.6**	**84**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-1.0	106	○
6.2.2	New businesses/th pop. 15–64	0.5	95	
6.2.3	Computer software spending, % GDP	0.0	50	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	5.5	50	
6.2.5	High- and medium-high-tech manufacturing, %	21.6	52	
6.3	**Knowledge diffusion**	**10.5**	**120**	○ ◇
6.3.1	Intellectual property receipts, % total trade	0.1	45	
6.3.2	High-tech net exports, % total trade	0.4	83	
6.3.3	ICT services exports, % total trade	0.1	125	○
6.3.4	FDI net outflows, % GDP	0.0	117	○
	CREATIVE OUTPUTS	**17.5**	**84**	
7.1	**Intangible assets**	**19.9**	**90**	
7.1.1	Trademarks by origin/bn PPP$ GDP	31.9	76	
7.1.2	Global brand value, top 5,000, % GDP	7.8	63	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.3	96	
7.1.4	ICTs & organizational model creation†	52.6	68	
7.2	**Creative goods and services**	**14.3**	**68**	
7.2.1	Cultural & creative services exports, % total trade	0.0	108	○
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15–69	1.8	54	○ ◇
7.2.4	Printing and other media, % manufacturing	2.4	9	● ◆
7.2.5	Creative goods exports, % total trade	0.9	46	
7.3	**Online creativity**	**16.0**	**66**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	4.9	54	
7.3.2	Country-code TLDs/th pop. 15–69	0.2	108	
7.3.3	Wikipedia edits/mn pop. 15–69	48.6	63	
7.3.4	Mobile app creation/bn PPP$ GDP	13.1	36	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

KAZAKHSTAN

GII 2020 rank

77

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
94	60	Upper middle	CSA	18.6	537.7	25,186.2	79

		Score/Value	Rank	
	INSTITUTIONS	**69.0**	**49**	
1.1	**Political environment**	**57.0**	**68**	
1.1.1	Political and operational stability*	69.6	70	
1.1.2	Government effectiveness*	50.6	70	
1.2	**Regulatory environment**	**69.6**	**48**	
1.2.1	Regulatory quality*	45.5	63	
1.2.2	Rule of law*	35.4	92	
1.2.3	Cost of redundancy dismissal, salary weeks	8.7	18	●
1.3	**Business environment**	**80.6**	**31**	● ◆
1.3.1	Ease of starting a business*	94.4	20	● ◆
1.3.2	Ease of resolving insolvency*	66.7	39	
	HUMAN CAPITAL & RESEARCH	**29.7**	**68**	
2.1	**Education**	**41.4**	**76**	
2.1.1	Expenditure on education, % GDP	2.8	104	○
2.1.2	Government funding/pupil, secondary, % GDP/cap	21.2	43	
2.1.3	School life expectancy, years	15.6	40	
2.1.4	PISA scales in reading, maths, & science	402.4	64	
2.1.5	Pupil-teacher ratio, secondary	7.7	8	● ◆
2.2	**Tertiary education**	**37.4**	**55**	
2.2.1	Tertiary enrolment, % gross	61.7	45	
2.2.2	Graduates in science & engineering, %	24.7	39	
2.2.3	Tertiary inbound mobility, %	3.3	62	
2.3	**Research & development (R&D)**	**10.4**	**57**	
2.3.1	Researchers, FTE/mn pop	666.9	62	
2.3.2	Gross expenditure on R&D, % GDP	0.1	101	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	31.6	37	
	INFRASTRUCTURE	**40.8**	**66**	
3.1	**Information & communication technologies (ICTs)**	**76.3**	**42**	◆
3.1.1	ICT access*	75.2	42	◆
3.1.2	ICT use*	59.6	58	
3.1.3	Government's online service*	86.8	32	● ◆
3.1.4	E-participation*	83.7	42	
3.2	**General infrastructure**	**26.6**	**69**	
3.2.1	Electricity output, kWh/mn pop	5,716.6	36	◆
3.2.2	Logistics performance*	34.7	70	
3.2.3	Gross capital formation, % GDP	25.5	48	
3.3	**Ecological sustainability**	**19.6**	**103**	◇
3.3.1	GDP/unit of energy use	5.0	111	○ ◇
3.3.2	Environmental performance*	44.7	75	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.5	82	
	MARKET SOPHISTICATION	**50.0**	**53**	
4.1	**Credit**	**36.7**	**82**	
4.1.1	Ease of getting credit*	80.0	23	●
4.1.2	Domestic credit to private sector, % GDP	27.3	100	
4.1.3	Microfinance gross loans, % GDP	0.2	48	
4.2	**Investment**	**47.8**	**28**	●
4.2.1	Ease of protecting minority investors*	84.0	7	● ◆
4.2.2	Market capitalization, % GDP	25.7	51	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**65.5**	**50**	
4.3.1	Applied tariff rate, weighted avg., %	2.4	60	
4.3.2	Intensity of local competition†	60.0	107	◇
4.3.3	Domestic market scale, bn PPP$	537.7	40	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**24.3**	**71**	
5.1	**Knowledge workers**	**37.3**	**52**	
5.1.1	Knowledge-intensive employment, % ⊙	34.3	39	◆
5.1.2	Firms offering formal training, %	21.8	69	
5.1.3	GERD performed by business, % GDP	0.1	70	
5.1.4	GERD financed by business, %	47.4	34	
5.1.5	Females employed w/advanced degrees, % ⊙	20.7	27	● ◆
5.2	**Innovation linkages**	**13.0**	**124**	○ ◇
5.2.1	University/industry research collaboration†	40.9	68	
5.2.2	State of cluster development†	33.9	114	○ ◇
5.2.3	GERD financed by abroad, % GDP	0.0	89	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	99	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	89	
5.3	**Knowledge absorption**	**22.6**	**91**	
5.3.1	Intellectual property payments, % total trade	0.3	80	
5.3.2	High-tech imports, % total trade	7.1	72	
5.3.3	ICT services imports, % total trade	0.7	92	
5.3.4	FDI net inflows, % GDP	5.2	25	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**15.8**	**80**	
6.1	**Knowledge creation**	**11.7**	**72**	
6.1.1	Patents by origin/bn PPP$ GDP	1.7	44	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	79	
6.1.3	Utility models by origin/bn PPP$ GDP	1.5	15	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.1	117	○
6.1.5	Citable documents H-index	5.1	103	
6.2	**Knowledge impact**	**15.6**	**97**	
6.2.1	Growth rate of PPP$ GDP/worker, %	3.0	25	●
6.2.2	New businesses/th pop. 15–64	2.0	56	
6.2.3	Computer software spending, % GDP	0.0	118	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.1	100	
6.2.5	High- and medium-high-tech manufacturing, %	9.6	84	
6.3	**Knowledge diffusion**	**20.2**	**76**	
6.3.1	Intellectual property receipts, % total trade	0.0	99	○ ◇
6.3.2	High-tech net exports, % total trade	3.2	44	
6.3.3	ICT services exports, % total trade	0.2	115	○
6.3.4	FDI net outflows, % GDP	0.2	95	
	CREATIVE OUTPUTS	**12.9**	**105**	◇
7.1	**Intangible assets**	**16.6**	**107**	
7.1.1	Trademarks by origin/bn PPP$ GDP	20.8	93	
7.1.2	Global brand value, top 5,000, % GDP	3.6	72	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.2	106	
7.1.4	ICTs & organizational model creation†	48.2	88	
7.2	**Creative goods and services**	**6.6**	**96**	
7.2.1	Cultural & creative services exports, % total trade	0.1	89	
7.2.2	National feature films/mn pop. 15–69	6.1	38	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	0.5	90	○ ◇
7.2.5	Creative goods exports, % total trade	0.2	87	
7.3	**Online creativity**	**11.6**	**79**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.3	115	
7.3.2	Country-code TLDs/th pop. 15–69	3.7	60	
7.3.3	Wikipedia edits/mn pop. 15–69	45.4	70	
7.3.4	Mobile app creation/bn PPP$ GDP	0.0	94	○

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

KENYA

GII 2020 rank

86

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
78	92	Lower middle	SSF	52.6	191.3	3,382.6	77

		Score/Value	Rank	
	INSTITUTIONS	**59.9**	**78**	
1.1	**Political environment**	**47.0**	**97**	
1.1.1	Political and operational stability*	58.9	104	
1.1.2	Government effectiveness*	41.0	92	
1.2	**Regulatory environment**	**60.3**	**79**	
1.2.1	Regulatory quality*	35.8	89	
1.2.2	Rule of law*	36.0	88	
1.2.3	Cost of redundancy dismissal, salary weeks	15.8	61	
1.3	**Business environment**	**72.6**	**60**	
1.3.1	Ease of starting a business*	82.7	100	
1.3.2	Ease of resolving insolvency*	62.4	45	◆
	HUMAN CAPITAL & RESEARCH	**15.8**	**110**	
2.1	**Education**	**31.5**	**[101]**	
2.1.1	Expenditure on education, % GDP	5.3	29	●
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years ⊙	10.3	106	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⊙	33.4	121	○ ◇
2.2	**Tertiary education**	**11.5**	**112**	
2.2.1	Tertiary enrolment, % gross	11.5	107	
2.2.2	Graduates in science & engineering, % ⊙	16.5	85	
2.2.3	Tertiary inbound mobility, %	0.9	89	
2.3	**Research & development (R&D)**	**4.5**	**77**	
2.3.1	Researchers, FTE/mn pop. ⊙	221.4	80	
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.8	47	◆
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**25.5**	**114**	
3.1	**Information & communication technologies (ICTs)**	**44.8**	**102**	
3.1.1	ICT access*	43.0	102	
3.1.2	ICT use*	20.3	114	◇
3.1.3	Government's online service*	62.5	90	
3.1.4	E-participation*	53.4	102	
3.2	**General infrastructure**	**15.4**	**119**	○
3.2.1	Electricity output, kWh/mn pop.	207.7	114	○ ◇
3.2.2	Logistics performance*	35.0	67	
3.2.3	Gross capital formation, % GDP	16.9	116	○ ◇
3.3	**Ecological sustainability**	**16.3**	**119**	○ ◇
3.3.1	GDP/unit of energy use	5.4	105	◇
3.3.2	Environmental performance*	34.7	103	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	93	
	MARKET SOPHISTICATION	**49.1**	**57**	
4.1	**Credit**	**54.6**	**20**	● ◆
4.1.1	Ease of getting credit*	95.0	4	● ◆
4.1.2	Domestic credit to private sector, % GDP	28.0	97	
4.1.3	Microfinance gross loans, % GDP ⊙	4.2	10	● ◆
4.2	**Investment**	**36.6**	**67**	
4.2.1	Ease of protecting minority investors*	92.0	1	● ◆
4.2.2	Market capitalization, % GDP ⊙	30.2	47	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	49	
4.3	**Trade, competition, and market scale**	**56.1**	**93**	
4.3.1	Applied tariff rate, weighted avg., %	10.1	115	◇
4.3.2	Intensity of local competition†	72.0	46	◆
4.3.3	Domestic market scale, bn PPP$	191.3	70	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**24.8**	**68**	
5.1	**Knowledge workers**	**14.8**	**111**	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % ⊙	37.4	36	
5.1.3	GERD performed by business, % GDP ⊙	0.1	67	
5.1.4	GERD financed by business, % ⊙	4.3	86	
5.1.5	Females employed w/advanced degrees, % ⊙	1.5	106	
5.2	**Innovation linkages**	**33.4**	**31**	● ◆
5.2.1	University/industry research collaboration†	51.5	36	● ◆
5.2.2	State of cluster development†	53.5	39	◆
5.2.3	GERD financed by abroad, % GDP ⊙	0.4	5	● ◆
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	52	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**26.2**	**73**	
5.3.1	Intellectual property payments, % total trade ⊙	1.2	29	● ◆
5.3.2	High-tech imports, % total trade	9.4	40	
5.3.3	ICT services imports, % total trade ⊙	0.3	118	○ ◇
5.3.4	FDI net inflows, % GDP	1.1	107	
5.3.5	Research talent, % in business enterprise ⊙	11.4	61	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**18.4**	**70**	
6.1	**Knowledge creation**	**13.8**	**67**	
6.1.1	Patents by origin/bn PPP$ GDP	1.4	55	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	83	
6.1.3	Utility models by origin/bn PPP$ GDP	1.0	23	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.7	69	
6.1.5	Citable documents H-index	15.4	53	
6.2	**Knowledge impact**	**17.9**	**90**	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.2	43	
6.2.2	New businesses/th pop. 15–64	1.5	68	
6.2.3	Computer software spending, % GDP	0.0	77	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.1	70	
6.2.5	High- and medium-high-tech manufacturing, %	9.6	83	
6.3	**Knowledge diffusion**	**23.6**	**65**	
6.3.1	Intellectual property receipts, % total trade ⊙	0.6	25	● ◆
6.3.2	High-tech net exports, % total trade	0.4	86	
6.3.3	ICT services exports, % total trade ⊙	3.3	26	●
6.3.4	FDI net outflows, % GDP	0.8	62	
	CREATIVE OUTPUTS	**16.0**	**91**	
7.1	**Intangible assets**	**23.1**	**83**	
7.1.1	Trademarks by origin/bn PPP$ GDP ⊙	32.6	74	
7.1.2	Global brand value, top 5,000, % GDP	13.1	54	
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.0	71	
7.1.4	ICTs & organizational model creation†	60.0	44	◆
7.2	**Creative goods and services**	**17.3**	**59**	
7.2.1	Cultural & creative services exports, % total trade	0.0	104	○
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15–69	1.6	56	
7.2.4	Printing and other media, % manufacturing	4.1	3	● ◆
7.2.5	Creative goods exports, % total trade	0.2	85	
7.3	**Online creativity**	**0.5**	**124**	○ ◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.9	97	
7.3.2	Country-code TLDs/th pop. 15–69	1.0	87	
7.3.3	Wikipedia edits/mn pop. 15–69	5.2	121	○ ◇
7.3.4	Mobile app creation/bn PPP$ GDP ⊙	0.0	92	○

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

KUWAIT

GII 2020 rank

78

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
79	73	High	NAWA	4.2	312.1	57,957.5	60

		Score/Value	Rank	
	INSTITUTIONS	**56.7**	**88**	◇
1.1	**Political environment**	**53.0**	**82**	◇
1.1.1	Political and operational stability*	62.5	92	◇
1.1.2	Government effectiveness*	48.2	77	◇
1.2	**Regulatory environment**	**53.3**	**97**	◇
1.2.1	Regulatory quality*	40.9	71	◇
1.2.2	Rule of law*	52.2	54	◇
1.2.3	Cost of redundancy dismissal, salary weeks	28.1	115	○ ◇
1.3	**Business environment**	**63.8**	**90**	◇
1.3.1	Ease of starting a business*	88.4	67	
1.3.2	Ease of resolving insolvency*	39.2	101	◇

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**31.0**	**[63]**	
2.1	**Education**	**51.0**	**[49]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	17.3	67	
2.1.3	School life expectancy, years ⊙	14.7	59	◇
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⊙	7.6	5	● ◆
2.2	**Tertiary education**	**39.4**	**[44]**	
2.2.1	Tertiary enrolment, % gross	54.4	54	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**2.7**	**88**	◇
2.3.1	Researchers, FTE/mn pop.	513.9	67	◇
2.3.2	Gross expenditure on R&D, % GDP	0.1	111	○ ◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	3.6	72	◇

		Score/Value	Rank	
	INFRASTRUCTURE	**44.7**	**55**	◇
3.1	**Information & communication technologies (ICTs)**	**73.4**	**51**	◇
3.1.1	ICT access*	77.6	34	●
3.1.2	ICT use*	67.9	46	◇
3.1.3	Government's online service*	79.2	48	
3.1.4	E-participation*	69.1	71	◇
3.2	**General infrastructure**	**34.2**	**35**	●
3.2.1	Electricity output, kWh/mn pop.	17,581.6	4	● ◆
3.2.2	Logistics performance*	37.1	62	◇
3.2.3	Gross capital formation, % GDP	20.4	95	
3.3	**Ecological sustainability**	**26.5**	**75**	◇
3.3.1	GDP/unit of energy use	7.8	83	
3.3.2	Environmental performance*	53.6	45	◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.6	74	◇

		Score/Value	Rank	
	MARKET SOPHISTICATION	**45.3**	**81**	
4.1	**Credit**	**41.9**	**65**	
4.1.1	Ease of getting credit*	45.0	101	◇
4.1.2	Domestic credit to private sector, % GDP	88.7	30	●
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**35.3**	**73**	
4.2.1	Ease of protecting minority investors*	66.0	50	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	45	
4.3	**Trade, competition, and market scale**	**58.6**	**83**	◇
4.3.1	Applied tariff rate, weighted avg., %	4.8	86	◇
4.3.2	Intensity of local competition†	56.0	121	○ ◇
4.3.3	Domestic market scale, bn PPP$	312.1	57	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**20.4**	**[98]**	
5.1	**Knowledge workers**	**18.3**	**[102]**	
5.1.1	Knowledge-intensive employment, % ⊙	22.7	68	◇
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, % ⊙	1.0	96	○ ◇
5.1.5	Females employed w/advanced degrees, %	n/a	n/a	
5.2	**Innovation linkages**	**18.9**	**79**	◇
5.2.1	University/industry research collaboration†	44.6	54	
5.2.2	State of cluster development†	51.3	46	
5.2.3	GERD financed by abroad, % GDP ⊙	0.0	99	○ ◇
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	51	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	79	
5.3	**Knowledge absorption**	**24.0**	**[84]**	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports, % total trade	5.2	108	
5.3.3	ICT services imports, % total trade	0.5	103	◇
5.3.4	FDI net inflows, % GDP	0.1	123	○
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**17.8**	**73**	◇
6.1	**Knowledge creation**	**4.6**	**109**	◇
6.1.1	Patents by origin/bn PPP$ GDP	0.0	127	○ ◇
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	93	◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.9	106	◇
6.1.5	Citable documents H-index	8.9	82	◇
6.2	**Knowledge impact**	**20.2**	**83**	◇
6.2.1	Growth rate of PPP$ GDP/worker, %	-2.0	114	○ ◇
6.2.2	New businesses/th pop. 15–64	5.9	27	●
6.2.3	Computer software spending, % GDP	0.0	25	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.6	89	◇
6.2.5	High- and medium-high-tech manufacturing, %	22.8	48	
6.3	**Knowledge diffusion**	**28.6**	**46**	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade	0.3	89	◇
6.3.3	ICT services exports, % total trade	3.8	22	●
6.3.4	FDI net outflows, % GDP	4.6	13	●

		Score/Value	Rank	
	CREATIVE OUTPUTS	**16.5**	**88**	◇
7.1	**Intangible assets**	**24.2**	**76**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP	11.6	106	◇
7.1.2	Global brand value, top 5,000, % GDP	49.1	36	●
7.1.3	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.4	ICTs & organizational model creation†	50.9	79	◇
7.2	**Creative goods and services**	**5.7**	**101**	◇
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	1.9	70	◇
7.2.3	Entertainment & Media market/th pop. 15–69	15.0	31	◇
7.2.4	Printing and other media, % manufacturing	0.4	94	○ ◇
7.2.5	Creative goods exports, % total trade	0.1	97	
7.3	**Online creativity**	**11.9**	**76**	◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	7.6	44	●
7.3.2	Country-code TLDs/th pop. 15–69	0.3	105	◇
7.3.3	Wikipedia edits/mn pop. 15–69	42.3	78	◇
7.3.4	Mobile app creation/bn PPP$ GDP	0.6	71	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

KYRGYZSTAN

GII 2020 rank

94

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
107	88	Lower middle	CSA	6.4	25.9	3,541.3	90

		Score/Value	Rank	
	INSTITUTIONS	**56.1**	**92**	
1.1	**Political environment**	**42.2**	**114**	
1.1.1	Political and operational stability*	53.6	120	○ ◇
1.1.2	Government effectiveness*	36.5	109	
1.2	**Regulatory environment**	**54.7**	**93**	
1.2.1	Regulatory quality*	32.6	97	
1.2.2	Rule of law*	23.0	119	
1.2.3	Cost of redundancy dismissal, salary weeks	17.3	69	
1.3	**Business environment**	**71.5**	**66**	
1.3.1	Ease of starting a business*	93.0	40	●
1.3.2	Ease of resolving insolvency*	50.0	70	
	HUMAN CAPITAL & RESEARCH	**29.0**	**73**	
2.1	**Education**	**55.7**	**[33]**	
2.1.1	Expenditure on education, % GDP ◷	6.0	16	● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	13.0	81	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	10.6	40	● ◆
2.2	**Tertiary education**	**30.8**	**74**	
2.2.1	Tertiary enrolment, % gross	41.3	68	
2.2.2	Graduates in science & engineering, %	20.8	67	
2.2.3	Tertiary inbound mobility, %	7.6	31	● ◆
2.3	**Research & development (R&D)**	**0.6**	**109**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.1	104	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**32.3**	**97**	
3.1	**Information & communication technologies (ICTs)**	**56.6**	**86**	
3.1.1	ICT access*	46.3	96	
3.1.2	ICT use*	47.1	80	
3.1.3	Government's online service*	64.6	84	
3.1.4	E-participation*	68.5	74	
3.2	**General infrastructure**	**22.5**	**85**	
3.2.1	Electricity output, kWh/mn pop.	2,502.2	71	◆
3.2.2	Logistics performance*	22.3	102	
3.2.3	Gross capital formation, % GDP	28.1	34	●
3.3	**Ecological sustainability**	**17.6**	**112**	
3.3.1	GDP/unit of energy use	5.4	105	◇
3.3.2	Environmental performance*	39.8	89	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	111	
	MARKET SOPHISTICATION	**47.1**	**66**	
4.1	**Credit**	**50.4**	**34**	● ◆
4.1.1	Ease of getting credit*	85.0	14	● ◆
4.1.2	Domestic credit to private sector, % GDP	23.9	107	
4.1.3	Microfinance gross loans, % GDP	4.4	8	● ◆
4.2	**Investment**	**40.0**	**[60]**	
4.2.1	Ease of protecting minority investors*	40.0	110	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**51.0**	**110**	
4.3.1	Applied tariff rate, weighted avg., %	2.9	64	
4.3.2	Intensity of local competition†	56.5	118	◇
4.3.3	Domestic market scale, bn PPP$	25.9	124	○ ◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**18.6**	**105**	
5.1	**Knowledge workers**	**22.4**	**92**	
5.1.1	Knowledge-intensive employment, %	18.8	80	
5.1.2	Firms offering formal training, %	41.4	25	●
5.1.3	GERD performed by business, % GDP ◷	0.0	78	
5.1.4	GERD financed by business, %	6.4	83	
5.1.5	Females employed w/advanced degrees, % ◷	10.8	62	
5.2	**Innovation linkages**	**10.7**	**126**	○ ◇
5.2.1	University/industry research collaboration†	28.9	115	
5.2.2	State of cluster development†	29.1	124	○ ◇
5.2.3	GERD financed by abroad, % GDP	0.0	87	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	92	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**22.7**	**90**	
5.3.1	Intellectual property payments, % total trade ◷	0.2	92	
5.3.2	High-tech imports, % total trade	8.6	52	
5.3.3	ICT services imports, % total trade	0.6	98	
5.3.4	FDI net inflows, % GDP	3.2	47	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**15.6**	**81**	
6.1	**Knowledge creation**	**16.9**	**59**	
6.1.1	Patents by origin/bn PPP$ GDP ◷	6.0	16	● ◆
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	68	
6.1.3	Utility models by origin/bn PPP$ GDP ◷	0.9	24	
6.1.4	Scientific & technical articles/bn PPP$ GDP	4.7	92	
6.1.5	Citable documents H-index	3.0	122	○
6.2	**Knowledge impact**	**14.8**	**103**	
6.2.1	Growth rate of PPP$ GDP/worker, %	3.4	23	●
6.2.2	New businesses/th pop. 15-64 ◷	1.3	77	
6.2.3	Computer software spending, % GDP	0.0	90	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.4	121	◇
6.2.5	High- and medium-high-tech manufacturing, %	2.7	105	○ ◇
6.3	**Knowledge diffusion**	**15.2**	**93**	
6.3.1	Intellectual property receipts, % total trade ◷	0.0	68	
6.3.2	High-tech net exports, % total trade	1.0	69	
6.3.3	ICT services exports, % total trade	0.7	91	
6.3.4	FDI net outflows, % GDP	0.1	104	
	CREATIVE OUTPUTS	**9.2**	**117**	
7.1	**Intangible assets**	**12.9**	**121**	
7.1.1	Trademarks by origin/bn PPP$ GDP	22.5	88	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP ◷	0.5	84	
7.1.4	ICTs & organizational model creation†	34.8	121	○ ◇
7.2	**Creative goods and services**	**4.3**	**106**	
7.2.1	Cultural & creative services exports, % total trade	0.4	55	
7.2.2	National feature films/mn pop. 15-69	0.2	105	○
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	0.6	83	
7.2.5	Creative goods exports, % total trade	0.1	104	
7.3	**Online creativity**	**6.5**	**102**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	0.2	118	
7.3.2	Country-code TLDs/th pop. 15-69	0.8	91	
7.3.3	Wikipedia edits/mn pop. 15-69	28.7	97	
7.3.4	Mobile app creation/bn PPP$ GDP	0.1	87	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

LAO PEOPLE'S DEMOCRATIC REPUBLIC

GII 2020 rank

113

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
95	127	Lower middle	SEAO	7.2	58.1	7,079.9	n/a

		Score/Value	Rank	
	INSTITUTIONS	**38.2**	**130**	○ ◇
1.1	**Political environment**	**47.8**	**95**	
1.1.1	Political and operational stability*	73.2	49	● ◆
1.1.2	Government effectiveness*	35.1	114	
1.2	**Regulatory environment**	**35.5**	**123**	
1.2.1	Regulatory quality*	20.9	118	
1.2.2	Rule of law*	24.7	117	
1.2.3	Cost of redundancy dismissal, salary weeks	34.2	122	
1.3	**Business environment**	**31.3**	**131**	○ ◇
1.3.1	Ease of starting a business*	62.7	129	○ ◇
1.3.2	Ease of resolving insolvency*	0.0	129	○ ◇
	HUMAN CAPITAL & RESEARCH	**14.6**	**113**	
2.1	**Education**	**25.2**	**117**	
2.1.1	Expenditure on education, % GDP ⊙	2.9	99	◇
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	12.5	86	
2.1.3	School life expectancy, years	10.6	104	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	18.2	88	
2.2	**Tertiary education**	**18.7**	**98**	
2.2.1	Tertiary enrolment, % gross	15.0	99	
2.2.2	Graduates in science & engineering, %	22.5	55	
2.2.3	Tertiary inbound mobility, %	0.5	98	
2.3	**Research & development (R&D)**	**0.0**	**[121]**	
2.3.1	Researchers, FTE/mn pop	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**23.7**	**118**	◇
3.1	**Information & communication technologies (ICTs)**	**23.6**	**127**	◇
3.1.1	ICT access*	37.4	110	
3.1.2	ICT use*	22.9	112	◇
3.1.3	Government's online service*	16.7	128	○ ◇
3.1.4	E-participation*	17.4	126	○ ◇
3.2	**General infrastructure**	**29.6**	**[54]**	
3.2.1	Electricity output, kWh/mn pop	n/a	n/a	
3.2.2	Logistics performance*	29.6	81	
3.2.3	Gross capital formation, % GDP	n/a	n/a	
3.3	**Ecological sustainability**	**17.9**	**111**	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	34.8	102	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	119	
	MARKET SOPHISTICATION	**34.9**	**117**	◇
4.1	**Credit**	**29.0**	**110**	
4.1.1	Ease of getting credit*	60.0	74	
4.1.2	Domestic credit to private sector, % GDP ⊙	20.9	112	
4.1.3	Microfinance gross loans, % GDP	0.7	27	●
4.2	**Investment**	**20.0**	**[126]**	
4.2.1	Ease of protecting minority investors*	20.0	129	○ ◇
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**55.7**	**97**	
4.3.1	Applied tariff rate, weighted avg., %	0.7	8	● ◆
4.3.2	Intensity of local competition†	52.4	125	○ ◇
4.3.3	Domestic market scale, bn PPP$	58.1	97	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**24.2**	**[72]**	
5.1	**Knowledge workers**	**26.3**	**[81]**	
5.1.1	Knowledge-intensive employment, % ⊙	21.3	74	
5.1.2	Firms offering formal training, % ⊙	24.4	62	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ⊙	5.4	89	
5.2	**Innovation linkages**	**22.1**	**57**	●
5.2.1	University/industry research collaboration†	44.4	56	●
5.2.2	State of cluster development†	50.8	47	●
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	88	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**24.2**	**[83]**	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports, % total trade ⊙	4.3	118	
5.3.3	ICT services imports, % total trade ⊙	0.2	120	◇
5.3.4	FDI net inflows, % GDP	7.8	15	● ◆
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**11.5**	**108**	
6.1	**Knowledge creation**	**2.0**	**125**	
6.1.1	Patents by origin/bn PPP$ GDP	0.0	130	○ ◇
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	0.0	67	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.2	115	
6.1.5	Citable documents H-index	4.0	114	
6.2	**Knowledge impact**	**2.6**	**[129]**	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15-64	0.0	121	○ ◇
6.2.3	Computer software spending, % GDP	n/a	n/a	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.7	114	
6.2.5	High- and medium-high-tech manufacturing, % ⊙	4.7	97	◇
6.3	**Knowledge diffusion**	**30.0**	**44**	●
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade ⊙	4.8	34	● ◆
6.3.3	ICT services exports, % total trade ⊙	0.4	102	
6.3.4	FDI net outflows, % GDP	2.5	29	● ◆
	CREATIVE OUTPUTS	**16.8**	**[86]**	
7.1	**Intangible assets**	**19.1**	**97**	
7.1.1	Trademarks by origin/bn PPP$ GDP	4.6	119	
7.1.2	Global brand value, top 5,000, % GDP	10.6	58	
7.1.3	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.4	ICTs & organizational model creation†	52.5	71	
7.2	**Creative goods and services**	**26.8**	**[35]**	
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15-69	1.3	79	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing ⊙	0.1	100	○ ◇
7.2.5	Creative goods exports, % total trade	4.0	13	● ◆
7.3	**Online creativity**	**2.3**	**[120]**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	2.0	78	
7.3.2	Country-code TLDs/th pop. 15-69	2.6	64	● ◆
7.3.3	Wikipedia edits/mn pop. 15-69	n/a	n/a	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

LATVIA

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
35	35	High	EUR	1.9	60.6	27,415.1	34

		Score/Value	Rank	
	INSTITUTIONS	**78.0**	**30**	
1.1	**Political environment**	**75.8**	**33**	
1.1.1	Political and operational stability*	80.4	33	
1.1.2	Government effectiveness*	73.5	32	
1.2	**Regulatory environment**	**81.2**	**25**	
1.2.1	Regulatory quality*	73.2	26	
1.2.2	Rule of law*	71.6	32	
1.2.3	Cost of redundancy dismissal, salary weeks	13.0	41	
1.3	**Business environment**	**77.0**	**42**	
1.3.1	Ease of starting a business*	94.1	24	
1.3.2	Ease of resolving insolvency*	59.8	50	
	HUMAN CAPITAL & RESEARCH	**37.3**	**44**	
2.1	**Education**	**55.4**	**34**	
2.1.1	Expenditure on education, % GDP ⊙	4.7	53	
2.1.2	Government funding/pupil, secondary, % GDP/cap	26.0	19	
2.1.3	School life expectancy, years	16.2	29	
2.1.4	PISA scales in reading, maths, & science	487.4	28	
2.1.5	Pupil-teacher ratio, secondary ⊙	8.3	13	● ◆
2.2	**Tertiary education**	**44.5**	**30**	
2.2.1	Tertiary enrolment, % gross	88.1	9	●
2.2.2	Graduates in science & engineering, %	20.9	66	○
2.2.3	Tertiary inbound mobility, %	7.4	33	
2.3	**Research & development (R&D)**	**12.0**	**52**	◇
2.3.1	Researchers, FTE/mn pop.	1,912.9	42	
2.3.2	Gross expenditure on R&D, % GDP	0.6	54	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	12.7	60	
	INFRASTRUCTURE	**47.0**	**45**	◇
3.1	**Information & communication technologies (ICTs)**	**70.8**	**55**	◇
3.1.1	ICT access*	71.5	56	◇
3.1.2	ICT use*	76.3	28	
3.1.3	Government's online service*	66.7	76	◇
3.1.4	E-participation*	68.5	74	◇
3.2	**General infrastructure**	**23.8**	**79**	◇
3.2.1	Electricity output, kWh/mn pop.	3,484.4	57	
3.2.2	Logistics performance*	34.7	69	◇
3.2.3	Gross capital formation, % GDP	24.5	56	
3.3	**Ecological sustainability**	**46.4**	**27**	
3.3.1	GDP/unit of energy use	10.5	48	
3.3.2	Environmental performance*	61.6	36	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	5.8	16	●
	MARKET SOPHISTICATION	**51.4**	**43**	
4.1	**Credit**	**49.6**	**36**	
4.1.1	Ease of getting credit*	85.0	14	◆
4.1.2	Domestic credit to private sector, % GDP	36.1	84	○ ◇
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**41.2**	**57**	
4.2.1	Ease of protecting minority investors*	68.0	44	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	29	
4.3	**Trade, competition, and market scale**	**63.3**	**63**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	74.3	33	
4.3.3	Domestic market scale, bn PPP$	60.6	96	○ ◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**34.3**	**41**	
5.1	**Knowledge workers**	**44.8**	**35**	
5.1.1	Knowledge-intensive employment, %	40.7	26	
5.1.2	Firms offering formal training, %	52.9	14	◆
5.1.3	GERD performed by business, % GDP	0.2	54	
5.1.4	GERD financed by business, %	24.1	63	◇
5.1.5	Females employed w/advanced degrees, %	24.9	15	●
5.2	**Innovation linkages**	**27.1**	**39**	
5.2.1	University/industry research collaboration†	49.5	41	
5.2.2	State of cluster development†	48.6	57	
5.2.3	GERD financed by abroad, % GDP	0.2	27	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	28	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	43	
5.3	**Knowledge absorption**	**31.1**	**57**	
5.3.1	Intellectual property payments, % total trade	0.3	85	○ ◇
5.3.2	High-tech imports, % total trade	14.2	14	● ◆
5.3.3	ICT services imports, % total trade	2.1	26	
5.3.4	FDI net inflows, % GDP	2.1	82	○
5.3.5	Research talent, % in business enterprise	18.5	58	○ ◇
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**29.5**	**42**	
6.1	**Knowledge creation**	**17.5**	**56**	
6.1.1	Patents by origin/bn PPP$ GDP	1.7	47	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.6	31	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	11.9	45	
6.1.5	Citable documents H-index	9.3	79	◇
6.2	**Knowledge impact**	**28.3**	**47**	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.9	29	◆
6.2.2	New businesses/th pop. 15-64	8.0	20	
6.2.3	Computer software spending, % GDP	0.0	85	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	15.5	18	●
6.2.5	High- and medium-high-tech manufacturing, %	9.9	81	○ ◇
6.3	**Knowledge diffusion**	**42.7**	**24**	
6.3.1	Intellectual property receipts, % total trade	0.0	67	
6.3.2	High-tech net exports, % total trade	9.0	18	
6.3.3	ICT services exports, % total trade	4.4	17	●
6.3.4	FDI net outflows, % GDP	0.6	73	
	CREATIVE OUTPUTS	**35.7**	**28**	
7.1	**Intangible assets**	**34.0**	**39**	
7.1.1	Trademarks by origin/bn PPP$ GDP	100.4	11	● ◆
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	4.5	26	
7.1.4	ICTs & organizational model creation†	62.7	37	
7.2	**Creative goods and services**	**42.1**	**9**	● ◆
7.2.1	Cultural & creative services exports, % total trade	1.4	16	
7.2.2	National feature films/mn pop. 15-69	15.4	8	●
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	2.6	6	● ◆
7.2.5	Creative goods exports, % total trade	2.7	21	
7.3	**Online creativity**	**32.9**	**32**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	9.6	41	
7.3.2	Country-code TLDs/th pop. 15-69	28.6	23	
7.3.3	Wikipedia edits/mn pop. 15-69	81.4	20	
7.3.4	Mobile app creation/bn PPP$ GDP	12.9	38	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

LEBANON

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
80	93	Upper middle	NAWA	6.9	91.3	13,138.2	88

		Score/Value	Rank	
	INSTITUTIONS	**52.2**	**103**	◇
1.1	**Political environment**	**38.8**	**123**	○ ◇
1.1.1	Political and operational stability*	44.6	130	○ ◇
1.1.2	Government effectiveness*	35.8	113	○ ◇
1.2	**Regulatory environment**	**64.2**	**67**	
1.2.1	Regulatory quality*	32.8	96	
1.2.2	Rule of law*	26.7	110	◇
1.2.3	Cost of redundancy dismissal, salary weeks	8.7	20	●
1.3	**Business environment**	**53.6**	**121**	○ ◇
1.3.1	Ease of starting a business*	78.2	112	
1.3.2	Ease of resolving insolvency*	29.1	121	○ ◇
	HUMAN CAPITAL & RESEARCH	**24.7**	**85**	
2.1	**Education**	**21.9**	**123**	○ ◇
2.1.1	Expenditure on education, % GDP ⊙	2.4	111	○ ◇
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	6.4	102	○ ◇
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	376.8	73	○
2.1.5	Pupil-teacher ratio, secondary ⊙	7.7	7	● ◆
2.2	**Tertiary education**	**38.7**	**48**	
2.2.1	Tertiary enrolment, % gross	n/a	n/a	
2.2.2	Graduates in science & engineering, % ⊙	23.4	47	
2.2.3	Tertiary inbound mobility, %	9.3	22	● ◆
2.3	**Research & development (R&D)**	**13.4**	**[49]**	
2.3.1	Researchers, FTE/mn pop	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	26.8	43	
	INFRASTRUCTURE	**31.6**	**98**	◇
3.1	**Information & communication technologies (ICTs)**	**48.9**	**100**	◇
3.1.1	ICT access*	62.6	70	
3.1.2	ICT use*	41.2	98	◇
3.1.3	Government's online service*	47.2	110	◇
3.1.4	E-participation*	44.4	108	◇
3.2	**General infrastructure**	**21.2**	**93**	
3.2.1	Electricity output, kWh/mn pop	3,329.1	59	
3.2.2	Logistics performance*	30.3	78	
3.2.3	Gross capital formation, % GDP	n/a	n/a	
3.3	**Ecological sustainability**	**24.7**	**83**	
3.3.1	GDP/unit of energy use	8.7	70	
3.3.2	Environmental performance*	45.4	70	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.6	78	
	MARKET SOPHISTICATION	**43.1**	**90**	
4.1	**Credit**	**35.2**	**88**	
4.1.1	Ease of getting credit*	40.0	113	○ ◇
4.1.2	Domestic credit to private sector, % GDP ⊙	105.8	21	● ◆
4.1.3	Microfinance gross loans, % GDP	0.2	54	
4.2	**Investment**	**26.2**	**109**	
4.2.1	Ease of protecting minority investors*	44.0	98	
4.2.2	Market capitalization, % GDP	20.8	56	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	20	●
4.3	**Trade, competition, and market scale**	**67.8**	**41**	
4.3.1	Applied tariff rate, weighted avg., %	1.1	13	●
4.3.2	Intensity of local competition†	79.0	12	● ◆
4.3.3	Domestic market scale, bn PPP$	91.3	87	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**23.3**	**80**	
5.1	**Knowledge workers**	**28.2**	**[73]**	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % ⊙	26.6	57	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, %	n/a	n/a	
5.2	**Innovation linkages**	**21.8**	**60**	
5.2.1	University/industry research collaboration†	43.2	58	
5.2.2	State of cluster development†	48.8	53	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	82	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	77	
5.3	**Knowledge absorption**	**19.9**	**98**	
5.3.1	Intellectual property payments, % total trade ⊙	0.1	101	
5.3.2	High-tech imports, % total trade	3.9	123	○
5.3.3	ICT services imports, % total trade ⊙	1.8	33	◆
5.3.4	FDI net inflows, % GDP	4.8	29	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**17.0**	**[76]**	
6.1	**Knowledge creation**	**18.3**	**[53]**	
6.1.1	Patents by origin/bn PPP$ GDP ⊙	1.3	56	
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	12.9	43	
6.1.5	Citable documents H-index	12.2	61	
6.2	**Knowledge impact**	**14.9**	**[102]**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-1.1	107	○
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	101	◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	6.9	39	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**17.8**	**85**	
6.3.1	Intellectual property receipts, % total trade ⊙	0.1	62	
6.3.2	High-tech net exports, % total trade	0.2	102	
6.3.3	ICT services exports, % total trade ⊙	2.5	41	
6.3.4	FDI net outflows, % GDP	2.2	34	◆
	CREATIVE OUTPUTS	**17.2**	**85**	
7.1	**Intangible assets**	**17.2**	**104**	
7.1.1	Trademarks by origin/bn PPP$ GDP ⊙	15.1	102	
7.1.2	Global brand value, top 5,000, % GDP	9.6	61	
7.1.3	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.4	ICTs & organizational model creation†	42.4	106	◇
7.2	**Creative goods and services**	**15.6**	**62**	
7.2.1	Cultural & creative services exports, % total trade	1.9	7	● ◆
7.2.2	National feature films/mn pop. 15–69 ⊙	3.3	55	
7.2.3	Entertainment & Media market/th pop. 15–69	3.6	49	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.5	60	
7.3	**Online creativity**	**18.6**	**57**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	6.0	51	
7.3.2	Country-code TLDs/th pop. 15–69	0.3	106	
7.3.3	Wikipedia edits/mn pop. 15–69	46.9	66	
7.3.4	Mobile app creation/bn PPP$ GDP	24.2	23	●

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

LITHUANIA

GII 2020 rank
40

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
42	36	High	EUR	2.8	102.2	32,040.8	38

		Score/Value	Rank	
	INSTITUTIONS	**76.0**	**33**	
1.1	**Political environment**	**77.4**	**29**	
1.1.1	Political and operational stability*	83.9	21	
1.1.2	Government effectiveness*	74.1	31	
1.2	**Regulatory environment**	**80.7**	**29**	
1.2.1	Regulatory quality*	71.2	29	
1.2.2	Rule of law*	71.6	31	
1.2.3	Cost of redundancy dismissal, salary weeks	13.0	41	
1.3	**Business environment**	**70.0**	**71**	
1.3.1	Ease of starting a business*	93.3	32	
1.3.2	Ease of resolving insolvency*	46.7	81	◇
	HUMAN CAPITAL & RESEARCH	**36.9**	**45**	
2.1	**Education**	**49.2**	**55**	
2.1.1	Expenditure on education, % GDP ◷	4.0	72	
2.1.2	Government funding/pupil, secondary, % GDP/cap	17.7	63	
2.1.3	School life expectancy, years	16.6	21	●
2.1.4	PISA scales in reading, maths, & science	479.7	32	
2.1.5	Pupil-teacher ratio, secondary ◷	7.8	9	● ◆
2.2	**Tertiary education**	**42.7**	**35**	
2.2.1	Tertiary enrolment, % gross	72.4	24	
2.2.2	Graduates in science & engineering, %	25.7	32	
2.2.3	Tertiary inbound mobility, %	4.6	48	
2.3	**Research & development (R&D)**	**18.8**	**45**	
2.3.1	Researchers, FTE/mn pop.	3,131.8	30	
2.3.2	Gross expenditure on R&D, % GDP	0.9	41	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	20.1	53	
	INFRASTRUCTURE	**51.3**	**38**	
3.1	**Information & communication technologies (ICTs)**	**77.4**	**39**	
3.1.1	ICT access*	74.4	45	
3.1.2	ICT use*	75.1	30	
3.1.3	Government's online service*	79.9	45	
3.1.4	E-participation*	80.3	51	
3.2	**General infrastructure**	**19.9**	**98**	○ ◇
3.2.1	Electricity output, kWh/mn pop.	1,065.2	93	○ ◇
3.2.2	Logistics performance*	44.5	53	◇
3.2.3	Gross capital formation, % GDP	18.8	105	○
3.3	**Ecological sustainability**	**56.5**	**8**	● ◆
3.3.1	GDP/unit of energy use	10.5	48	
3.3.2	Environmental performance*	62.9	35	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	9.4	6	● ◆
	MARKET SOPHISTICATION	**51.2**	**46**	
4.1	**Credit**	**43.2**	**59**	
4.1.1	Ease of getting credit*	70.0	44	
4.1.2	Domestic credit to private sector, % GDP	40.7	80	○ ◇
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**44.5**	**35**	
4.2.1	Ease of protecting minority investors*	70.0	36	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	24	
4.3	**Trade, competition, and market scale**	**65.8**	**48**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	75.1	26	
4.3.3	Domestic market scale, bn PPP$	102.2	80	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**31.5**	**47**	
5.1	**Knowledge workers**	**42.7**	**40**	
5.1.1	Knowledge-intensive employment, %	42.2	23	
5.1.2	Firms offering formal training, %	27.5	55	
5.1.3	GERD performed by business, % GDP	0.3	45	
5.1.4	GERD financed by business, %	35.4	50	
5.1.5	Females employed w/advanced degrees, %	28.1	4	● ◆
5.2	**Innovation linkages**	**27.8**	**37**	
5.2.1	University/industry research collaboration†	53.4	34	
5.2.2	State of cluster development†	40.8	92	○ ◇
5.2.3	GERD financed by abroad, % GDP	0.2	15	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	34	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.3	35	
5.3	**Knowledge absorption**	**24.0**	**85**	○ ◇
5.3.1	Intellectual property payments, % total trade	0.2	91	○ ◇
5.3.2	High-tech imports, % total trade	6.1	94	○
5.3.3	ICT services imports, % total trade	0.8	86	○
5.3.4	FDI net inflows, % GDP	2.1	77	
5.3.5	Research talent, % in business enterprise	30.4	42	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**27.1**	**48**	
6.1	**Knowledge creation**	**22.4**	**46**	
6.1.1	Patents by origin/bn PPP$ GDP	1.2	61	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.3	40	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	19.7	28	
6.1.5	Citable documents H-index	13.1	58	
6.2	**Knowledge impact**	**28.9**	**44**	
6.2.1	Growth rate of PPP$ GDP/worker, %	3.6	22	◆
6.2.2	New businesses/th pop. 15–64	3.3	41	
6.2.3	Computer software spending, % GDP	0.0	96	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	15.1	20	●
6.2.5	High- and medium-high-tech manufacturing, %	18.0	59	
6.3	**Knowledge diffusion**	**30.0**	**43**	
6.3.1	Intellectual property receipts, % total trade	0.1	61	
6.3.2	High-tech net exports, % total trade	5.8	27	
6.3.3	ICT services exports, % total trade	1.5	70	
6.3.4	FDI net outflows, % GDP	1.5	44	
	CREATIVE OUTPUTS	**30.9**	**40**	
7.1	**Intangible assets**	**27.6**	**66**	
7.1.1	Trademarks by origin/bn PPP$ GDP	47.7	53	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	2.9	39	
7.1.4	ICTs & organizational model creation†	68.4	21	●
7.2	**Creative goods and services**	**19.0**	**57**	
7.2.1	Cultural & creative services exports, % total trade	0.6	39	
7.2.2	National feature films/mn pop. 15–69	5.4	40	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	1.1	51	
7.2.5	Creative goods exports, % total trade	1.6	33	
7.3	**Online creativity**	**49.3**	**21**	●
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	13.7	33	
7.3.2	Country-code TLDs/th pop. 15–69	31.2	21	●
7.3.3	Wikipedia edits/mn pop. 15–69	81.0	22	●
7.3.4	Mobile app creation/bn PPP$ GDP	72.1	8	● ◆

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

LUXEMBOURG

GII 2020 rank

18

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
14	24	High	EUR	0.6	66.8	95,117.1	18

		Score/Value	Rank	
	INSTITUTIONS	**80.2**	**26**	
1.1	**Political environment**	**91.5**	**6**	
1.1.1	Political and operational stability*	94.6	3	● ◆
1.1.2	Government effectiveness*	89.9	9	
1.2	**Regulatory environment**	**82.0**	**24**	
1.2.1	Regulatory quality*	88.2	11	
1.2.2	Rule of law*	93.9	10	
1.2.3	Cost of redundancy dismissal, salary weeks	21.7	92	○ ◇
1.3	**Business environment**	**67.2**	**77**	◇
1.3.1	Ease of starting a business*	88.8	61	
1.3.2	Ease of resolving insolvency*	45.5	84	◇

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**38.6**	**41**	◇
2.1	**Education**	**45.6**	**66**	◇
2.1.1	Expenditure on education, % GDP ⊙	4.0	75	
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	19.4	51	
2.1.3	School life expectancy, years	14.3	68	◇
2.1.4	PISA scales in reading, maths, & science	476.7	35	◇
2.1.5	Pupil-teacher ratio, secondary ⊙	8.8	20	◆
2.2	**Tertiary education**	**34.5**	**61**	
2.2.1	Tertiary enrolment, % gross	19.2	95	○ ◇
2.2.2	Graduates in science & engineering, % ⊙	17.9	80	○ ◇
2.2.3	Tertiary inbound mobility, %	46.7	1	● ◆
2.3	**Research & development (R&D)**	**35.6**	**31**	◇
2.3.1	Researchers, FTE/mn pop.	4,941.7	17	
2.3.2	Gross expenditure on R&D, % GDP	1.2	32	◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	58.5	24	
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**54.9**	**23**	
3.1	**Information & communication technologies (ICTs)**	**90.8**	**5**	
3.1.1	ICT access*	92.8	1	● ◆
3.1.2	ICT use*	84.3	10	
3.1.3	Government's online service*	92.4	22	
3.1.4	E-participation*	93.8	19	
3.2	**General infrastructure**	**27.1**	**64**	◇
3.2.1	Electricity output, kWh/mn pop.	1,536.6	88	○ ◇
3.2.2	Logistics performance*	73.2	24	
3.2.3	Gross capital formation, % GDP	18.2	111	○ ◇
3.3	**Ecological sustainability**	**46.9**	**24**	
3.3.1	GDP/unit of energy use	13.5	19	
3.3.2	Environmental performance*	82.3	2	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.0	45	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**53.4**	**32**	
4.1	**Credit**	**31.9**	**102**	○ ◇
4.1.1	Ease of getting credit*	15.0	127	○ ◇
4.1.2	Domestic credit to private sector, % GDP	109.8	20	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**65.3**	**11**	
4.2.1	Ease of protecting minority investors*	54.0	88	◇
4.2.2	Market capitalization, % GDP	92.5	14	
4.2.3	Venture capital deals/bn PPP$ GDP	1.3	1	● ◆
4.3	**Trade, competition, and market scale**	**63.0**	**66**	◇
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	72.4	43	
4.3.3	Domestic market scale, bn PPP$	66.8	94	◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**59.0**	**9**	
5.1	**Knowledge workers**	**59.7**	**15**	
5.1.1	Knowledge-intensive employment, %	57.7	1	● ◆
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	0.7	33	◇
5.1.4	GERD financed by business, %	49.6	27	
5.1.5	Females employed w/advanced degrees, %	22.7	18	
5.2	**Innovation linkages**	**63.3**	**6**	
5.2.1	University/industry research collaboration†	69.4	9	
5.2.2	State of cluster development†	68.8	10	
5.2.3	GERD financed by abroad, % GDP	0.1	45	◇
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.2	8	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	7.0	1	● ◆
5.3	**Knowledge absorption**	**54.0**	**9**	
5.3.1	Intellectual property payments, % total trade	4.4	1	● ◆
5.3.2	High-tech imports, % total trade	1.6	130	○ ◇
5.3.3	ICT services imports, % total trade	3.4	5	◆
5.3.4	FDI net inflows, % GDP	11.3	8	
5.3.5	Research talent, % in business enterprise	43.9	30	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**33.9**	**31**	◇
6.1	**Knowledge creation**	**43.7**	**19**	
6.1.1	Patents by origin/bn PPP$ GDP	9.4	11	
6.1.2	PCT patents by origin/bn PPP$ GDP	5.3	7	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	13.5	40	◇
6.1.5	Citable documents H-index	10.9	70	◇
6.2	**Knowledge impact**	**21.1**	**79**	◇
6.2.1	Growth rate of PPP$ GDP/worker, %	-1.1	108	○ ◇
6.2.2	New businesses/th pop. 15-64	17.2	7	◆
6.2.3	Computer software spending, % GDP	0.0	69	◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.0	63	
6.2.5	High- and medium-high-tech manufacturing, %	14.2	67	◇
6.3	**Knowledge diffusion**	**37.0**	**29**	
6.3.1	Intellectual property receipts, % total trade	1.9	12	
6.3.2	High-tech net exports, % total trade	0.7	74	◇
6.3.3	ICT services exports, % total trade	3.1	28	
6.3.4	FDI net outflows, % GDP	11.3	5	◆

		Score/Value	Rank	
	CREATIVE OUTPUTS	**55.0**	**3**	● ◆
7.1	**Intangible assets**	**51.5**	**11**	
7.1.1	Trademarks by origin/bn PPP$ GDP	89.8	19	
7.1.2	Global brand value, top 5,000, % GDP	129.9	15	
7.1.3	Industrial designs by origin/bn PPP$ GDP	8.4	15	
7.1.4	ICTs & organizational model creation†	72.2	15	
7.2	**Creative goods and services**	**43.2**	**8**	
7.2.1	Cultural & creative services exports, % total trade	4.5	1	● ◆
7.2.2	National feature films/mn pop. 15-69	29.6	1	● ◆
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	0.8	69	
7.2.5	Creative goods exports, % total trade	0.1	100	○ ◇
7.3	**Online creativity**	**73.6**	**1**	● ◆
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	86.0	4	● ◆
7.3.2	Country-code TLDs/th pop. 15-69	68.1	9	
7.3.3	Wikipedia edits/mn pop. 15-69	87.8	9	
7.3.4	Mobile app creation/bn PPP$ GDP	53.1	11	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

MADAGASCAR

GII 2020 rank

115

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
100	125	Low	SSF	27.0	46.0	1,483.5	121

		Score/Value	Rank	
	INSTITUTIONS	**51.4**	**108**	
1.1	**Political environment**	**37.1**	**125**	
1.1.1	Political and operational stability*	62.5	92	
1.1.2	Government effectiveness*	24.4	129	○
1.2	**Regulatory environment**	**55.4**	**91**	
1.2.1	Regulatory quality*	22.4	114	
1.2.2	Rule of law*	25.4	113	
1.2.3	Cost of redundancy dismissal, salary weeks	14.7	57	●
1.3	**Business environment**	**61.6**	**100**	
1.3.1	Ease of starting a business*	88.5	65	
1.3.2	Ease of resolving insolvency*	34.8	113	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**13.6**	**116**	
2.1	**Education**	**22.5**	**121**	
2.1.1	Expenditure on education, % GDP	3.2	92	
2.1.2	Government funding/pupil, secondary, % GDP/cap ◷	8.4	98	◇
2.1.3	School life expectancy, years	10.2	107	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	19.3	96	
2.2	**Tertiary education**	**18.2**	**100**	◆
2.2.1	Tertiary enrolment, % gross	5.4	118	
2.2.2	Graduates in science & engineering, %	23.8	43	● ◆
2.2.3	Tertiary inbound mobility, %	1.4	83	
2.3	**Research & development (R&D)**	**0.1**	**120**	
2.3.1	Researchers, FTE/mn pop.	34.0	100	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.0	115	○ ◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**18.8**	**127**	
3.1	**Information & communication technologies (ICTs)**	**23.5**	**128**	○
3.1.1	ICT access*	22.5	129	○ ◇
3.1.2	ICT use*	8.5	129	○
3.1.3	Government's online service*	30.6	120	
3.1.4	E-participation*	32.6	117	
3.2	**General infrastructure**	**19.0**	**106**	
3.2.1	Electricity output, kWh/mn pop.	n/a	n/a	
3.2.2	Logistics performance*	15.0	115	
3.2.3	Gross capital formation, % GDP	22.4	75	
3.3	**Ecological sustainability**	**14.0**	**126**	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	26.5	126	○ ◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	107	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**36.2**	**115**	
4.1	**Credit**	**22.7**	**120**	
4.1.1	Ease of getting credit*	40.0	113	
4.1.2	Domestic credit to private sector, % GDP	14.7	118	
4.1.3	Microfinance gross loans, % GDP	1.7	20	●
4.2	**Investment**	**36.0**	**[69]**	
4.2.1	Ease of protecting minority investors*	36.0	116	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**50.0**	**117**	
4.3.1	Applied tariff rate, weighted avg., %	7.7	101	
4.3.2	Intensity of local competition† ◷	63.7	87	
4.3.3	Domestic market scale, bn PPP$	46.0	104	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**17.0**	**[121]**	
5.1	**Knowledge workers**	**4.9**	**[130]**	
5.1.1	Knowledge-intensive employment, % ◷	3.7	119	○
5.1.2	Firms offering formal training, % ◷	12.7	89	◇
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ◷	1.9	103	
5.2	**Innovation linkages**	**22.1**	**[58]**	
5.2.1	University/industry research collaboration†	32.3	102	
5.2.2	State of cluster development†	39.1	99	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**24.0**	**86**	
5.3.1	Intellectual property payments, % total trade ◷	0.4	74	
5.3.2	High-tech imports, % total trade ◷	4.2	119	
5.3.3	ICT services imports, % total trade ◷	2.5	15	● ◆
5.3.4	FDI net inflows, % GDP	4.2	36	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**11.4**	**109**	
6.1	**Knowledge creation**	**4.0**	**114**	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	101	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.3	103	
6.1.5	Citable documents H-index	4.8	106	
6.2	**Knowledge impact**	**13.8**	**106**	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.7	51	●
6.2.2	New businesses/th pop. 15-64	0.1	116	
6.2.3	Computer software spending, % GDP	0.0	114	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.6	90	◆
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**16.4**	**89**	
6.3.1	Intellectual property receipts, % total trade ◷	0.2	35	● ◆
6.3.2	High-tech net exports, % total trade ◷	0.1	112	
6.3.3	ICT services exports, % total trade ◷	2.3	49	●
6.3.4	FDI net outflows, % GDP	0.8	61	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**15.4**	**[93]**	
7.1	**Intangible assets**	**28.4**	**[63]**	
7.1.1	Trademarks by origin/bn PPP$ GDP	57.0	40	● ◆
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	6.8	19	● ◆
7.1.4	ICTs & organizational model creation†	n/a	n/a	
7.2	**Creative goods and services**	**2.3**	**[115]**	
7.2.1	Cultural & creative services exports, % total trade ◷	0.1	76	
7.2.2	National feature films/mn pop. 15-69	0.8	92	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade ◷	0.1	91	
7.3	**Online creativity**	**2.5**	**118**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	0.1	123	
7.3.2	Country-code TLDs/th pop. 15-69	0.1	118	
7.3.3	Wikipedia edits/mn pop. 15-69	12.1	117	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

MALAWI

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
103	114	Low	SSF	18.6	25.2	1,082.9	118

		Score/Value	Rank	
	INSTITUTIONS	**52.2**	**106**	
1.1	**Political environment**	**43.4**	**111**	
1.1.1	Political and operational stability*	62.5	92	
1.1.2	Government effectiveness*	33.9	116	
1.2	**Regulatory environment**	**56.6**	**89**	
1.2.1	Regulatory quality*	24.1	112	
1.2.2	Rule of law*	36.8	84	
1.2.3	Cost of redundancy dismissal, salary weeks	16.7	65	
1.3	**Business environment**	**56.4**	**115**	
1.3.1	Ease of starting a business*	77.9	114	
1.3.2	Ease of resolving insolvency*	34.9	112	
	HUMAN CAPITAL & RESEARCH	**10.5**	**124**	
2.1	**Education**	**29.9**	**105**	
2.1.1	Expenditure on education, % GDP	4.7	54	●
2.1.2	Government funding/pupil, secondary, % GDP/cap	24.0	23	●
2.1.3	School life expectancy, years ⊙	10.9	101	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	72.3	124	○ ◇
2.2	**Tertiary education**	**1.6**	**129**	○ ◇
2.2.1	Tertiary enrolment, % gross ⊙	0.8	124	○ ◇
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, % ⊙	1.1	86	
2.3	**Research & development (R&D)**	**0.2**	**117**	
2.3.1	Researchers, FTE/mn pop. ⊙	50.4	92	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**17.4**	**128**	◇
3.1	**Information & communication technologies (ICTs)**	**20.3**	**129**	○ ◇
3.1.1	ICT access*	21.4	131	○ ◇
3.1.2	ICT use*	13.7	123	
3.1.3	Government's online service*	25.7	122	
3.1.4	E-participation*	20.2	123	◇
3.2	**General infrastructure**	**12.3**	**124**	
3.2.1	Electricity output, kWh/mn pop.	n/a	n/a	
3.2.2	Logistics performance*	24.2	93	
3.2.3	Gross capital formation, % GDP	12.3	123	○ ◇
3.3	**Ecological sustainability**	**19.5**	**104**	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	38.3	93	◆
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	123	
	MARKET SOPHISTICATION	**48.9**	**58**	● ◆
4.1	**Credit**	**38.4**	**79**	
4.1.1	Ease of getting credit*	90.0	10	● ◆
4.1.2	Domestic credit to private sector, % GDP ⊙	10.5	126	○
4.1.3	Microfinance gross loans, % GDP	0.5	36	●
4.2	**Investment**	**58.0**	**[17]**	
4.2.1	Ease of protecting minority investors*	58.0	77	◆
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**50.3**	**114**	
4.3.1	Applied tariff rate, weighted avg., % ⊙	4.8	86	◆
4.3.2	Intensity of local competition†	61.1	106	
4.3.3	Domestic market scale, bn PPP$	25.2	126	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**21.2**	**[92]**	
5.1	**Knowledge workers**	**15.3**	**[107]**	
5.1.1	Knowledge-intensive employment, % ⊙	3.7	118	○
5.1.2	Firms offering formal training, % ⊙	32.9	43	● ◆
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ⊙	0.6	115	
5.2	**Innovation linkages**	**20.9**	**[66]**	
5.2.1	University/industry research collaboration†	31.0	105	
5.2.2	State of cluster development†	35.9	110	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	71	◆
5.3	**Knowledge absorption**	**27.4**	**71**	
5.3.1	Intellectual property payments, % total trade ⊙	0.2	88	
5.3.2	High-tech imports, % total trade ⊙	10.7	23	●
5.3.3	ICT services imports, % total trade ⊙	1.5	45	●
5.3.4	FDI net inflows, % GDP	1.7	91	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**13.4**	**92**	
6.1	**Knowledge creation**	**9.3**	**79**	
6.1.1	Patents by origin/bn PPP$ GDP ⊙	0.1	109	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	9.3	56	● ◆
6.1.5	Citable documents H-index	8.1	85	
6.2	**Knowledge impact**	**10.7**	**115**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.5	75	
6.2.2	New businesses/th pop. 15–64 ⊙	0.1	119	○
6.2.3	Computer software spending, % GDP	0.0	110	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.8	112	
6.2.5	High- and medium-high-tech manufacturing, % ⊙	8.6	86	
6.3	**Knowledge diffusion**	**20.3**	**75**	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade ⊙	0.5	81	
6.3.3	ICT services exports, % total trade ⊙	2.1	53	●
6.3.4	FDI net outflows, % GDP	-0.1	120	
	CREATIVE OUTPUTS	**12.3**	**[107]**	
7.1	**Intangible assets**	**19.2**	**[96]**	
7.1.1	Trademarks by origin/bn PPP$ GDP ⊙	23.6	87	
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.4	ICTs & organizational model creation†	28.7	124	○ ◇
7.2	**Creative goods and services**	**6.6**	**[97]**	
7.2.1	Cultural & creative services exports, % total trade ⊙	0.1	84	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing ⊙	1.2	35	●
7.2.5	Creative goods exports, % total trade ⊙	0.1	103	
7.3	**Online creativity**	**4.2**	**112**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.2	117	
7.3.2	Country-code TLDs/th pop. 15–69	0.0	124	
7.3.3	Wikipedia edits/mn pop. 15–69	17.0	113	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

MALAYSIA

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
36	34	Upper middle	SEAO	31.9	1,078.5	28,705.9	35

		Score/Value	Rank	
	INSTITUTIONS	**72.5**	**40**	◆
1.1	**Political environment**	**77.4**	**28**	◆
1.1.1	Political and operational stability*	83.9	21	◆
1.1.2	Government effectiveness*	74.2	30	◆
1.2	**Regulatory environment**	**64.9**	**64**	
1.2.1	Regulatory quality*	59.8	40	◆
1.2.2	Rule of law*	62.9	38	◆
1.2.3	Cost of redundancy dismissal, salary weeks	23.9	102	○
1.3	**Business environment**	**75.2**	**50**	
1.3.1	Ease of starting a business*	83.3	97	○
1.3.2	Ease of resolving insolvency*	67.0	37	
	HUMAN CAPITAL & RESEARCH	**46.0**	**29**	◆
2.1	**Education**	**45.1**	**68**	
2.1.1	Expenditure on education, % GDP	4.5	62	
2.1.2	Government funding/pupil, secondary, % GDP/cap	22.8	31	
2.1.3	School life expectancy, years	13.7	74	
2.1.4	PISA scales in reading, maths, & science	430.9	48	
2.1.5	Pupil-teacher ratio, secondary	11.4	49	
2.2	**Tertiary education**	**55.4**	**8**	● ◆
2.2.1	Tertiary enrolment, % gross	45.1	65	
2.2.2	Graduates in science & engineering, %	40.8	4	● ◆
2.2.3	Tertiary inbound mobility, %	9.6	21	◆
2.3	**Research & development (R&D)**	**37.4**	**29**	◆
2.3.1	Researchers, FTE/mn pop. ⊙	2,396.5	35	◆
2.3.2	Gross expenditure on R&D, % GDP ⊙	1.4	24	◆
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	37.4	41	◆
2.3.4	QS university ranking, average score top 3*	54.6	17	● ◆
	INFRASTRUCTURE	**46.4**	**48**	
3.1	**Information & communication technologies (ICTs)**	**79.4**	**35**	◆
3.1.1	ICT access*	74.8	44	◆
3.1.2	ICT use*	65.2	52	◆
3.1.3	Government's online service*	88.9	27	◆
3.1.4	E-participation*	88.8	32	◆
3.2	**General infrastructure**	**28.8**	**59**	
3.2.1	Electricity output, kWh/mn pop.	5,202.5	38	◆
3.2.2	Logistics performance*	54.0	40	◆
3.2.3	Gross capital formation, % GDP	22.5	73	
3.3	**Ecological sustainability**	**31.0**	**56**	
3.3.1	GDP/unit of energy use	9.8	58	
3.3.2	Environmental performance*	47.9	62	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.1	40	
	MARKET SOPHISTICATION	**58.3**	**20**	◆
4.1	**Credit**	**52.1**	**26**	◆
4.1.1	Ease of getting credit*	75.0	34	
4.1.2	Domestic credit to private sector, % GDP	121.8	18	◆
4.1.3	Microfinance gross loans, % GDP ⊙	0.1	57	○
4.2	**Investment**	**50.0**	**25**	
4.2.1	Ease of protecting minority investors*	88.0	2	● ◆
4.2.2	Market capitalization, % GDP	124.4	7	● ◆
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	44	
4.3	**Trade, competition, and market scale**	**72.8**	**28**	◆
4.3.1	Applied tariff rate, weighted avg., % ⊙	4.0	76	
4.3.2	Intensity of local competition†	76.7	17	◆
4.3.3	Domestic market scale, bn PPP$	1,078.5	25	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**38.0**	**31**	◆
5.1	**Knowledge workers**	**37.3**	**53**	
5.1.1	Knowledge-intensive employment, %	27.2	54	
5.1.2	Firms offering formal training, % ⊙	18.5	77	○ ◇
5.1.3	GERD performed by business, % GDP ⊙	0.8	25	◆
5.1.4	GERD financed by business, % ⊙	56.9	15	◆
5.1.5	Females employed w/advanced degrees, % ⊙	12.5	56	
5.2	**Innovation linkages**	**30.3**	**33**	◆
5.2.1	University/industry research collaboration†	68.3	14	● ◆
5.2.2	State of cluster development†	69.8	7	● ◆
5.2.3	GERD financed by abroad, % GDP ⊙	0.0	73	○
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	25	◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.4	33	◆
5.3	**Knowledge absorption**	**46.3**	**22**	◆
5.3.1	Intellectual property payments, % total trade	0.8	47	
5.3.2	High-tech imports, % total trade	27.0	3	● ◆
5.3.3	ICT services imports, % total trade	1.4	47	
5.3.4	FDI net inflows, % GDP	3.3	45	
5.3.5	Research talent, % in business enterprise ⊙	21.9	55	○
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**31.3**	**38**	◆
6.1	**Knowledge creation**	**12.1**	**70**	
6.1.1	Patents by origin/bn PPP$ GDP	1.1	63	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.2	49	
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	55	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	8.6	58	
6.1.5	Citable documents H-index	18.9	42	
6.2	**Knowledge impact**	**36.2**	**22**	◆
6.2.1	Growth rate of PPP$ GDP/worker, %	2.6	36	
6.2.2	New businesses/th pop. 15-64	2.4	52	
6.2.3	Computer software spending, % GDP	0.0	28	◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	9.4	29	
6.2.5	High- and medium-high-tech manufacturing, %	43.1	17	◆
6.3	**Knowledge diffusion**	**45.5**	**18**	◆
6.3.1	Intellectual property receipts, % total trade	0.1	57	
6.3.2	High-tech net exports, % total trade	38.6	1	● ◆
6.3.3	ICT services exports, % total trade	1.2	76	
6.3.4	FDI net outflows, % GDP	2.2	32	◆
	CREATIVE OUTPUTS	**33.9**	**35**	◆
7.1	**Intangible assets**	**39.5**	**28**	
7.1.1	Trademarks by origin/bn PPP$ GDP	19.6	96	○
7.1.2	Global brand value, top 5,000, % GDP	158.9	7	● ◆
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.5	82	○
7.1.4	ICTs & organizational model creation†	71.9	17	◆
7.2	**Creative goods and services**	**40.9**	**11**	● ◆
7.2.1	Cultural & creative services exports, % total trade	0.2	66	
7.2.2	National feature films/mn pop. 15-69	3.8	50	
7.2.3	Entertainment & Media market/th pop. 15-69	12.4	35	◆
7.2.4	Printing and other media, % manufacturing	0.8	68	○
7.2.5	Creative goods exports, % total trade	9.8	1	● ◆
7.3	**Online creativity**	**15.9**	**68**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	6.3	50	
7.3.2	Country-code TLDs/th pop. 15-69	4.0	57	
7.3.3	Wikipedia edits/mn pop. 15-69	52.5	57	
7.3.4	Mobile app creation/bn PPP$ GDP	3.3	61	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

MALI

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
116	126	Low	SSF	19.7	47.2	2,157.1	112

		Score/Value	Rank	
	INSTITUTIONS	**52.0**	**107**	
1.1	**Political environment**	**34.5**	**128**	○
1.1.1	Political and operational stability*	48.2	128	○
1.1.2	Government effectiveness*	27.7	124	
1.2	**Regulatory environment**	**57.7**	**85**	
1.2.1	Regulatory quality*	27.3	106	
1.2.2	Rule of law*	25.9	112	
1.2.3	Cost of redundancy dismissal, salary weeks	13.6	50	●
1.3	**Business environment**	**63.8**	**89**	
1.3.1	Ease of starting a business*	84.3	95	
1.3.2	Ease of resolving insolvency*	43.4	91	
	HUMAN CAPITAL & RESEARCH	**11.6**	**120**	
2.1	**Education**	**30.6**	**104**	
2.1.1	Expenditure on education, % GDP ⊙	3.8	81	
2.1.2	Government funding/pupil, secondary, % GDP/cap	25.4	20	●
2.1.3	School life expectancy, years	7.5	119	○ ◇
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⊙	17.4	85	◆
2.2	**Tertiary education**	**2.6**	**125**	◇
2.2.1	Tertiary enrolment, % gross	4.5	120	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	0.6	94	
2.3	**Research & development (R&D)**	**1.5**	**103**	
2.3.1	Researchers, FTE/mn pop. ⊙	32.9	101	
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.3	82	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**19.8**	**125**	
3.1	**Information & communication technologies (ICTs)**	**25.4**	**126**	
3.1.1	ICT access*	36.4	113	◆
3.1.2	ICT use*	14.8	121	
3.1.3	Government's online service*	26.4	121	
3.1.4	E-participation*	24.2	121	◇
3.2	**General infrastructure**	**18.5**	**111**	
3.2.1	Electricity output, kWh/mn pop.	n/a	n/a	
3.2.2	Logistics performance*	24.4	92	
3.2.3	Gross capital formation, % GDP	18.6	106	
3.3	**Ecological sustainability**	**15.4**	**124**	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	29.4	122	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	110	
	MARKET SOPHISTICATION	**34.8**	**119**	
4.1	**Credit**	**16.7**	**125**	
4.1.1	Ease of getting credit*	30.0	122	
4.1.2	Domestic credit to private sector, % GDP	25.4	104	
4.1.3	Microfinance gross loans, % GDP	0.3	41	●
4.2	**Investment**	**42.0**	**[47]**	
4.2.1	Ease of protecting minority investors*	42.0	102	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**45.8**	**126**	
4.3.1	Applied tariff rate, weighted avg., %	9.4	111	
4.3.2	Intensity of local competition†	58.3	112	
4.3.3	Domestic market scale, bn PPP$	47.2	103	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**18.5**	**106**	
5.1	**Knowledge workers**	**5.5**	**127**	◇
5.1.1	Knowledge-intensive employment, %	4.3	116	
5.1.2	Firms offering formal training, % ⊙	17.7	80	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	0.8	97	
5.1.5	Females employed w/advanced degrees, %	0.5	117	○
5.2	**Innovation linkages**	**21.1**	**65**	●
5.2.1	University/industry research collaboration†	40.2	72	
5.2.2	State of cluster development†	44.5	78	
5.2.3	GERD financed by abroad, % GDP	0.1	28	● ◆
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	71	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**28.8**	**62**	●
5.3.1	Intellectual property payments, % total trade ⊙	0.1	107	
5.3.2	High-tech imports, % total trade ⊙	6.8	75	
5.3.3	ICT services imports, % total trade ⊙	3.1	9	● ◆
5.3.4	FDI net inflows, % GDP	3.0	58	●
5.3.5	Research talent, % in business enterprise ⊙	31.4	40	● ◆
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**13.4**	**93**	
6.1	**Knowledge creation**	**3.5**	**119**	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	104	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.6	110	◇
6.1.5	Citable documents H-index	5.0	104	
6.2	**Knowledge impact**	**12.7**	**111**	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.5	54	●
6.2.2	New businesses/th pop. 15–64	0.3	108	
6.2.3	Computer software spending, % GDP	0.0	112	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.3	126	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**24.0**	**64**	● ◆
6.3.1	Intellectual property receipts, % total trade ⊙	0.0	94	
6.3.2	High-tech net exports, % total trade ⊙	0.1	116	
6.3.3	ICT services exports, % total trade ⊙	5.0	11	● ◆
6.3.4	FDI net outflows, % GDP	0.3	91	
	CREATIVE OUTPUTS	**8.5**	**120**	
7.1	**Intangible assets**	**13.3**	**118**	
7.1.1	Trademarks by origin/bn PPP$ GDP	4.4	121	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.3	94	
7.1.4	ICTs & organizational model creation†	45.0	96	
7.2	**Creative goods and services**	**0.9**	**[126]**	
7.2.1	Cultural & creative services exports, % total trade ⊙	0.1	75	
7.2.2	National feature films/mn pop. 15–69	0.1	109	○ ◇
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade ⊙	0.0	129	○
7.3	**Online creativity**	**6.6**	**100**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.1	122	
7.3.2	Country-code TLDs/th pop. 15–69	7.0	45	● ◆
7.3.3	Wikipedia edits/mn pop. 15–69	17.1	112	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

MALTA

GII 2020 rank

27

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
21	31	High	EUR	0.4	23.0	41,386.0	27

		Score/Value	Rank	
1	**INSTITUTIONS**	**75.6**	**34**	
1.1	**Political environment**	**75.8**	**31**	
1.1.1	Political and operational stability*	83.9	21	
1.1.2	Government effectiveness*	71.8	34	
1.2	**Regulatory environment**	**87.8**	**15**	
1.2.1	Regulatory quality*	77.1	21	
1.2.2	Rule of law*	74.1	27	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	● ◆
1.3	**Business environment**	**63.3**	**93**	◇
1.3.1	Ease of starting a business*	88.2	69	
1.3.2	Ease of resolving insolvency*	38.3	105	○ ◇

		Score/Value	Rank	
2	**HUMAN CAPITAL & RESEARCH**	**33.6**	**52**	◇
2.1	**Education**	**57.7**	**21**	
2.1.1	Expenditure on education, % GDP ◷	5.2	36	
2.1.2	Government funding/pupil, secondary, % GDP/cap ◷	29.5	14	◆
2.1.3	School life expectancy, years	16.1	32	
2.1.4	PISA scales in reading, maths, & science	458.8	42	
2.1.5	Pupil-teacher ratio, secondary ◷	7.1	2	● ◆
2.2	**Tertiary education**	**34.7**	**60**	
2.2.1	Tertiary enrolment, % gross	54.3	55	
2.2.2	Graduates in science & engineering, %	20.3	72	
2.2.3	Tertiary inbound mobility, %	8.3	26	
2.3	**Research & development (R&D)**	**8.5**	**63**	◇
2.3.1	Researchers, FTE/mn pop.	1,937.4	40	
2.3.2	Gross expenditure on R&D, % GDP	0.6	60	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
3	**INFRASTRUCTURE**	**54.4**	**25**	
3.1	**Information & communication technologies (ICTs)**	**86.3**	**19**	
3.1.1	ICT access*	91.4	5	● ◆
3.1.2	ICT use*	84.8	9	
3.1.3	Government's online service*	84.0	36	
3.1.4	E-participation*	84.8	39	
3.2	**General infrastructure**	**20.9**	**94**	◇
3.2.1	Electricity output, kWh/mn pop.	3,499.0	56	
3.2.2	Logistics performance*	34.9	68	◇
3.2.3	Gross capital formation, % GDP	20.3	97	○
3.3	**Ecological sustainability**	**56.1**	**9**	◆
3.3.1	GDP/unit of energy use	24.4	3	● ◆
3.3.2	Environmental performance*	70.7	23	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.7	51	

		Score/Value	Rank	
4	**MARKET SOPHISTICATION**	**46.4**	**74**	
4.1	**Credit**	**34.2**	**94**	◇
4.1.1	Ease of getting credit*	35.0	118	○ ◇
4.1.2	Domestic credit to private sector, % GDP	77.1	40	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**43.3**	**43**	
4.2.1	Ease of protecting minority investors*	66.0	50	
4.2.2	Market capitalization, % GDP	38.0	38	
4.2.3	Venture capital deals/bn PPP$ GDP	0.3	11	
4.3	**Trade, competition, and market scale**	**61.6**	**70**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	80.4	7	◆
4.3.3	Domestic market scale, bn PPP$	23.0	127	○ ◇

		Score/Value	Rank	
5	**BUSINESS SOPHISTICATION**	**53.1**	**13**	
5.1	**Knowledge workers**	**51.9**	**25**	
5.1.1	Knowledge-intensive employment, %	43.8	19	
5.1.2	Firms offering formal training, %	49.9	17	
5.1.3	GERD performed by business, % GDP	0.3	46	
5.1.4	GERD financed by business, %	56.4	16	
5.1.5	Females employed w/advanced degrees, %	15.6	43	
5.2	**Innovation linkages**	**55.2**	**11**	
5.2.1	University/industry research collaboration†	45.1	52	
5.2.2	State of cluster development†	53.1	40	
5.2.3	GERD financed by abroad, % GDP	0.1	46	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.3	2	● ◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	4.3	11	
5.3	**Knowledge absorption**	**52.2**	**11**	
5.3.1	Intellectual property payments, % total trade	3.3	4	● ◆
5.3.2	High-tech imports, % total trade	5.7	102	○
5.3.3	ICT services imports, % total trade	1.2	61	
5.3.4	FDI net inflows, % GDP	30.4	3	● ◆
5.3.5	Research talent, % in business enterprise	52.6	20	

		Score/Value	Rank	
6	**KNOWLEDGE & TECHNOLOGY OUTPUTS**	**26.8**	**49**	
6.1	**Knowledge creation**	**25.5**	**39**	
6.1.1	Patents by origin/bn PPP$ GDP ◷	5.1	21	
6.1.2	PCT patents by origin/bn PPP$ GDP	1.7	20	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	9.8	52	
6.1.5	Citable documents H-index	6.5	93	◇
6.2	**Knowledge impact**	**27.4**	**54**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-0.5	102	○
6.2.2	New businesses/th pop. 15-64	17.5	6	● ◆
6.2.3	Computer software spending, % GDP	0.0	33	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	8.2	31	
6.2.5	High- and medium-high-tech manufacturing, %	12.5	76	◇
6.3	**Knowledge diffusion**	**27.5**	**52**	
6.3.1	Intellectual property receipts, % total trade	2.1	9	
6.3.2	High-tech net exports, % total trade	4.4	36	
6.3.3	ICT services exports, % total trade	0.5	98	○
6.3.4	FDI net outflows, % GDP	-51.5	130	○ ◇

		Score/Value	Rank	
7	**CREATIVE OUTPUTS**	**53.5**	**4**	● ◆
7.1	**Intangible assets**	**60.1**	**4**	● ◆
7.1.1	Trademarks by origin/bn PPP$ GDP ◷	117.5	7	◆
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP ◷	12.9	9	◆
7.1.4	ICTs & organizational model creation†	64.4	31	
7.2	**Creative goods and services**	**45.6**	**5**	● ◆
7.2.1	Cultural & creative services exports, % total trade	11.0	1	● ◆
7.2.2	National feature films/mn pop. 15-69	15.7	7	◆
7.2.3	Entertainment & Media market/th pop. 15-69	15.6	29	◇
7.2.4	Printing and other media, % manufacturing	12.9	1	● ◆
7.2.5	Creative goods exports, % total trade	0.2	79	
7.3	**Online creativity**	**48.1**	**22**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	94.9	3	● ◆
7.3.2	Country-code TLDs/th pop. 15-69	17.9	31	
7.3.3	Wikipedia edits/mn pop. 15-69	66.6	44	
7.3.4	Mobile app creation/bn PPP$ GDP	14.8	33	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

MAURITIUS

GII 2020 rank

52

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
60	47	Upper middle	SSF	1.3	31.7	21,822.3	82

		Score/Value	Rank	
	INSTITUTIONS	**81.1**	**22**	◆
1.1	**Political environment**	**76.2**	**30**	◆
1.1.1	Political and operational stability*	89.3	10	● ◆
1.1.2	Government effectiveness*	69.7	37	◆
1.2	**Regulatory environment**	**83.1**	**23**	◆
1.2.1	Regulatory quality*	68.9	31	◆
1.2.2	Rule of law*	67.0	34	◆
1.2.3	Cost of redundancy dismissal, salary weeks	8.9	23	
1.3	**Business environment**	**84.1**	**21**	● ◆
1.3.1	Ease of starting a business*	94.5	19	● ◆
1.3.2	Ease of resolving insolvency*	73.8	26	◆
	HUMAN CAPITAL & RESEARCH	**29.6**	**69**	
2.1	**Education**	**54.8**	**36**	
2.1.1	Expenditure on education, % GDP	4.8	48	
2.1.2	Government funding/pupil, secondary, % GDP/cap	31.3	9	● ◆
2.1.3	School life expectancy, years	15.1	50	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	11.0	41	
2.2	**Tertiary education**	**31.4**	**70**	
2.2.1	Tertiary enrolment, % gross	40.6	69	
2.2.2	Graduates in science & engineering, %	23.3	48	
2.2.3	Tertiary inbound mobility, %	5.4	41	
2.3	**Research & development (R&D)**	**2.5**	**90**	
2.3.1	Researchers, FTE/mn pop	288.1	77	
2.3.2	Gross expenditure on R&D, % GDP	0.3	78	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**41.0**	**64**	
3.1	**Information & communication technologies (ICTs)**	**67.0**	**66**	
3.1.1	ICT access*	72.8	50	◆
3.1.2	ICT use*	53.3	70	
3.1.3	Government's online service*	72.9	64	
3.1.4	E-participation*	69.1	71	
3.2	**General infrastructure**	**19.2**	**104**	
3.2.1	Electricity output, kWh/mn pop	2,485.8	72	
3.2.2	Logistics performance*	31.1	77	
3.2.3	Gross capital formation, % GDP	20.6	94	
3.3	**Ecological sustainability**	**36.7**	**44**	
3.3.1	GDP/unit of energy use	17.9	8	● ◆
3.3.2	Environmental performance*	45.1	73	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.7	69	
	MARKET SOPHISTICATION	**59.8**	**16**	● ◆
4.1	**Credit**	**49.5**	**37**	
4.1.1	Ease of getting credit*	65.0	61	
4.1.2	Domestic credit to private sector, % GDP	78.0	37	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**69.6**	**9**	● ◆
4.2.1	Ease of protecting minority investors*	78.0	18	● ◆
4.2.2	Market capitalization, % GDP	68.2	21	
4.2.3	Venture capital deals/bn PPP$ GDP	0.8	1	● ◆
4.3	**Trade, competition, and market scale**	**60.2**	**71**	
4.3.1	Applied tariff rate, weighted avg., %	0.8	9	●
4.3.2	Intensity of local competition†	70.5	54	
4.3.3	Domestic market scale, bn PPP$	31.7	119	○ ◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**17.4**	**117**	○ ◇
5.1	**Knowledge workers**	**16.2**	**106**	◇
5.1.1	Knowledge-intensive employment, %	25.0	59	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	0.0	83	○
5.1.4	GERD financed by business, %	3.2	90	○ ◇
5.1.5	Females employed w/advanced degrees, %	8.9	75	
5.2	**Innovation linkages**	**17.2**	**93**	
5.2.1	University/industry research collaboration†	30.8	107	○ ◇
5.2.2	State of cluster development†	48.8	52	
5.2.3	GERD financed by abroad, % GDP	0.0	85	○
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	57	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	45	
5.3	**Knowledge absorption**	**18.9**	**108**	
5.3.1	Intellectual property payments, % total trade	0.3	82	
5.3.2	High-tech imports, % total trade	6.5	84	
5.3.3	ICT services imports, % total trade	2.0	28	◆
5.3.4	FDI net inflows, % GDP	3.0	52	
5.3.5	Research talent, % in business enterprise	2.2	77	○ ◇
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**16.0**	**79**	
6.1	**Knowledge creation**	**7.1**	**[88]**	
6.1.1	Patents by origin/bn PPP$ GDP	0.5	82	
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.7	77	
6.1.5	Citable documents H-index	3.6	117	○
6.2	**Knowledge impact**	**22.5**	**70**	
6.2.1	Growth rate of PPP$ GDP/worker, %	3.0	26	
6.2.2	New businesses/th pop. 15-64	9.3	18	● ◆
6.2.3	Computer software spending, % GDP	0.0	73	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	6.2	46	
6.2.5	High- and medium-high-tech manufacturing, %	3.2	103	○ ◇
6.3	**Knowledge diffusion**	**18.3**	**83**	
6.3.1	Intellectual property receipts, % total trade	0.0	77	
6.3.2	High-tech net exports, % total trade	0.5	80	
6.3.3	ICT services exports, % total trade	2.0	55	
6.3.4	FDI net outflows, % GDP	3.0	21	● ◆
	CREATIVE OUTPUTS	**29.9**	**43**	◆
7.1	**Intangible assets**	**38.7**	**32**	
7.1.1	Trademarks by origin/bn PPP$ GDP	84.1	21	●
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	2.5	46	
7.1.4	ICTs & organizational model creation†	53.2	65	
7.2	**Creative goods and services**	**21.2**	**50**	
7.2.1	Cultural & creative services exports, % total trade	0.7	38	
7.2.2	National feature films/mn pop. 15-69	9.5	21	◆
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	1.8	18	
7.2.5	Creative goods exports, % total trade	0.8	50	
7.3	**Online creativity**	**20.8**	**53**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	13.0	34	◆
7.3.2	Country-code TLDs/th pop. 15-69	2.4	65	
7.3.3	Wikipedia edits/mn pop. 15-69	49.9	60	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

MEXICO

GII 2020 rank

55

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
57	61	Upper middle	LCN	127.6	2,627.9	18,218.1	56

		Score/Value	Rank	
	INSTITUTIONS	**61.3**	**74**	
1.1	**Political environment**	**50.8**	**88**	
1.1.1	Political and operational stability*	58.9	104	○
1.1.2	Government effectiveness*	46.7	80	
1.2	**Regulatory environment**	**54.9**	**92**	
1.2.1	Regulatory quality*	45.8	62	
1.2.2	Rule of law*	29.1	106	◇
1.2.3	Cost of redundancy dismissal, salary weeks	22.0	95	
1.3	**Business environment**	**78.2**	**37**	
1.3.1	Ease of starting a business*	86.1	83	
1.3.2	Ease of resolving insolvency*	70.3	31	◆
	HUMAN CAPITAL & RESEARCH	**32.1**	**58**	
2.1	**Education**	**40.8**	**78**	
2.1.1	Expenditure on education, % GDP ◷	4.9	45	
2.1.2	Government funding/pupil, secondary, % GDP/cap	14.4	83	
2.1.3	School life expectancy, years	14.8	56	
2.1.4	PISA scales in reading, maths, & science	416.2	57	
2.1.5	Pupil-teacher ratio, secondary ◷	16.9	83	
2.2	**Tertiary education**	**29.2**	**77**	
2.2.1	Tertiary enrolment, % gross	40.2	70	
2.2.2	Graduates in science & engineering, %	25.2	36	
2.2.3	Tertiary inbound mobility, %	0.6	93	
2.3	**Research & development (R&D)**	**26.3**	**41**	◆
2.3.1	Researchers, FTE/mn pop. ◷	315.3	76	
2.3.2	Gross expenditure on R&D, % GDP	0.3	79	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	52.6	27	◆
2.3.4	QS university ranking, average score top 3*	42.8	27	◆
	INFRASTRUCTURE	**43.0**	**59**	
3.1	**Information & communication technologies (ICTs)**	**74.1**	**50**	
3.1.1	ICT access*	56.5	79	
3.1.2	ICT use*	53.3	69	
3.1.3	Government's online service*	92.4	22	● ◆
3.1.4	E-participation*	94.4	17	● ◆
3.2	**General infrastructure**	**23.9**	**78**	
3.2.1	Electricity output, kWh/mn pop.	2,738.1	66	
3.2.2	Logistics performance*	46.0	50	
3.2.3	Gross capital formation, % GDP	21.7	82	
3.3	**Ecological sustainability**	**31.0**	**57**	
3.3.1	GDP/unit of energy use	11.8	36	
3.3.2	Environmental performance*	52.6	49	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.6	77	
	MARKET SOPHISTICATION	**48.4**	**59**	
4.1	**Credit**	**42.1**	**61**	
4.1.1	Ease of getting credit*	90.0	10	● ◆
4.1.2	Domestic credit to private sector, % GDP	34.5	87	
4.1.3	Microfinance gross loans, % GDP	0.2	46	
4.2	**Investment**	**25.9**	**113**	○
4.2.1	Ease of protecting minority investors*	62.0	60	
4.2.2	Market capitalization, % GDP	33.4	42	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	74	○
4.3	**Trade, competition, and market scale**	**77.3**	**14**	● ◆
4.3.1	Applied tariff rate, weighted avg., %	1.2	14	●
4.3.2	Intensity of local competition†	70.1	59	
4.3.3	Domestic market scale, bn PPP$	2,627.9	11	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**27.1**	**59**	
5.1	**Knowledge workers**	**28.5**	**72**	
5.1.1	Knowledge-intensive employment, %	19.5	78	
5.1.2	Firms offering formal training, % ◷	50.8	16	●
5.1.3	GERD performed by business, % GDP	0.1	64	
5.1.4	GERD financed by business, %	18.6	68	
5.1.5	Females employed w/advanced degrees, %	9.0	74	
5.2	**Innovation linkages**	**17.8**	**89**	
5.2.1	University/industry research collaboration†	42.1	64	
5.2.2	State of cluster development†	54.7	35	◆
5.2.3	GERD financed by abroad, % GDP	0.0	92	○
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	100	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	70	
5.3	**Knowledge absorption**	**35.0**	**41**	
5.3.1	Intellectual property payments, % total trade	0.1	108	○
5.3.2	High-tech imports, % total trade	17.5	9	● ◆
5.3.3	ICT services imports, % total trade	0.0	127	○ ◇
5.3.4	FDI net inflows, % GDP	3.1	50	
5.3.5	Research talent, % in business enterprise ◷	37.3	35	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**23.4**	**55**	
6.1	**Knowledge creation**	**11.4**	**74**	
6.1.1	Patents by origin/bn PPP$ GDP	0.6	78	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	64	
6.1.3	Utility models by origin/bn PPP$ GDP	0.3	42	
6.1.4	Scientific & technical articles/bn PPP$ GDP	4.8	91	
6.1.5	Citable documents H-index	28.6	34	◆
6.2	**Knowledge impact**	**26.4**	**58**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-0.8	105	○
6.2.2	New businesses/th pop. 15-64	1.0	84	
6.2.3	Computer software spending, % GDP	0.0	66	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.5	81	
6.2.5	High- and medium-high-tech manufacturing, %	52.6	10	● ◆
6.3	**Knowledge diffusion**	**32.3**	**38**	
6.3.1	Intellectual property receipts, % total trade	0.0	102	○ ◇
6.3.2	High-tech net exports, % total trade ◷	15.6	8	● ◆
6.3.3	ICT services exports, % total trade	0.0	127	○
6.3.4	FDI net outflows, % GDP	0.6	70	
	CREATIVE OUTPUTS	**26.2**	**54**	
7.1	**Intangible assets**	**28.6**	**60**	
7.1.1	Trademarks by origin/bn PPP$ GDP	42.5	62	
7.1.2	Global brand value, top 5,000, % GDP	61.8	30	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.6	80	
7.1.4	ICTs & organizational model creation†	57.9	53	
7.2	**Creative goods and services**	**36.7**	**17**	● ◆
7.2.1	Cultural & creative services exports, % total trade	0.0	110	○
7.2.2	National feature films/mn pop. 15-69	2.1	65	
7.2.3	Entertainment & Media market/th pop. 15-69	8.2	39	
7.2.4	Printing and other media, % manufacturing	0.4	93	○ ◇
7.2.5	Creative goods exports, % total trade	9.6	1	● ◆
7.3	**Online creativity**	**11.1**	**80**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	2.6	70	
7.3.2	Country-code TLDs/th pop. 15-69	4.2	56	
7.3.3	Wikipedia edits/mn pop. 15-69	40.3	79	
7.3.4	Mobile app creation/bn PPP$ GDP	0.7	69	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

MONGOLIA

GII 2020 rank

58

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
54	65	Lower middle	SEAO	3.2	47.2	12,492.2	53

		Score/Value	Rank	
	INSTITUTIONS	**61.0**	**76**	◆
1.1	**Political environment**	**55.0**	**74**	◆
1.1.1	Political and operational stability*	75.0	44	◆
1.1.2	Government effectiveness*	44.9	83	
1.2	**Regulatory environment**	**69.5**	**49**	◆
1.2.1	Regulatory quality*	41.0	70	◆
1.2.2	Rule of law*	39.7	77	
1.2.3	Cost of redundancy dismissal, salary weeks	8.7	18	● ◆
1.3	**Business environment**	**58.4**	**110**	
1.3.1	Ease of starting a business*	86.7	78	
1.3.2	Ease of resolving insolvency*	30.1	120	○
	HUMAN CAPITAL & RESEARCH	**26.0**	**80**	
2.1	**Education**	**40.0**	**79**	
2.1.1	Expenditure on education, % GDP ⊙	4.1	69	
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	15.4	75	
2.1.3	School life expectancy, years ⊙	14.6	60	◆
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⊙	14.5	71	
2.2	**Tertiary education**	**37.2**	**56**	◆
2.2.1	Tertiary enrolment, % gross	65.6	38	◆
2.2.2	Graduates in science & engineering, %	25.3	34	
2.2.3	Tertiary inbound mobility, %	1.1	87	
2.3	**Research & development (R&D)**	**0.6**	**110**	
2.3.1	Researchers, FTE/mn pop	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	0.1	105	○
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**35.6**	**87**	
3.1	**Information & communication technologies (ICTs)**	**59.0**	**81**	
3.1.1	ICT access*	53.7	84	
3.1.2	ICT use*	49.0	78	◆
3.1.3	Government's online service*	59.7	92	
3.1.4	E-participation*	73.6	64	
3.2	**General infrastructure**	**30.9**	**47**	◆
3.2.1	Electricity output, kWh/mn pop	1,956.9	78	◆
3.2.2	Logistics performance*	14.2	116	○
3.2.3	Gross capital formation, % GDP	43.2	7	● ◆
3.3	**Ecological sustainability**	**17.0**	**116**	
3.3.1	GDP/unit of energy use	6.9	90	
3.3.2	Environmental performance*	32.2	114	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	109	
	MARKET SOPHISTICATION	**61.6**	**13**	● ◆
4.1	**Credit**	**58.2**	**18**	● ◆
4.1.1	Ease of getting credit*	80.0	23	
4.1.2	Domestic credit to private sector, % GDP	56.2	60	
4.1.3	Microfinance gross loans, % GDP	13.0	2	● ◆
4.2	**Investment**	**74.0**	**[4]**	
4.2.1	Ease of protecting minority investors*	74.0	24	● ◆
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**52.7**	**105**	
4.3.1	Applied tariff rate, weighted avg., %	5.3	96	
4.3.2	Intensity of local competition†	61.9	99	
4.3.3	Domestic market scale, bn PPP$	47.2	102	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**23.2**	**81**	
5.1	**Knowledge workers**	**36.6**	**55**	◆
5.1.1	Knowledge-intensive employment, %	25.1	58	◆
5.1.2	Firms offering formal training, %	66.2	4	● ◆
5.1.3	GERD performed by business, % GDP	0.0	84	
5.1.4	GERD financed by business, %	8.1	79	
5.1.5	Females employed w/advanced degrees, %	22.8	17	● ◆
5.2	**Innovation linkages**	**14.3**	**116**	
5.2.1	University/industry research collaboration†	30.4	109	
5.2.2	State of cluster development†	33.7	115	○ ◇
5.2.3	GERD financed by abroad, % GDP	0.0	84	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	78	
5.3	**Knowledge absorption**	**18.6**	**112**	
5.3.1	Intellectual property payments, % total trade	0.3	81	
5.3.2	High-tech imports, % total trade	4.8	112	
5.3.3	ICT services imports, % total trade	1.3	52	
5.3.4	FDI net inflows, % GDP	-3.0	130	○ ◇
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**15.5**	**84**	
6.1	**Knowledge creation**	**29.3**	**34**	◆
6.1.1	Patents by origin/bn PPP$ GDP	1.9	40	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	5.1	1	● ◆
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.6	79	
6.1.5	Citable documents H-index	4.8	106	
6.2	**Knowledge impact**	**7.9**	**122**	○ ◇
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	5.5	29	◆
6.2.3	Computer software spending, % GDP	0.0	81	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.1	103	
6.2.5	High- and medium-high-tech manufacturing, %	4.3	101	○ ◇
6.3	**Knowledge diffusion**	**9.3**	**124**	○ ◇
6.3.1	Intellectual property receipts, % total trade	0.0	79	
6.3.2	High-tech net exports, % total trade	0.1	114	
6.3.3	ICT services exports, % total trade	0.6	96	
6.3.4	FDI net outflows, % GDP	0.3	92	
	CREATIVE OUTPUTS	**35.2**	**30**	◆
7.1	**Intangible assets**	**50.5**	**12**	● ◆
7.1.1	Trademarks by origin/bn PPP$ GDP	199.8	3	● ◆
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	17.0	4	● ◆
7.1.4	ICTs & organizational model creation†	42.8	102	
7.2	**Creative goods and services**	**30.4**	**[25]**	
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	26.1	3	● ◆
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	1.7	22	
7.2.5	Creative goods exports, % total trade	0.0	115	
7.3	**Online creativity**	**9.4**	**86**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.6	105	
7.3.2	Country-code TLDs/th pop. 15–69	2.4	66	◆
7.3.3	Wikipedia edits/mn pop. 15–69	38.0	82	
7.3.4	Mobile app creation/bn PPP$ GDP	0.1	86	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

MONTENEGRO

GII 2020 rank

49

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
49	53	Upper middle	EUR	0.6	12.5	17,533.9	45

		Score/Value	Rank	
	INSTITUTIONS	**69.6**	**44**	
1.1	**Political environment**	**60.4**	**57**	
1.1.1	Political and operational stability*	75.0	44	
1.1.2	Government effectiveness*	53.1	62	
1.2	**Regulatory environment**	**72.0**	**41**	
1.2.1	Regulatory quality*	51.4	54	
1.2.2	Rule of law*	49.2	58	
1.2.3	Cost of redundancy dismissal, salary weeks	11.2	35	
1.3	**Business environment**	**76.4**	**44**	
1.3.1	Ease of starting a business*	86.7	79	
1.3.2	Ease of resolving insolvency*	66.1	40	
	HUMAN CAPITAL & RESEARCH	**33.5**	**[54]**	
2.1	**Education**	**55.9**	**[32]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	15.0	52	
2.1.4	PISA scales in reading, maths, & science	421.9	55	
2.1.5	Pupil-teacher ratio, secondary	14.4	70	
2.2	**Tertiary education**	**40.7**	**[40]**	
2.2.1	Tertiary enrolment, % gross	56.1	49	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**4.0**	**81**	
2.3.1	Researchers, FTE/mn pop.	734.3	57	
2.3.2	Gross expenditure on R&D, % GDP	0.4	73	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**46.0**	**53**	
3.1	**Information & communication technologies (ICTs)**	**70.0**	**57**	
3.1.1	ICT access*	76.9	36	◆
3.1.2	ICT use*	62.3	54	
3.1.3	Government's online service*	66.7	76	
3.1.4	E-participation*	74.2	63	
3.2	**General infrastructure**	**28.9**	**56**	
3.2.1	Electricity output, kWh/mn pop.	4,004.5	51	
3.2.2	Logistics performance*	31.7	76	
3.2.3	Gross capital formation, % GDP	31.8	20	● ◆
3.3	**Ecological sustainability**	**39.0**	**38**	
3.3.1	GDP/unit of energy use	9.8	58	
3.3.2	Environmental performance*	46.3	68	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	5.3	20	●
	MARKET SOPHISTICATION	**48.2**	**61**	
4.1	**Credit**	**45.2**	**51**	
4.1.1	Ease of getting credit*	85.0	14	●
4.1.2	Domestic credit to private sector, % GDP	49.6	72	
4.1.3	Microfinance gross loans, % GDP	1.0	24	
4.2	**Investment**	**49.7**	**26**	
4.2.1	Ease of protecting minority investors*	62.0	60	
4.2.2	Market capitalization, % GDP	82.6	18	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**49.8**	**118**	○ ◇
4.3.1	Applied tariff rate, weighted avg., %	3.1	65	
4.3.2	Intensity of local competition†	62.9	93	
4.3.3	Domestic market scale, bn PPP$	12.5	130	○ ◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**23.6**	**78**	
5.1	**Knowledge workers**	**27.3**	**77**	
5.1.1	Knowledge-intensive employment, %	36.6	34	◆
5.1.2	Firms offering formal training, %	15.8	86	○ ◇
5.1.3	GERD performed by business, % GDP	0.1	71	
5.1.4	GERD financed by business, %	18.7	67	
5.1.5	Females employed w/advanced degrees, %	17.0	37	
5.2	**Innovation linkages**	**19.0**	**76**	
5.2.1	University/industry research collaboration†	45.3	51	
5.2.2	State of cluster development†	44.8	77	
5.2.3	GERD financed by abroad, % GDP	0.0	56	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	45	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**24.3**	**81**	
5.3.1	Intellectual property payments, % total trade	0.2	86	
5.3.2	High-tech imports, % total trade	6.4	86	
5.3.3	ICT services imports, % total trade	3.2	6	● ◆
5.3.4	FDI net inflows, % GDP	8.5	12	● ◆
5.3.5	Research talent, % in business enterprise	11.1	62	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**19.6**	**66**	
6.1	**Knowledge creation**	**15.9**	**61**	
6.1.1	Patents by origin/bn PPP$ GDP	0.3	94	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	67	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	19.5	29	◆
6.1.5	Citable documents H-index	1.9	128	○ ◇
6.2	**Knowledge impact**	**26.4**	**57**	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15-64	11.3	10	● ◆
6.2.3	Computer software spending, % GDP	0.0	24	● ◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	11.5	26	
6.2.5	High- and medium-high-tech manufacturing, %	7.3	91	○
6.3	**Knowledge diffusion**	**16.5**	**87**	
6.3.1	Intellectual property receipts, % total trade	0.0	81	
6.3.2	High-tech net exports, % total trade	0.1	104	○
6.3.3	ICT services exports, % total trade	2.7	36	
6.3.4	FDI net outflows, % GDP	-0.7	125	○ ◇
	CREATIVE OUTPUTS	**33.6**	**36**	◆
7.1	**Intangible assets**	**28.6**	**58**	
7.1.1	Trademarks by origin/bn PPP$ GDP	43.7	59	
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.1	111	○
7.1.4	ICTs & organizational model creation†	52.6	70	
7.2	**Creative goods and services**	**23.8**	**40**	
7.2.1	Cultural & creative services exports, % total trade	0.5	50	
7.2.2	National feature films/mn pop. 15-69	13.3	11	● ◆
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	3.0	4	● ◆
7.2.5	Creative goods exports, % total trade	0.1	95	
7.3	**Online creativity**	**53.5**	**15**	● ◆
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	1.4	90	
7.3.2	Country-code TLDs/th pop. 15-69	100.0	1	● ◆
7.3.3	Wikipedia edits/mn pop. 15-69	61.1	52	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

MOROCCO

GII 2020 rank

75

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
69	85	Lower middle	NAWA	36.5	328.7	8,062.6	74

		Score/Value	Rank	
	INSTITUTIONS	**60.8**	**77**	◆
1.1	**Political environment**	**52.3**	**86**	
1.1.1	Political and operational stability*	66.1	76	
1.1.2	Government effectiveness*	45.5	81	
1.2	**Regulatory environment**	**57.0**	**87**	
1.2.1	Regulatory quality*	35.4	91	
1.2.2	Rule of law*	43.1	69	
1.2.3	Cost of redundancy dismissal, salary weeks	20.7	87	
1.3	**Business environment**	**73.0**	**59**	◆
1.3.1	Ease of starting a business*	93.0	41	●
1.3.2	Ease of resolving insolvency*	52.9	67	
	HUMAN CAPITAL & RESEARCH	**25.9**	**81**	
2.1	**Education**	**48.5**	**58**	
2.1.1	Expenditure on education, % GDP	5.3	34	●
2.1.2	Government funding/pupil, secondary, % GDP/cap	36.4	5	● ◆
2.1.3	School life expectancy, years	13.7	73	◆
2.1.4	PISA scales in reading, maths, & science	367.9	75	○
2.1.5	Pupil-teacher ratio, secondary	19.4	97	
2.2	**Tertiary education**	**22.4**	**88**	
2.2.1	Tertiary enrolment, % gross	35.9	74	
2.2.2	Graduates in science & engineering, %	19.0	76	
2.2.3	Tertiary inbound mobility, %	1.9	77	
2.3	**Research & development (R&D)**	**6.7**	**71**	
2.3.1	Researchers, FTE/mn pop.	1,073.5	51	◆
2.3.2	Gross expenditure on R&D, % GDP	0.7	50	◆
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**39.3**	**71**	◆
3.1	**Information & communication technologies (ICTs)**	**63.2**	**75**	◆
3.1.1	ICT access*	65.1	67	◆
3.1.2	ICT use*	43.7	88	
3.1.3	Government's online service*	66.7	76	
3.1.4	E-participation*	77.5	56	
3.2	**General infrastructure**	**25.5**	**73**	
3.2.1	Electricity output, kWh/mn pop.	918.1	96	
3.2.2	Logistics performance*	22.0	103	○
3.2.3	Gross capital formation, % GDP	34.3	19	●
3.3	**Ecological sustainability**	**29.2**	**64**	◆
3.3.1	GDP/unit of energy use	13.0	24	● ◆
3.3.2	Environmental performance*	42.3	85	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.6	75	
	MARKET SOPHISTICATION	**43.3**	**88**	
4.1	**Credit**	**33.6**	**95**	
4.1.1	Ease of getting credit*	45.0	101	○
4.1.2	Domestic credit to private sector, % GDP	84.9	33	● ◆
4.1.3	Microfinance gross loans, % GDP	0.2	47	
4.2	**Investment**	**31.8**	**90**	
4.2.1	Ease of protecting minority investors*	70.0	36	●
4.2.2	Market capitalization, % GDP	56.2	30	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	81	○ ◇
4.3	**Trade, competition, and market scale**	**64.5**	**53**	
4.3.1	Applied tariff rate, weighted avg., %	3.9	75	
4.3.2	Intensity of local competition†	67.2	73	
4.3.3	Domestic market scale, bn PPP$	328.7	54	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**18.4**	**107**	
5.1	**Knowledge workers**	**22.3**	**94**	
5.1.1	Knowledge-intensive employment, %	6.9	110	○ ◇
5.1.2	Firms offering formal training, %	35.7	39	
5.1.3	GERD performed by business, % GDP	0.2	49	◆
5.1.4	GERD financed by business, %	29.9	60	
5.1.5	Females employed w/advanced degrees, %	n/a	n/a	
5.2	**Innovation linkages**	**14.0**	**117**	○
5.2.1	University/industry research collaboration†	29.2	113	○
5.2.2	State of cluster development†	42.9	84	
5.2.3	GERD financed by abroad, % GDP	0.0	77	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	105	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	72	
5.3	**Knowledge absorption**	**18.8**	**110**	○
5.3.1	Intellectual property payments, % total trade	0.3	78	
5.3.2	High-tech imports, % total trade	7.6	65	
5.3.3	ICT services imports, % total trade	0.6	99	
5.3.4	FDI net inflows, % GDP	2.5	67	
5.3.5	Research talent, % in business enterprise	7.0	67	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**21.9**	**60**	
6.1	**Knowledge creation**	**10.3**	**77**	
6.1.1	Patents by origin/bn PPP$ GDP	0.6	79	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	61	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	7.5	63	
6.1.5	Citable documents H-index	11.4	66	
6.2	**Knowledge impact**	**27.7**	**51**	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.3	41	
6.2.2	New businesses/th pop. 15–64	1.9	57	
6.2.3	Computer software spending, % GDP	0.0	59	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.9	75	
6.2.5	High- and medium-high-tech manufacturing, %	36.7	29	● ◆
6.3	**Knowledge diffusion**	**27.6**	**51**	
6.3.1	Intellectual property receipts, % total trade	0.0	84	
6.3.2	High-tech net exports, % total trade	1.7	58	
6.3.3	ICT services exports, % total trade	3.5	24	●
6.3.4	FDI net outflows, % GDP	0.7	66	
	CREATIVE OUTPUTS	**19.0**	**75**	
7.1	**Intangible assets**	**31.3**	**45**	
7.1.1	Trademarks by origin/bn PPP$ GDP	46.4	55	
7.1.2	Global brand value, top 5,000, % GDP	17.5	49	
7.1.3	Industrial designs by origin/bn PPP$ GDP	12.3	10	● ◆
7.1.4	ICTs & organizational model creation†	51.3	77	
7.2	**Creative goods and services**	**5.1**	**105**	
7.2.1	Cultural & creative services exports, % total trade	0.4	56	
7.2.2	National feature films/mn pop. 15–69	1.5	76	
7.2.3	Entertainment & Media market/th pop. 15–69	1.1	58	○
7.2.4	Printing and other media, % manufacturing	0.7	77	
7.2.5	Creative goods exports, % total trade	0.1	99	
7.3	**Online creativity**	**8.2**	**95**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.5	87	
7.3.2	Country-code TLDs/th pop. 15–69	1.0	86	
7.3.3	Wikipedia edits/mn pop. 15–69	33.4	90	
7.3.4	Mobile app creation/bn PPP$ GDP	0.3	76	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

MOZAMBIQUE

GII 2020 rank

124

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
125	122	Low	SSF	30.4	40.6	1,137.6	119

		Score/Value	Rank	
	INSTITUTIONS	**43.1**	**127**	◇
1.1	**Political environment**	**39.5**	**121**	
1.1.1	Political and operational stability*	57.1	110	
1.1.2	Government effectiveness*	30.6	121	
1.2	**Regulatory environment**	**31.3**	**125**	◇
1.2.1	Regulatory quality*	22.6	113	
1.2.2	Rule of law*	19.5	122	
1.2.3	Cost of redundancy dismissal, salary weeks	37.5	125	◇
1.3	**Business environment**	**58.5**	**108**	
1.3.1	Ease of starting a business*	69.3	126	◇
1.3.2	Ease of resolving insolvency*	47.8	78	● ◆
	HUMAN CAPITAL & RESEARCH	**16.1**	**108**	
2.1	**Education**	**44.3**	**72**	● ◆
2.1.1	Expenditure on education, % GDP	5.6	18	● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	42.5	3	● ◆
2.1.3	School life expectancy, years	10.0	109	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⊙	36.5	123	○ ◇
2.2	**Tertiary education**	**2.2**	**128**	○ ◇
2.2.1	Tertiary enrolment, % gross	7.3	115	
2.2.2	Graduates in science & engineering, %	9.6	106	○ ◇
2.2.3	Tertiary inbound mobility, %	0.4	103	
2.3	**Research & development (R&D)**	**1.7**	**99**	
2.3.1	Researchers, FTE/mn pop. ⊙	43.0	95	
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.3	77	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**37.0**	**83**	◆
3.1	**Information & communication technologies (ICTs)**	**30.2**	**122**	
3.1.1	ICT access*	25.7	126	
3.1.2	ICT use*	8.5	130	○ ◇
3.1.3	Government's online service*	42.4	115	
3.1.4	E-participation*	44.4	108	
3.2	**General infrastructure**	**67.3**	**1**	● ◆
3.2.1	Electricity output, kWh/mn pop.	572.7	105	
3.2.2	Logistics performance*	n/a	n/a	
3.2.3	Gross capital formation, % GDP	76.8	1	● ◆
3.3	**Ecological sustainability**	**13.5**	**129**	○
3.3.1	GDP/unit of energy use	3.1	120	○
3.3.2	Environmental performance*	33.9	106	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.5	84	◆
	MARKET SOPHISTICATION	**32.2**	**125**	
4.1	**Credit**	**13.8**	**126**	
4.1.1	Ease of getting credit*	25.0	126	
4.1.2	Domestic credit to private sector, % GDP	23.0	110	
4.1.3	Microfinance gross loans, % GDP	0.2	51	
4.2	**Investment**	**32.0**	**[88]**	
4.2.1	Ease of protecting minority investors*	32.0	120	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**50.6**	**113**	
4.3.1	Applied tariff rate, weighted avg., %	4.2	78	● ◆
4.3.2	Intensity of local competition†	54.9	124	○
4.3.3	Domestic market scale, bn PPP$	40.6	110	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**15.8**	**124**	
5.1	**Knowledge workers**	**5.0**	**129**	○ ◇
5.1.1	Knowledge-intensive employment, % ⊙	3.9	117	
5.1.2	Firms offering formal training, % ⊙	20.7	73	
5.1.3	GERD performed by business, % GDP ⊙	0.0	88	○ ◇
5.1.4	GERD financed by business, % ⊙	0.5	98	
5.1.5	Females employed w/advanced degrees, % ⊙	0.7	113	
5.2	**Innovation linkages**	**26.2**	**42**	●
5.2.1	University/industry research collaboration†	34.0	100	
5.2.2	State of cluster development†	35.0	112	
5.2.3	GERD financed by abroad, % GDP ⊙	0.1	31	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	33	● ◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	n/a	n/a	
5.3	**Knowledge absorption**	**16.3**	**122**	
5.3.1	Intellectual property payments, % total trade	0.2	89	
5.3.2	High-tech imports, % total trade	4.3	117	
5.3.3	ICT services imports, % total trade	1.0	71	●
5.3.4	FDI net inflows, % GDP	20.6	5	● ◆
5.3.5	Research talent, % in business enterprise ⊙	0.3	85	○
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**8.9**	**122**	
6.1	**Knowledge creation**	**5.9**	**99**	
6.1.1	Patents by origin/bn PPP$ GDP	0.9	68	● ◆
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	88	◆
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	56	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.1	87	
6.1.5	Citable documents H-index	5.3	101	
6.2	**Knowledge impact**	**10.9**	**[114]**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-0.3	100	
6.2.2	New businesses/th pop. 15-64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	115	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.4	94	◆
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**9.9**	**122**	◇
6.3.1	Intellectual property receipts, % total trade ⊙	0.0	98	
6.3.2	High-tech net exports, % total trade	0.3	88	
6.3.3	ICT services exports, % total trade	0.2	116	
6.3.4	FDI net outflows, % GDP	0.1	102	
	CREATIVE OUTPUTS	**8.2**	**122**	
7.1	**Intangible assets**	**14.1**	**113**	
7.1.1	Trademarks by origin/bn PPP$ GDP	31.8	77	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.1	108	
7.1.4	ICTs & organizational model creation†	35.8	120	
7.2	**Creative goods and services**	**2.2**	**[117]**	
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15-69	2.0	66	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.0	125	
7.3	**Online creativity**	**2.3**	**119**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	0.0	129	○
7.3.2	Country-code TLDs/th pop. 15-69	0.2	109	
7.3.3	Wikipedia edits/mn pop. 15-69	11.5	118	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

MYANMAR

GII 2020 rank

129

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
120	129	Lower middle	SEAO	54.0	355.6	5,855.6	n/a

		Score/Value	Rank	
	INSTITUTIONS	**45.6**	**123**	◇
1.1	**Political environment**	**36.6**	**127**	◇
1.1.1	Political and operational stability*	57.1	110	
1.1.2	Government effectiveness*	26.3	127	◇
1.2	**Regulatory environment**	**45.5**	**112**	
1.2.1	Regulatory quality*	21.9	116	
1.2.2	Rule of law*	19.8	121	◇
1.2.3	Cost of redundancy dismissal, salary weeks	23.1	97	
1.3	**Business environment**	**54.9**	**119**	
1.3.1	Ease of starting a business*	89.3	58	●
1.3.2	Ease of resolving insolvency*	20.4	128	◇
	HUMAN CAPITAL & RESEARCH	**16.1**	**107**	
2.1	**Education**	**16.4**	**128**	◇
2.1.1	Expenditure on education, % GDP	2.0	116	○ ◇
2.1.2	Government funding/pupil, secondary, % GDP/cap	10.3	95	
2.1.3	School life expectancy, years	10.7	103	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	27.2	112	◇
2.2	**Tertiary education**	**31.7**	**69**	
2.2.1	Tertiary enrolment, % gross	18.8	96	
2.2.2	Graduates in science & engineering, %	33.7	10	● ◆
2.2.3	Tertiary inbound mobility, %	0.0	111	○
2.3	**Research & development (R&D)**	**0.1**	**118**	
2.3.1	Researchers, FTE/mn pop. ⓘ	29.1	103	
2.3.2	Gross expenditure on R&D, % GDP ⓘ	0.0	113	◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**25.0**	**115**	
3.1	**Information & communication technologies (ICTs)**	**29.0**	**123**	◇
3.1.1	ICT access*	38.5	106	
3.1.2	ICT use*	41.3	97	
3.1.3	Government's online service*	22.9	124	◇
3.1.4	E-participation*	13.5	129	○ ◇
3.2	**General infrastructure**	**24.3**	**77**	
3.2.1	Electricity output, kWh/mn pop.	420.1	111	
3.2.2	Logistics performance*	10.7	119	◇
3.2.3	Gross capital formation, % GDP	37.2	15	● ◆
3.3	**Ecological sustainability**	**21.8**	**89**	
3.3.1	GDP/unit of energy use	12.8	26	● ◆
3.3.2	Environmental performance*	25.1	129	○ ◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.0	129	◇
	MARKET SOPHISTICATION	**27.7**	**127**	◇
4.1	**Credit**	**8.6**	**130**	○ ◇
4.1.1	Ease of getting credit*	10.0	129	○ ◇
4.1.2	Domestic credit to private sector, % GDP	25.3	105	
4.1.3	Microfinance gross loans, % GDP	0.3	42	
4.2	**Investment**	**11.2**	**129**	◇
4.2.1	Ease of protecting minority investors*	22.0	128	◇
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	75	
4.3	**Trade, competition, and market scale**	**63.3**	**65**	
4.3.1	Applied tariff rate, weighted avg., % ⓘ	1.7	51	● ◆
4.3.2	Intensity of local competition† ⓘ	56.4	119	◇
4.3.3	Domestic market scale, bn PPP$	355.6	50	●

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**10.4**	**131**	○ ◇
5.1	**Knowledge workers**	**3.3**	**131**	○ ◇
5.1.1	Knowledge-intensive employment, %	5.5	113	◇
5.1.2	Firms offering formal training, % ⓘ	5.9	95	○ ◇
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	0.0	103	○ ◇
5.1.5	Females employed w/advanced degrees, %	5.5	87	
5.2	**Innovation linkages**	**2.6**	**[130]**	
5.2.1	University/industry research collaboration†	n/a	n/a	
5.2.2	State of cluster development†	n/a	n/a	
5.2.3	GERD financed by abroad, % GDP	0.0	82	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	69	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**25.4**	**76**	
5.3.1	Intellectual property payments, % total trade	0.7	57	
5.3.2	High-tech imports, % total trade	6.2	91	
5.3.3	ICT services imports, % total trade	1.2	62	
5.3.4	FDI net inflows, % GDP	4.3	34	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**15.6**	**83**	
6.1	**Knowledge creation**	**1.9**	**[126]**	
6.1.1	Patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	0.6	127	
6.1.5	Citable documents H-index	3.3	119	
6.2	**Knowledge impact**	**25.1**	**62**	
6.2.1	Growth rate of PPP$ GDP/worker, %	6.3	3	● ◆
6.2.2	New businesses/th pop. 15–64	0.4	104	
6.2.3	Computer software spending, % GDP	n/a	n/a	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.5	119	◇
6.2.5	High- and medium-high-tech manufacturing, % ⓘ	9.7	82	
6.3	**Knowledge diffusion**	**19.7**	**79**	
6.3.1	Intellectual property receipts, % total trade	0.0	72	
6.3.2	High-tech net exports, % total trade	1.7	60	
6.3.3	ICT services exports, % total trade	0.4	103	
6.3.4	FDI net outflows, % GDP	5.4	9	● ◆
	CREATIVE OUTPUTS	**5.5**	**130**	○ ◇
7.1	**Intangible assets**	**7.2**	**[129]**	
7.1.1	Trademarks by origin/bn PPP$ GDP ⓘ	22.2	89	
7.1.2	Global brand value, top 5,000, % GDP	15.3	51	
7.1.3	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.4	ICTs & organizational model creation†	n/a	n/a	
7.2	**Creative goods and services**	**7.3**	**91**	
7.2.1	Cultural & creative services exports, % total trade	0.2	72	
7.2.2	National feature films/mn pop. 15–69 ⓘ	0.9	89	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing ⓘ	0.4	95	
7.2.5	Creative goods exports, % total trade	1.0	42	●
7.3	**Online creativity**	**0.0**	**130**	○ ◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.1	127	◇
7.3.2	Country-code TLDs/th pop. 15–69	0.0	126	
7.3.3	Wikipedia edits/mn pop. 15–69	n/a	n/a	
7.3.4	Mobile app creation/bn PPP$ GDP	0.0	91	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⓘ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

NAMIBIA

GII 2020 rank

104

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
104	**101**	**Upper middle**	**SSF**	**2.5**	**27.7**	**9,835.4**	**101**

		Score/Value	Rank	
	INSTITUTIONS	**62.1**	**69**	
1.1	**Political environment**	**60.0**	**59**	●
1.1.1	Political and operational stability*	75.0	44	●
1.1.2	Government effectiveness*	52.5	66	
1.2	**Regulatory environment**	**71.7**	**42**	●
1.2.1	Regulatory quality*	40.4	76	
1.2.2	Rule of law*	53.1	52	● ◆
1.2.3	Cost of redundancy dismissal, salary weeks	9.7	28	●
1.3	**Business environment**	**54.6**	**120**	◇
1.3.1	Ease of starting a business*	72.2	119	◇
1.3.2	Ease of resolving insolvency*	36.9	109	◇
	HUMAN CAPITAL & RESEARCH	**13.6**	**115**	◇
2.1	**Education**	**24.1**	**[119]**	
2.1.1	Expenditure on education, % GDP ◷	3.1	97	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ◷	25.9	108	◇
2.2	**Tertiary education**	**14.6**	**106**	◇
2.2.1	Tertiary enrolment, % gross	22.9	90	◇
2.2.2	Graduates in science & engineering, %	12.1	100	○ ◇
2.2.3	Tertiary inbound mobility, %	6.1	39	●
2.3	**Research & development (R&D)**	**2.1**	**93**	
2.3.1	Researchers, FTE/mn pop. ◷	149.5	84	◇
2.3.2	Gross expenditure on R&D, % GDP ◷	0.3	76	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**26.4**	**112**	◇
3.1	**Information & communication technologies (ICTs)**	**43.2**	**103**	◇
3.1.1	ICT access*	45.4	100	◇
3.1.2	ICT use*	42.9	94	◇
3.1.3	Government's online service*	45.1	113	◇
3.1.4	E-participation*	39.3	113	◇
3.2	**General infrastructure**	**9.6**	**127**	○ ◇
3.2.1	Electricity output, kWh/mn pop.	655.9	104	◇
3.2.2	Logistics performance*	n/a	n/a	
3.2.3	Gross capital formation, % GDP	17.1	115	○ ◇
3.3	**Ecological sustainability**	**26.3**	**76**	
3.3.1	GDP/unit of energy use	11.6	37	●
3.3.2	Environmental performance*	40.2	88	◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.4	86	
	MARKET SOPHISTICATION	**41.0**	**103**	
4.1	**Credit**	**34.6**	**90**	
4.1.1	Ease of getting credit*	60.0	74	
4.1.2	Domestic credit to private sector, % GDP	62.0	55	●
4.1.3	Microfinance gross loans, % GDP ◷	0.0	65	
4.2	**Investment**	**32.4**	**86**	
4.2.1	Ease of protecting minority investors*	56.0	82	
4.2.2	Market capitalization, % GDP	19.7	59	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**56.0**	**94**	
4.3.1	Applied tariff rate, weighted avg., %	1.0	11	●
4.3.2	Intensity of local competition†	62.0	97	
4.3.3	Domestic market scale, bn PPP$	27.7	122	○ ◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**17.9**	**111**	◇
5.1	**Knowledge workers**	**17.5**	**104**	◇
5.1.1	Knowledge-intensive employment, %	18.1	84	
5.1.2	Firms offering formal training, % ◷	25.4	61	
5.1.3	GERD performed by business, % GDP ◷	0.0	75	
5.1.4	GERD financed by business, % ◷	11.1	74	
5.1.5	Females employed w/advanced degrees, %	7.4	81	
5.2	**Innovation linkages**	**18.7**	**82**	
5.2.1	University/industry research collaboration†	43.1	59	●
5.2.2	State of cluster development†	45.4	76	
5.2.3	GERD financed by abroad, % GDP ◷	0.1	48	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	63	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	75	
5.3	**Knowledge absorption**	**17.6**	**115**	◇
5.3.1	Intellectual property payments, % total trade	0.0	112	○
5.3.2	High-tech imports, % total trade	7.4	71	
5.3.3	ICT services imports, % total trade	0.9	81	
5.3.4	FDI net inflows, % GDP	2.5	68	
5.3.5	Research talent, % in business enterprise ◷	6.9	68	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**7.3**	**127**	○ ◇
6.1	**Knowledge creation**	**7.8**	**83**	
6.1.1	Patents by origin/bn PPP$ GDP	0.8	71	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	59	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.1	73	
6.1.5	Citable documents H-index	4.8	106	
6.2	**Knowledge impact**	**6.1**	**123**	○ ◇
6.2.1	Growth rate of PPP$ GDP/worker, %	-3.1	116	○ ◇
6.2.2	New businesses/th pop. 15-64 ◷	1.2	79	
6.2.3	Computer software spending, % GDP	0.0	82	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.2	98	
6.2.5	High- and medium-high-tech manufacturing, % ◷	4.7	99	○ ◇
6.3	**Knowledge diffusion**	**8.1**	**127**	○ ◇
6.3.1	Intellectual property receipts, % total trade	0.0	87	
6.3.2	High-tech net exports, % total trade	0.1	120	○ ◇
6.3.3	ICT services exports, % total trade	0.3	111	
6.3.4	FDI net outflows, % GDP	0.0	112	
	CREATIVE OUTPUTS	**18.3**	**79**	
7.1	**Intangible assets**	**26.7**	**70**	
7.1.1	Trademarks by origin/bn PPP$ GDP	75.5	26	●
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.4	ICTs & organizational model creation†	46.7	95	
7.2	**Creative goods and services**	**3.4**	**[110]**	
7.2.1	Cultural & creative services exports, % total trade	0.1	85	
7.2.2	National feature films/mn pop. 15-69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.3	70	
7.3	**Online creativity**	**16.6**	**64**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	9.0	42	● ◆
7.3.2	Country-code TLDs/th pop. 15-69	0.9	90	
7.3.3	Wikipedia edits/mn pop. 15-69	43.1	76	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

NEPAL

GII 2020 rank

95

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
106	89	Low	CSA	28.6	94.4	2,896.9	109

		Score/Value	Rank	
	INSTITUTIONS	**49.9**	**114**	
1.1	**Political environment**	**40.2**	**119**	
1.1.1	Political and operational stability*	60.7	103	
1.1.2	Government effectiveness*	30.0	122	
1.2	**Regulatory environment**	**45.1**	**115**	
1.2.1	Regulatory quality*	22.1	115	
1.2.2	Rule of law*	34.2	95	
1.2.3	Cost of redundancy dismissal, salary weeks	27.2	107	◇
1.3	**Business environment**	**64.4**	**86**	
1.3.1	Ease of starting a business*	81.7	104	
1.3.2	Ease of resolving insolvency*	47.2	79	
	HUMAN CAPITAL & RESEARCH	**13.6**	**114**	
2.1	**Education**	**31.8**	**98**	
2.1.1	Expenditure on education, % GDP	5.2	39	●
2.1.2	Government funding/pupil, secondary, % GDP/cap. ◷	10.5	94	
2.1.3	School life expectancy, years	12.8	83	◆
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	28.3	117	○
2.2	**Tertiary education**	**7.1**	**119**	
2.2.1	Tertiary enrolment, % gross	12.4	104	
2.2.2	Graduates in science & engineering, %	12.9	99	
2.2.3	Tertiary inbound mobility, % ◷	0.0	112	○ ◇
2.3	**Research & development (R&D)**	**1.9**	**95**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.3	81	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**38.0**	**76**	◆
3.1	**Information & communication technologies (ICTs)**	**54.2**	**88**	◆
3.1.1	ICT access*	41.1	104	◆
3.1.2	ICT use*	28.7	106	◆
3.1.3	Government's online service*	68.8	73	◆
3.1.4	E-participation*	78.1	55	● ◆
3.2	**General infrastructure**	**44.8**	**13**	● ◆
3.2.1	Electricity output, kWh/mn pop.	158.3	117	○
3.2.2	Logistics performance*	20.8	107	
3.2.3	Gross capital formation, % GDP	62.3	2	● ◆
3.3	**Ecological sustainability**	**15.1**	**125**	○
3.3.1	GDP/unit of energy use	5.2	108	
3.3.2	Environmental performance*	32.7	113	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	108	
	MARKET SOPHISTICATION	**51.8**	**40**	● ◆
4.1	**Credit**	**50.6**	**33**	● ◆
4.1.1	Ease of getting credit*	75.0	34	●
4.1.2	Domestic credit to private sector, % GDP	87.7	31	● ◆
4.1.3	Microfinance gross loans, % GDP	1.8	18	●
4.2	**Investment**	**58.0**	**[17]**	
4.2.1	Ease of protecting minority investors*	58.0	77	◆
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**46.7**	**124**	○
4.3.1	Applied tariff rate, weighted avg., %	12.4	126	○ ◇
4.3.2	Intensity of local competition†	63.1	92	
4.3.3	Domestic market scale, bn PPP$	94.4	84	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**27.5**	**[58]**	
5.1	**Knowledge workers**	**23.5**	**[88]**	
5.1.1	Knowledge-intensive employment, % ◷	13.8	96	◆
5.1.2	Firms offering formal training, % ◷	31.9	46	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ◷	3.0	97	◆
5.2	**Innovation linkages**	**23.7**	**[54]**	
5.2.1	University/industry research collaboration†	32.8	101	
5.2.2	State of cluster development†	37.6	106	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	83	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	n/a	n/a	
5.3	**Knowledge absorption**	**35.3**	**[40]**	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports, % total trade ◷	11.6	20	●
5.3.3	ICT services imports, % total trade ◷	0.2	122	○
5.3.4	FDI net inflows, % GDP	0.5	122	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**12.8**	**102**	
6.1	**Knowledge creation**	**8.6**	**[80]**	
6.1.1	Patents by origin/bn PPP$ GDP ◷	0.3	92	
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.6	70	
6.1.5	Citable documents H-index	7.6	86	
6.2	**Knowledge impact**	**3.9**	**127**	○ ◇
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15-64	1.3	75	◆
6.2.3	Computer software spending, % GDP	0.0	117	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.1	102	
6.2.5	High- and medium-high-tech manufacturing, % ◷	6.7	94	
6.3	**Knowledge diffusion**	**25.9**	**57**	● ◆
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade ◷	0.1	113	
6.3.3	ICT services exports, % total trade ◷	4.2	20	● ◆
6.3.4	FDI net outflows, % GDP	0.5	76	
	CREATIVE OUTPUTS	**12.3**	**106**	
7.1	**Intangible assets**	**17.2**	**103**	
7.1.1	Trademarks by origin/bn PPP$ GDP ◷	50.5	47	● ◆
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP ◷	0.2	101	
7.1.4	ICTs & organizational model creation†	37.9	118	○
7.2	**Creative goods and services**	**4.0**	**[107]**	
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15-69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing ◷	0.4	92	◇
7.2.5	Creative goods exports, % total trade ◷	0.2	75	
7.3	**Online creativity**	**10.8**	**83**	◆
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	0.5	110	
7.3.2	Country-code TLDs/th pop. 15-69	1.0	84	
7.3.3	Wikipedia edits/mn pop. 15-69	35.8	88	◆
7.3.4	Mobile app creation/bn PPP$ GDP	9.3	46	● ◆

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

NETHERLANDS

GII 2020 rank

5

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
4	11	High	EUR	17.1	1,005.3	50,933.1	4

		Score/Value	Rank
	INSTITUTIONS	**89.7**	**7**
1.1	**Political environment**	**90.2**	**9**
1.1.1	Political and operational stability*	87.5	11
1.1.2	Government effectiveness*	91.5	7
1.2	**Regulatory environment**	**89.5**	**14**
1.2.1	Regulatory quality*	95.0	3 ●
1.2.2	Rule of law*	94.0	9
1.2.3	Cost of redundancy dismissal, salary weeks	15.8	63 ○
1.3	**Business environment**	**89.4**	**5 ●**
1.3.1	Ease of starting a business*	94.3	22
1.3.2	Ease of resolving insolvency*	84.4	7
	HUMAN CAPITAL & RESEARCH	**55.3**	**14**
2.1	**Education**	**58.5**	**19**
2.1.1	Expenditure on education, % GDP ⊙	5.5	23
2.1.2	Government funding/pupil, secondary, % GDP/cap	23.1	26
2.1.3	School life expectancy, years	18.5	10
2.1.4	PISA scales in reading, maths, & science	502.5	15
2.1.5	Pupil-teacher ratio, secondary ⊙	14.5	72 ○ ◇
2.2	**Tertiary education**	**42.0**	**37**
2.2.1	Tertiary enrolment, % gross	85.0	12
2.2.2	Graduates in science & engineering, %	16.6	84 ○ ◇
2.2.3	Tertiary inbound mobility, %	11.0	16
2.3	**Research & development (R&D)**	**65.3**	**11**
2.3.1	Researchers, FTE/mn pop.	5,604.5	10
2.3.2	Gross expenditure on R&D, % GDP	2.2	14
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	83.0	9
2.3.4	QS university ranking, average score top 3*	67.4	13
	INFRASTRUCTURE	**57.4**	**18**
3.1	**Information & communication technologies (ICTs)**	**91.0**	**4 ●**
3.1.1	ICT access*	86.0	9
3.1.2	ICT use*	86.0	8
3.1.3	Government's online service*	93.1	17
3.1.4	E-participation*	98.9	4 ●
3.2	**General infrastructure**	**38.4**	**28**
3.2.1	Electricity output, kWh/mn pop.	6,589.6	30
3.2.2	Logistics performance*	91.5	6
3.2.3	Gross capital formation, % GDP	21.2	87 ○
3.3	**Ecological sustainability**	**42.9**	**32**
3.3.1	GDP/unit of energy use	11.6	37
3.3.2	Environmental performance*	75.3	11
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.2	37
	MARKET SOPHISTICATION	**56.5**	**23**
4.1	**Credit**	**46.0**	**47**
4.1.1	Ease of getting credit*	45.0	101 ○ ◇
4.1.2	Domestic credit to private sector, % GDP	105.8	22
4.1.3	Microfinance gross loans, % GDP	n/a	n/a
4.2	**Investment**	**46.5**	**29**
4.2.1	Ease of protecting minority investors*	58.0	77 ○ ◇
4.2.2	Market capitalization, % GDP ⊙	110.1	9
4.2.3	Venture capital deals/bn PPP$ GDP	0.2	16
4.3	**Trade, competition, and market scale**	**77.0**	**16**
4.3.1	Applied tariff rate, weighted avg., %	1.7	22 ○
4.3.2	Intensity of local competition†	80.5	5 ●
4.3.3	Domestic market scale, bn PPP$	1,005.3	27

		Score/Value	Rank
	BUSINESS SOPHISTICATION	**63.4**	**4 ● ◆**
5.1	**Knowledge workers**	**59.3**	**17**
5.1.1	Knowledge-intensive employment, %	47.7	11
5.1.2	Firms offering formal training, %	n/a	n/a
5.1.3	GERD performed by business, % GDP	1.5	13
5.1.4	GERD financed by business, %	51.6	26
5.1.5	Females employed w/advanced degrees, %	20.3	28
5.2	**Innovation linkages**	**62.6**	**7**
5.2.1	University/industry research collaboration†	74.4	5 ● ◆
5.2.2	State of cluster development†	70.4	6
5.2.3	GERD financed by abroad, % GDP	0.3	10
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	23
5.2.5	Patent families 2+ offices/bn PPP$ GDP	7.8	1 ● ◆
5.3	**Knowledge absorption**	**68.3**	**1 ● ◆**
5.3.1	Intellectual property payments, % total trade	7.9	1 ● ◆
5.3.2	High-tech imports, % total trade	11.3	22
5.3.3	ICT services imports, % total trade	2.4	19
5.3.4	FDI net inflows, % GDP	5.4	23
5.3.5	Research talent, % in business enterprise	70.0	7
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**54.5**	**8**
6.1	**Knowledge creation**	**65.7**	**8**
6.1.1	Patents by origin/bn PPP$ GDP	9.5	10
6.1.2	PCT patents by origin/bn PPP$ GDP	4.0	10
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a
6.1.4	Scientific & technical articles/bn PPP$ GDP	22.3	22
6.1.5	Citable documents H-index	69.1	7
6.2	**Knowledge impact**	**35.9**	**24**
6.2.1	Growth rate of PPP$ GDP/worker, %	0.3	85 ○
6.2.2	New businesses/th pop. 15-64	6.4	25
6.2.3	Computer software spending, % GDP	0.0	9
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	8.1	32
6.2.5	High- and medium-high-tech manufacturing, %	32.6	35
6.3	**Knowledge diffusion**	**61.8**	**5 ●**
6.3.1	Intellectual property receipts, % total trade	7.2	1 ● ◆
6.3.2	High-tech net exports, % total trade	11.1	15
6.3.3	ICT services exports, % total trade	3.5	23
6.3.4	FDI net outflows, % GDP	8.2	7
	CREATIVE OUTPUTS	**51.7**	**6**
7.1	**Intangible assets**	**47.9**	**16**
7.1.1	Trademarks by origin/bn PPP$ GDP	49.6	49 ○
7.1.2	Global brand value, top 5,000, % GDP	153.4	9
7.1.3	Industrial designs by origin/bn PPP$ GDP	4.1	30
7.1.4	ICTs & organizational model creation†	80.2	4 ● ◆
7.2	**Creative goods and services**	**38.6**	**13**
7.2.1	Cultural & creative services exports, % total trade	1.8	9
7.2.2	National feature films/mn pop. 15-69	7.6	25
7.2.3	Entertainment & Media market/th pop. 15-69	51.5	17
7.2.4	Printing and other media, % manufacturing	1.1	53 ○
7.2.5	Creative goods exports, % total trade	3.4	17
7.3	**Online creativity**	**72.4**	**2 ● ◆**
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	78.4	5 ● ◆
7.3.2	Country-code TLDs/th pop. 15-69	100.0	1 ● ◆
7.3.3	Wikipedia edits/mn pop. 15-69	93.4	5 ● ◆
7.3.4	Mobile app creation/bn PPP$ GDP	18.1	27

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

NEW ZEALAND

GII 2020 rank

26

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
33	19	High	SEAO	4.8	206.2	35,744.0	25

		Score/Value	Rank	
	INSTITUTIONS	**90.9**	**4**	● ◆
1.1	**Political environment**	**90.5**	**8**	● ◆
1.1.1	Political and operational stability*	96.4	2	● ◆
1.1.2	Government effectiveness*	87.5	12	
1.2	**Regulatory environment**	**97.4**	**3**	● ◆
1.2.1	Regulatory quality*	94.0	4	● ◆
1.2.2	Rule of law*	95.6	5	● ◆
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	● ◆
1.3	**Business environment**	**84.7**	**19**	
1.3.1	Ease of starting a business*	100.0	1	● ◆
1.3.2	Ease of resolving insolvency*	69.5	33	
	HUMAN CAPITAL & RESEARCH	**54.4**	**18**	
2.1	**Education**	**61.5**	**14**	
2.1.1	Expenditure on education, % GDP ◷	6.4	10	◆
2.1.2	Government funding/pupil, secondary, % GDP/cap	21.1	46	
2.1.3	School life expectancy, years	18.8	8	● ◆
2.1.4	PISA scales in reading, maths, & science	502.9	13	
2.1.5	Pupil-teacher ratio, secondary ◷	13.6	68	○ ◇
2.2	**Tertiary education**	**53.6**	**11**	
2.2.1	Tertiary enrolment, % gross	82.0	15	
2.2.2	Graduates in science & engineering, %	21.2	62	○
2.2.3	Tertiary inbound mobility, %	19.6	6	● ◆
2.3	**Research & development (R&D)**	**48.1**	**21**	
2.3.1	Researchers, FTE/mn pop. ◷	5,529.5	11	
2.3.2	Gross expenditure on R&D, % GDP ◷	1.4	27	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	47.9	31	
2.3.4	QS university ranking, average score top 3*	50.7	18	
	INFRASTRUCTURE	**57.7**	**15**	
3.1	**Information & communication technologies (ICTs)**	**90.5**	**8**	● ◆
3.1.1	ICT access*	85.6	12	
3.1.2	ICT use*	82.9	13	
3.1.3	Government's online service*	95.1	9	
3.1.4	E-participation*	98.3	5	◆
3.2	**General infrastructure**	**41.0**	**21**	
3.2.1	Electricity output, kWh/mn pop.	9,023.2	17	
3.2.2	Logistics performance*	84.7	15	
3.2.3	Gross capital formation, % GDP	24.1	59	
3.3	**Ecological sustainability**	**41.5**	**34**	
3.3.1	GDP/unit of energy use	8.5	73	○
3.3.2	Environmental performance*	71.3	19	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.7	28	
	MARKET SOPHISTICATION	**63.9**	**10**	
4.1	**Credit**	**85.8**	**3**	● ◆
4.1.1	Ease of getting credit*	100.0	1	● ◆
4.1.2	Domestic credit to private sector, % GDP	158.3	7	● ◆
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**38.6**	**63**	
4.2.1	Ease of protecting minority investors*	86.0	3	● ◆
4.2.2	Market capitalization, % GDP	43.8	35	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	34	
4.3	**Trade, competition, and market scale**	**67.4**	**44**	
4.3.1	Applied tariff rate, weighted avg., % ◷	1.4	15	
4.3.2	Intensity of local competition†	70.8	52	
4.3.3	Domestic market scale, bn PPP$	206.2	63	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**37.9**	**32**	
5.1	**Knowledge workers**	**41.0**	**[43]**	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP ◷	0.8	30	
5.1.4	GERD financed by business, %	46.4	36	
5.1.5	Females employed w/advanced degrees, % ◷	19.5	29	
5.2	**Innovation linkages**	**35.7**	**29**	
5.2.1	University/industry research collaboration†	59.5	24	
5.2.2	State of cluster development†	49.5	49	
5.2.3	GERD financed by abroad, % GDP	0.1	35	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	19	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	1.9	21	
5.3	**Knowledge absorption**	**37.2**	**35**	
5.3.1	Intellectual property payments, % total trade	1.6	18	
5.3.2	High-tech imports, % total trade	10.2	28	
5.3.3	ICT services imports, % total trade	1.5	43	
5.3.4	FDI net inflows, % GDP	1.0	108	○
5.3.5	Research talent, % in business enterprise ◷	31.2	41	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**31.2**	**39**	
6.1	**Knowledge creation**	**47.5**	**17**	
6.1.1	Patents by origin/bn PPP$ GDP	5.1	22	
6.1.2	PCT patents by origin/bn PPP$ GDP	1.2	26	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	29.7	10	◆
6.1.5	Citable documents H-index	34.8	27	
6.2	**Knowledge impact**	**26.3**	**60**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.7	71	○
6.2.2	New businesses/th pop. 15-64	17.8	4	● ◆
6.2.3	Computer software spending, % GDP	0.0	55	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	5.1	54	
6.2.5	High- and medium-high-tech manufacturing, % ◷	14.1	69	○
6.3	**Knowledge diffusion**	**19.9**	**77**	○
6.3.1	Intellectual property receipts, % total trade	0.7	23	
6.3.2	High-tech net exports, % total trade	1.1	67	○
6.3.3	ICT services exports, % total trade	1.1	79	○
6.3.4	FDI net outflows, % GDP	0.0	119	○
	CREATIVE OUTPUTS	**34.9**	**33**	
7.1	**Intangible assets**	**35.4**	**37**	
7.1.1	Trademarks by origin/bn PPP$ GDP	90.1	18	◆
7.1.2	Global brand value, top 5,000, % GDP	18.8	48	
7.1.3	Industrial designs by origin/bn PPP$ GDP	2.3	49	
7.1.4	ICTs & organizational model creation†	71.3	18	
7.2	**Creative goods and services**	**21.5**	**48**	
7.2.1	Cultural & creative services exports, % total trade	0.4	57	
7.2.2	National feature films/mn pop. 15-69	6.1	37	
7.2.3	Entertainment & Media market/th pop. 15-69	53.5	14	
7.2.4	Printing and other media, % manufacturing ◷	1.8	21	
7.2.5	Creative goods exports, % total trade	0.5	65	○
7.3	**Online creativity**	**47.1**	**23**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	32.1	20	
7.3.2	Country-code TLDs/th pop. 15-69	64.6	10	◆
7.3.3	Wikipedia edits/mn pop. 15-69	80.4	24	
7.3.4	Mobile app creation/bn PPP$ GDP	12.3	40	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

NIGER

GII 2020 rank

128

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
129	124	Low	SSF	23.3	25.8	965.5	127

		Score/Value	Rank	
	INSTITUTIONS	**54.9**	**96**	
1.1	**Political environment**	**41.1**	**117**	
1.1.1	Political and operational stability*	57.1	110	
1.1.2	Government effectiveness*	33.0	119	
1.2	**Regulatory environment**	**58.2**	**84**	
1.2.1	Regulatory quality*	24.9	108	
1.2.2	Rule of law*	31.5	100	
1.2.3	Cost of redundancy dismissal, salary weeks	14.0	53	●
1.3	**Business environment**	**65.4**	**83**	
1.3.1	Ease of starting a business*	91.5	49	●
1.3.2	Ease of resolving insolvency*	39.3	100	
	HUMAN CAPITAL & RESEARCH	**9.5**	**127**	
2.1	**Education**	**22.0**	**122**	
2.1.1	Expenditure on education, % GDP	4.9	44	●
2.1.2	Government funding/pupil, secondary, % GDP/cap	16.1	71	
2.1.3	School life expectancy, years	6.4	120	○ ◇
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	29.7	119	
2.2	**Tertiary education**	**6.5**	**122**	
2.2.1	Tertiary enrolment, % gross	4.4	121	
2.2.2	Graduates in science & engineering, %	10.4	104	◇
2.2.3	Tertiary inbound mobility, %	5.2	43	●
2.3	**Research & development (R&D)**	**0.0**	**[121]**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**19.6**	**126**	
3.1	**Information & communication technologies (ICTs)**	**15.9**	**130**	○ ◇
3.1.1	ICT access*	23.1	128	◇
3.1.2	ICT use*	3.1	131	○ ◇
3.1.3	Government's online service*	16.0	129	○ ◇
3.1.4	E-participation*	21.4	122	◇
3.2	**General infrastructure**	**27.3**	**62**	
3.2.1	Electricity output, kWh/mn pop.	25.7	122	○ ◇
3.2.2	Logistics performance*	0.0	124	○ ◇
3.2.3	Gross capital formation, % GDP	45.5	4	●
3.3	**Ecological sustainability**	**15.6**	**123**	
3.3.1	GDP/unit of energy use	6.2	100	
3.3.2	Environmental performance*	30.8	118	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	117	
	MARKET SOPHISTICATION	**33.9**	**124**	
4.1	**Credit**	**30.0**	**107**	
4.1.1	Ease of getting credit*	70.0	44	●
4.1.2	Domestic credit to private sector, % GDP	14.2	120	
4.1.3	Microfinance gross loans, % GDP	0.1	55	
4.2	**Investment**	**42.0**	**[47]**	
4.2.1	Ease of protecting minority investors*	42.0	102	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**29.6**	**129**	◇
4.3.1	Applied tariff rate, weighted avg., %	11.0	121	
4.3.2	Intensity of local competition†	n/a	n/a	
4.3.3	Domestic market scale, bn PPP$	25.8	125	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**21.9**	**[89]**	
5.1	**Knowledge workers**	**20.8**	**[100]**	
5.1.1	Knowledge-intensive employment, %	15.3	91	◆
5.1.2	Firms offering formal training, %	27.5	55	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, %	0.7	114	
5.2	**Innovation linkages**	**1.5**	**[131]**	
5.2.1	University/industry research collaboration†	n/a	n/a	
5.2.2	State of cluster development†	n/a	n/a	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	104	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**43.3**	**[25]**	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports, % total trade	7.5	70	
5.3.3	ICT services imports, % total trade	3.5	4	● ◆
5.3.4	FDI net inflows, % GDP	9.9	9	● ◆
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**13.0**	**100**	
6.1	**Knowledge creation**	**3.5**	**117**	
6.1.1	Patents by origin/bn PPP$ GDP	0.3	93	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.0	105	
6.1.5	Citable documents H-index	3.6	117	
6.2	**Knowledge impact**	**13.2**	**110**	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.9	49	●
6.2.2	New businesses/th pop. 15–64	0.1	118	
6.2.3	Computer software spending, % GDP	0.0	109	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.2	130	○ ◇
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**22.2**	**70**	◆
6.3.1	Intellectual property receipts, % total trade	0.0	107	
6.3.2	High-tech net exports, % total trade	0.1	107	
6.3.3	ICT services exports, % total trade	4.3	18	● ◆
6.3.4	FDI net outflows, % GDP	0.4	80	
	CREATIVE OUTPUTS	**2.4**	**[131]**	
7.1	**Intangible assets**	**4.1**	**[131]**	
7.1.1	Trademarks by origin/bn PPP$ GDP	15.9	99	
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.0	119	
7.1.4	ICTs & organizational model creation†	n/a	n/a	
7.2	**Creative goods and services**	**1.2**	**[123]**	
7.2.1	Cultural & creative services exports, % total trade	0.1	81	
7.2.2	National feature films/mn pop. 15–69	0.7	94	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.0	124	
7.3	**Online creativity**	**0.3**	**127**	◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.9	98	◆
7.3.2	Country-code TLDs/th pop. 15–69	0.0	130	○
7.3.3	Wikipedia edits/mn pop. 15–69	n/a	n/a	
7.3.4	Mobile app creation/bn PPP$ GDP	0.0	90	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

NIGERIA

GII 2020 rank

117

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
121	115	Lower middle	SSF	201.0	1,216.8	5,286.0	114

		Score/Value	Rank	
	INSTITUTIONS	**51.1**	**110**	
1.1	**Political environment**	**34.3**	**129**	○ ◇
1.1.1	Political and operational stability*	48.2	128	○ ◇
1.1.2	Government effectiveness*	27.3	125	◇
1.2	**Regulatory environment**	**60.6**	**78**	
1.2.1	Regulatory quality*	18.5	122	◇
1.2.2	Rule of law*	23.7	118	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	● ◆
1.3	**Business environment**	**58.4**	**109**	
1.3.1	Ease of starting a business*	86.2	81	
1.3.2	Ease of resolving insolvency*	30.6	118	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**11.2**	**[121]**	
2.1	**Education**	**26.8**	**[113]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years ⊙	8.7	114	◇
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⊙	23.2	105	
2.2	**Tertiary education**	**6.9**	**[120]**	
2.2.1	Tertiary enrolment, % gross ⊙	10.2	108	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**0.0**	**[121]**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**21.3**	**124**	◇
3.1	**Information & communication technologies (ICTs)**	**38.3**	**112**	
3.1.1	ICT access*	27.9	123	◇
3.1.2	ICT use*	24.2	109	
3.1.3	Government's online service*	52.8	104	
3.1.4	E-participation*	48.3	106	
3.2	**General infrastructure**	**10.1**	**126**	◇
3.2.1	Electricity output, kWh/mn pop.	168.9	116	◇
3.2.2	Logistics performance*	21.7	104	
3.2.3	Gross capital formation, % GDP	14.2	121	○ ◇
3.3	**Ecological sustainability**	**15.6**	**122**	◇
3.3.1	GDP/unit of energy use	6.4	98	
3.3.2	Environmental performance*	31.0	117	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	127	○

		Score/Value	Rank	
	MARKET SOPHISTICATION	**41.6**	**102**	
4.1	**Credit**	**35.3**	**87**	
4.1.1	Ease of getting credit*	85.0	14	● ◆
4.1.2	Domestic credit to private sector, % GDP	10.9	125	○ ◇
4.1.3	Microfinance gross loans, % GDP	0.1	60	
4.2	**Investment**	**25.4**	**116**	
4.2.1	Ease of protecting minority investors*	72.0	27	●
4.2.2	Market capitalization, % GDP	8.4	68	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	78	
4.3	**Trade, competition, and market scale**	**64.1**	**58**	●
4.3.1	Applied tariff rate, weighted avg., % ⊙	8.5	106	
4.3.2	Intensity of local competition†	68.7	66	●
4.3.3	Domestic market scale, bn PPP$	1,216.8	23	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**23.8**	**75**	
5.1	**Knowledge workers**	**34.7**	**[57]**	
5.1.1	Knowledge-intensive employment, % ⊙	28.4	51	● ◆
5.1.2	Firms offering formal training, % ⊙	30.7	48	●
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ⊙	5.0	90	
5.2	**Innovation linkages**	**18.2**	**86**	
5.2.1	University/industry research collaboration†	26.4	122	○ ◇
5.2.2	State of cluster development†	46.3	70	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	89	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	97	
5.3	**Knowledge absorption**	**18.6**	**111**	
5.3.1	Intellectual property payments, % total trade	0.5	67	
5.3.2	High-tech imports, % total trade	4.0	122	
5.3.3	ICT services imports, % total trade	0.6	97	
5.3.4	FDI net inflows, % GDP	0.8	117	
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**9.4**	**120**	◇
6.1	**Knowledge creation**	**4.9**	**108**	
6.1.1	Patents by origin/bn PPP$ GDP	0.1	113	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	99	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.3	114	
6.1.5	Citable documents H-index	11.5	65	●
6.2	**Knowledge impact**	**13.4**	**109**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.8	66	● ◇
6.2.2	New businesses/th pop. 15–64	0.8	87	
6.2.3	Computer software spending, % GDP	0.0	83	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.2	127	○ ◇
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**10.0**	**121**	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade	0.1	119	
6.3.3	ICT services exports, % total trade	0.3	107	
6.3.4	FDI net outflows, % GDP	0.3	84	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**11.5**	**110**	
7.1	**Intangible assets**	**17.2**	**105**	
7.1.1	Trademarks by origin/bn PPP$ GDP ⊙	19.8	95	
7.1.2	Global brand value, top 5,000, % GDP	6.3	66	
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.0	68	
7.1.4	ICTs & organizational model creation†	47.5	89	
7.2	**Creative goods and services**	**9.7**	**[78]**	
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69 ⊙	11.3	15	● ◆
7.2.3	Entertainment & Media market/th pop. 15–69	0.8	59	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade ⊙	0.0	128	○
7.3	**Online creativity**	**1.8**	**122**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.5	108	
7.3.2	Country-code TLDs/th pop. 15–69	0.4	101	
7.3.3	Wikipedia edits/mn pop. 15–69	10.8	119	○ ◇
7.3.4	Mobile app creation/bn PPP$ GDP	0.2	79	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

NORTH MACEDONIA

GII 2020 rank

57

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
63	46	Upper middle	EUR	2.1	34.3	14,393.0	59

		Score/Value	Rank	
	INSTITUTIONS	**68.9**	**50**	
1.1	**Political environment**	**58.6**	**65**	
1.1.1	Political and operational stability*	71.4	59	
1.1.2	Government effectiveness*	52.2	67	
1.2	**Regulatory environment**	**67.3**	**58**	
1.2.1	Regulatory quality*	55.6	44	
1.2.2	Rule of law*	39.3	79	
1.2.3	Cost of redundancy dismissal, salary weeks	14.4	55	
1.3	**Business environment**	**80.7**	**30**	● ◆
1.3.1	Ease of starting a business*	88.6	63	
1.3.2	Ease of resolving insolvency*	72.7	28	● ◆
	HUMAN CAPITAL & RESEARCH	**29.1**	**72**	
2.1	**Education**	**53.3**	**[44]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	13.6	76	
2.1.4	PISA scales in reading, maths, & science	400.1	67	○
2.1.5	Pupil-teacher ratio, secondary ⌚	8.7	18	●
2.2	**Tertiary education**	**29.8**	**75**	
2.2.1	Tertiary enrolment, % gross	42.5	67	
2.2.2	Graduates in science & engineering, %	21.9	58	
2.2.3	Tertiary inbound mobility, %	4.7	47	
2.3	**Research & development (R&D)**	**4.1**	**79**	
2.3.1	Researchers, FTE/mn pop.	799.3	56	
2.3.2	Gross expenditure on R&D, % GDP	0.4	74	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**46.4**	**49**	
3.1	**Information & communication technologies (ICTs)**	**66.2**	**69**	
3.1.1	ICT access*	63.8	68	
3.1.2	ICT use*	59.4	60	
3.1.3	Government's online service*	71.5	70	
3.1.4	E-participation*	70.2	70	
3.2	**General infrastructure**	**19.7**	**100**	
3.2.1	Electricity output, kWh/mn pop.	2,692.4	69	
3.2.2	Logistics performance*	29.8	80	
3.2.3	Gross capital formation, % GDP	n/a	n/a	
3.3	**Ecological sustainability**	**53.2**	**17**	● ◆
3.3.1	GDP/unit of energy use	10.0	55	
3.3.2	Environmental performance*	55.4	41	◆
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	9.4	7	● ◆
	MARKET SOPHISTICATION	**59.7**	**17**	● ◆
4.1	**Credit**	**41.2**	**68**	
4.1.1	Ease of getting credit*	80.0	23	●
4.1.2	Domestic credit to private sector, % GDP	50.3	68	
4.1.3	Microfinance gross loans, % GDP	0.3	43	
4.2	**Investment**	**82.0**	**[3]**	
4.2.1	Ease of protecting minority investors*	82.0	12	● ◆
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**55.9**	**95**	
4.3.1	Applied tariff rate, weighted avg., %	1.9	55	
4.3.2	Intensity of local competition†	62.5	96	
4.3.3	Domestic market scale, bn PPP$	34.3	115	○ ◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**25.4**	**66**	
5.1	**Knowledge workers**	**33.4**	**60**	
5.1.1	Knowledge-intensive employment, %	28.7	49	
5.1.2	Firms offering formal training, %	39.0	31	
5.1.3	GERD performed by business, % GDP	0.1	60	
5.1.4	GERD financed by business, %	30.1	59	
5.1.5	Females employed w/advanced degrees, %	13.4	52	
5.2	**Innovation linkages**	**13.4**	**120**	○ ◇
5.2.1	University/industry research collaboration†	30.2	112	○ ◇
5.2.2	State of cluster development†	38.6	101	○
5.2.3	GERD financed by abroad, % GDP	0.0	69	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	102	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	65	
5.3	**Knowledge absorption**	**29.5**	**61**	
5.3.1	Intellectual property payments, % total trade	1.4	23	●
5.3.2	High-tech imports, % total trade	5.5	103	
5.3.3	ICT services imports, % total trade	1.3	55	
5.3.4	FDI net inflows, % GDP	4.5	33	●
5.3.5	Research talent, % in business enterprise	24.1	50	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**23.0**	**58**	
6.1	**Knowledge creation**	**12.0**	**71**	
6.1.1	Patents by origin/bn PPP$ GDP ⌚	1.6	48	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	58	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	8.8	57	
6.1.5	Citable documents H-index	6.1	95	
6.2	**Knowledge impact**	**28.7**	**46**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-1.1	109	○
6.2.2	New businesses/th pop. 15-64	3.6	39	
6.2.3	Computer software spending, % GDP	0.0	79	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	13.4	22	●
6.2.5	High- and medium-high-tech manufacturing, % ⌚	41.6	21	● ◆
6.3	**Knowledge diffusion**	**28.3**	**48**	
6.3.1	Intellectual property receipts, % total trade	0.1	48	
6.3.2	High-tech net exports, % total trade	2.8	48	
6.3.3	ICT services exports, % total trade	2.6	40	
6.3.4	FDI net outflows, % GDP	1.0	57	
	CREATIVE OUTPUTS	**18.9**	**76**	
7.1	**Intangible assets**	**18.4**	**99**	
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.9	51	
7.1.4	ICTs & organizational model creation†	41.1	112	○ ◇
7.2	**Creative goods and services**	**16.7**	**61**	
7.2.1	Cultural & creative services exports, % total trade	0.9	29	●
7.2.2	National feature films/mn pop. 15-69	5.1	44	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing ⌚	2.1	14	● ◆
7.2.5	Creative goods exports, % total trade	0.2	86	
7.3	**Online creativity**	**22.0**	**51**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	6.8	47	
7.3.2	Country-code TLDs/th pop. 15-69	5.7	49	
7.3.3	Wikipedia edits/mn pop. 15-69	66.2	45	
7.3.4	Mobile app creation/bn PPP$ GDP	11.3	43	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⌚ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

NORWAY

GII 2020 rank

20

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
28	15	High	EUR	5.4	410.7	66,947.8	19

		Score/Value	Rank	
	INSTITUTIONS	**92.5**	**3**	● ◆
1.1	**Political environment**	**91.9**	**4**	●
1.1.1	Political and operational stability*	91.1	5	
1.1.2	Government effectiveness*	92.3	5	●
1.2	**Regulatory environment**	**95.9**	**4**	●
1.2.1	Regulatory quality*	88.2	10	
1.2.2	Rule of law*	97.9	2	●
1.2.3	Cost of redundancy dismissal, salary weeks	8.7	20	
1.3	**Business environment**	**89.9**	**3**	●
1.3.1	Ease of starting a business*	94.3	23	
1.3.2	Ease of resolving insolvency*	85.4	5	●

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**55.1**	**16**	
2.1	**Education**	**69.9**	**5**	● ◆
2.1.1	Expenditure on education, % GDP ⊙	8.0	2	● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap	26.8	18	◆
2.1.3	School life expectancy, years	18.1	11	
2.1.4	PISA scales in reading, maths, & science	496.9	22	
2.1.5	Pupil-teacher ratio, secondary ⊙	8.6	17	◆
2.2	**Tertiary education**	**40.3**	**42**	
2.2.1	Tertiary enrolment, % gross	82.0	16	
2.2.2	Graduates in science & engineering, %	22.1	56	○
2.2.3	Tertiary inbound mobility, %	3.2	64	○ ◇
2.3	**Research & development (R&D)**	**55.0**	**19**	
2.3.1	Researchers, FTE/mn pop.	6,466.7	7	●
2.3.2	Gross expenditure on R&D, % GDP	2.1	15	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	56.2	25	
2.3.4	QS university ranking, average score top 3*	44.4	25	

		Score/Value	Rank	
	INFRASTRUCTURE	**64.6**	**1**	● ◆
3.1	**Information & communication technologies (ICTs)**	**89.3**	**12**	
3.1.1	ICT access*	76.2	38	◇
3.1.2	ICT use*	88.2	5	● ◆
3.1.3	Government's online service*	95.1	9	
3.1.4	E-participation*	97.8	11	
3.2	**General infrastructure**	**58.8**	**3**	● ◆
3.2.1	Electricity output, kWh/mn pop.	27,634.6	1	● ◆
3.2.2	Logistics performance*	76.3	21	
3.2.3	Gross capital formation, % GDP	28.2	33	
3.3	**Ecological sustainability**	**45.7**	**28**	
3.3.1	GDP/unit of energy use	11.0	44	
3.3.2	Environmental performance*	77.7	9	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.3	30	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**56.1**	**25**	
4.1	**Credit**	**59.9**	**16**	
4.1.1	Ease of getting credit*	55.0	88	○
4.1.2	Domestic credit to private sector, % GDP	144.0	11	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**41.2**	**58**	
4.2.1	Ease of protecting minority investors*	76.0	21	
4.2.2	Market capitalization, % GDP	65.5	23	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	26	
4.3	**Trade, competition, and market scale**	**67.1**	**46**	◇
4.3.1	Applied tariff rate, weighted avg., %	3.2	66	◇
4.3.2	Intensity of local competition†	69.3	65	○ ◇
4.3.3	Domestic market scale, bn PPP$	410.7	47	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**45.1**	**25**	◇
5.1	**Knowledge workers**	**58.1**	**19**	
5.1.1	Knowledge-intensive employment, %	52.2	5	●
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	1.1	21	
5.1.4	GERD financed by business, %	42.8	40	◇
5.1.5	Females employed w/advanced degrees, %	25.2	13	
5.2	**Innovation linkages**	**43.1**	**22**	
5.2.1	University/industry research collaboration† ⊙	61.7	21	
5.2.2	State of cluster development† ⊙	64.6	19	
5.2.3	GERD financed by abroad, % GDP	0.2	20	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	17	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	1.9	19	
5.3	**Knowledge absorption**	**34.1**	**44**	◇
5.3.1	Intellectual property payments, % total trade	0.5	69	○ ◇
5.3.2	High-tech imports, % total trade	6.7	79	○
5.3.3	ICT services imports, % total trade	2.8	11	
5.3.4	FDI net inflows, % GDP	-2.5	129	○
5.3.5	Research talent, % in business enterprise	48.9	25	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**33.1**	**33**	◇
6.1	**Knowledge creation**	**42.6**	**20**	
6.1.1	Patents by origin/bn PPP$ GDP	4.3	26	
6.1.2	PCT patents by origin/bn PPP$ GDP	1.9	17	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	21.1	26	
6.1.5	Citable documents H-index	41.1	20	
6.2	**Knowledge impact**	**30.5**	**40**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.1	86	○
6.2.2	New businesses/th pop. 15–64	8.6	19	
6.2.3	Computer software spending, % GDP	0.0	16	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	6.3	44	
6.2.5	High- and medium-high-tech manufacturing, %	19.6	57	○ ◇
6.3	**Knowledge diffusion**	**26.2**	**55**	◇
6.3.1	Intellectual property receipts, % total trade	0.3	28	◇
6.3.2	High-tech net exports, % total trade	2.8	47	
6.3.3	ICT services exports, % total trade	1.6	65	
6.3.4	FDI net outflows, % GDP	1.2	50	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**38.7**	**19**	
7.1	**Intangible assets**	**34.1**	**38**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP	35.2	68	○
7.1.2	Global brand value, top 5,000, % GDP	65.2	28	◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.4	57	
7.1.4	ICTs & organizational model creation†	77.4	10	
7.2	**Creative goods and services**	**28.7**	**30**	
7.2.1	Cultural & creative services exports, % total trade	0.5	51	
7.2.2	National feature films/mn pop. 15–69	10.1	19	
7.2.3	Entertainment & Media market/th pop. 15–69	94.0	3	● ◆
7.2.4	Printing and other media, % manufacturing	1.1	42	
7.2.5	Creative goods exports, % total trade	0.5	64	
7.3	**Online creativity**	**57.9**	**12**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	50.6	15	
7.3.2	Country-code TLDs/th pop. 15–69	61.7	13	
7.3.3	Wikipedia edits/mn pop. 15–69	100.0	1	● ◆
7.3.4	Mobile app creation/bn PPP$ GDP	19.4	26	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

OMAN

GII 2020 rank

84

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
109	68	High	NAWA	5.0	204.0	41,351.8	80

		Score/Value	Rank	
	INSTITUTIONS	**61.8**	**70**	◇
1.1	**Political environment**	**62.4**	**52**	◇
1.1.1	Political and operational stability*	78.6	38	
1.1.2	Government effectiveness*	54.3	59	◇
1.2	**Regulatory environment**	**54.4**	**94**	◇
1.2.1	Regulatory quality*	50.0	56	◇
1.2.2	Rule of law*	58.8	44	◇
1.2.3	Cost of redundancy dismissal, salary weeks	n/a	n/a	
1.3	**Business environment**	**68.7**	**73**	◇
1.3.1	Ease of starting a business*	93.5	30	●
1.3.2	Ease of resolving insolvency*	44.0	88	◇
	HUMAN CAPITAL & RESEARCH	**38.1**	**43**	
2.1	**Education**	**56.8**	**24**	●
2.1.1	Expenditure on education, % GDP ⊙	5.0	42	
2.1.2	Government funding/pupil, secondary, % GDP/cap	36.0	6	● ◆
2.1.3	School life expectancy, years	14.1	70	◇
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	10.2	36	●
2.2	**Tertiary education**	**53.3**	**12**	●
2.2.1	Tertiary enrolment, % gross	38.0	72	◇
2.2.2	Graduates in science & engineering, %	46.1	1	● ◆
2.2.3	Tertiary inbound mobility, %	2.7	69	◇
2.3	**Research & development (R&D)**	**4.1**	**80**	◇
2.3.1	Researchers, FTE/mn pop.	236.0	79	◇
2.3.2	Gross expenditure on R&D, % GDP	0.2	89	◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	9.6	64	◇
	INFRASTRUCTURE	**44.5**	**56**	◇
3.1	**Information & communication technologies (ICTs)**	**75.2**	**47**	
3.1.1	ICT access*	76.6	37	●
3.1.2	ICT use*	60.0	57	◇
3.1.3	Government's online service*	81.3	43	
3.1.4	E-participation*	83.2	43	
3.2	**General infrastructure**	**37.6**	**29**	●
3.2.1	Electricity output, kWh/mn pop.	7,785.8	23	●
3.2.2	Logistics performance*	52.9	42	
3.2.3	Gross capital formation, % GDP	31.8	21	● ◆
3.3	**Ecological sustainability**	**20.6**	**97**	◇
3.3.1	GDP/unit of energy use	6.5	97	
3.3.2	Environmental performance*	38.5	91	◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.9	64	
	MARKET SOPHISTICATION	**40.7**	**104**	◇
4.1	**Credit**	**32.7**	**99**	◇
4.1.1	Ease of getting credit*	35.0	118	○ ◇
4.1.2	Domestic credit to private sector, % GDP	70.5	44	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**24.4**	**118**	○ ◇
4.2.1	Ease of protecting minority investors*	56.0	82	
4.2.2	Market capitalization, % GDP	29.7	48	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	50	
4.3	**Trade, competition, and market scale**	**65.0**	**51**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	52	
4.3.2	Intensity of local competition†	66.2	76	
4.3.3	Domestic market scale, bn PPP$	204.0	64	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**20.7**	**95**	◇
5.1	**Knowledge workers**	**22.9**	**[90]**	
5.1.1	Knowledge-intensive employment, % ⊙	18.5	81	◇
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	0.1	66	◇
5.1.4	GERD financed by business, %	31.8	54	
5.1.5	Females employed w/advanced degrees, %	n/a	n/a	
5.2	**Innovation linkages**	**22.1**	**59**	◇
5.2.1	University/industry research collaboration†	50.7	38	●
5.2.2	State of cluster development†	59.4	27	●
5.2.3	GERD financed by abroad, % GDP	0.0	88	○ ◇
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	42	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	95	
5.3	**Knowledge absorption**	**17.0**	**118**	○ ◇
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports, % total trade ⊙	5.3	107	○
5.3.3	ICT services imports, % total trade ⊙	0.3	116	○ ◇
5.3.4	FDI net inflows, % GDP	5.2	24	●
5.3.5	Research talent, % in business enterprise	0.3	86	○ ◇
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**8.4**	**124**	○ ◇
6.1	**Knowledge creation**	**5.0**	**107**	◇
6.1.1	Patents by origin/bn PPP$ GDP	0.1	117	○
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	81	◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.7	99	◇
6.1.5	Citable documents H-index	7.3	88	◇
6.2	**Knowledge impact**	**8.8**	**121**	○ ◇
6.2.1	Growth rate of PPP$ GDP/worker, %	-3.4	118	○ ◇
6.2.2	New businesses/th pop. 15-64	1.4	72	
6.2.3	Computer software spending, % GDP	0.0	97	◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.6	80	
6.2.5	High- and medium-high-tech manufacturing, %	16.5	62	
6.3	**Knowledge diffusion**	**11.5**	**114**	○ ◇
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade ⊙	0.1	106	◇
6.3.3	ICT services exports, % total trade ⊙	0.3	106	
6.3.4	FDI net outflows, % GDP	1.6	43	
	CREATIVE OUTPUTS	**15.2**	**94**	◇
7.1	**Intangible assets**	**23.1**	**82**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP	57.3	38	●
7.1.2	Global brand value, top 5,000, % GDP	9.7	60	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.0	118	○
7.1.4	ICTs & organizational model creation†	52.5	72	◇
7.2	**Creative goods and services**	**6.4**	**99**	◇
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15-69	1.1	84	◇
7.2.3	Entertainment & Media market/th pop. 15-69	7.3	43	◇
7.2.4	Printing and other media, % manufacturing	0.5	86	○
7.2.5	Creative goods exports, % total trade ⊙	0.5	61	
7.3	**Online creativity**	**8.3**	**94**	◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	1.7	85	◇
7.3.2	Country-code TLDs/th pop. 15-69	0.3	107	◇
7.3.3	Wikipedia edits/mn pop. 15-69	30.0	94	◇
7.3.4	Mobile app creation/bn PPP$ GDP	5.0	55	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

PAKISTAN

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
88	118	Lower middle	CSA	216.6	1,202.1	5,126.1	105

		Score/Value	Rank	
	INSTITUTIONS	**54.1**	**99**	
1.1	**Political environment**	**43.6**	**109**	
1.1.1	Political and operational stability*	58.9	104	
1.1.2	Government effectiveness*	36.0	112	
1.2	**Regulatory environment**	**44.5**	**116**	
1.2.1	Regulatory quality*	24.8	109	
1.2.2	Rule of law*	29.1	105	
1.2.3	Cost of redundancy dismissal, salary weeks	27.2	107	
1.3	**Business environment**	**74.1**	**55**	◆
1.3.1	Ease of starting a business*	89.3	59	
1.3.2	Ease of resolving insolvency*	59.0	53	◆

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**12.2**	**118**	◇
2.1	**Education**	**21.9**	**124**	○ ◇
2.1.1	Expenditure on education, % GDP ◷	2.9	101	◇
2.1.2	Government funding/pupil, secondary, % GDP/cap ◷	16.0	72	
2.1.3	School life expectancy, years	8.3	117	○ ◇
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	20.4	98	
2.2	**Tertiary education**	**6.0**	**[123]**	
2.2.1	Tertiary enrolment, % gross	9.0	113	○
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**8.8**	**62**	
2.3.1	Researchers, FTE/mn pop. ◷	335.6	75	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.2	88	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	26.9	42	● ◆

		Score/Value	Rank	
	INFRASTRUCTURE	**23.3**	**119**	○ ◇
3.1	**Information & communication technologies (ICTs)**	**38.7**	**111**	
3.1.1	ICT access*	34.7	115	◇
3.1.2	ICT use*	15.4	117	◇
3.1.3	Government's online service*	54.9	101	
3.1.4	E-participation*	50.0	105	
3.2	**General infrastructure**	**10.1**	**125**	○ ◇
3.2.1	Electricity output, kWh/mn pop.	666.3	103	
3.2.2	Logistics performance*	16.4	112	○
3.2.3	Gross capital formation, % GDP	15.4	119	○ ◇
3.3	**Ecological sustainability**	**21.0**	**94**	
3.3.1	GDP/unit of energy use	9.3	65	
3.3.2	Environmental performance*	33.1	111	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.4	88	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**36.0**	**116**	◇
4.1	**Credit**	**21.1**	**124**	○ ◇
4.1.1	Ease of getting credit*	45.0	101	
4.1.2	Domestic credit to private sector, % GDP	19.0	114	
4.1.3	Microfinance gross loans, % GDP	0.2	49	
4.2	**Investment**	**28.5**	**100**	
4.2.1	Ease of protecting minority investors*	72.0	27	●
4.2.2	Market capitalization, % GDP ◷	29.2	50	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	77	○
4.3	**Trade, competition, and market scale**	**58.5**	**85**	
4.3.1	Applied tariff rate, weighted avg., %	9.5	112	
4.3.2	Intensity of local competition†	57.7	115	○ ◇
4.3.3	Domestic market scale, bn PPP$	1,202.1	24	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**22.0**	**87**	
5.1	**Knowledge workers**	**21.1**	**[98]**	
5.1.1	Knowledge-intensive employment, %	11.6	103	
5.1.2	Firms offering formal training, % ◷	32.0	44	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, %	1.6	105	
5.2	**Innovation linkages**	**18.5**	**83**	
5.2.1	University/industry research collaboration†	47.7	46	● ◆
5.2.2	State of cluster development†	48.8	54	
5.2.3	GERD financed by abroad, % GDP	0.0	90	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	55	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	88	
5.3	**Knowledge absorption**	**26.6**	**72**	
5.3.1	Intellectual property payments, % total trade	0.5	66	
5.3.2	High-tech imports, % total trade	9.5	39	●
5.3.3	ICT services imports, % total trade	1.0	75	
5.3.4	FDI net inflows, % GDP	0.9	114	
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**18.6**	**69**	
6.1	**Knowledge creation**	**15.3**	**[63]**	
6.1.1	Patents by origin/bn PPP$ GDP	0.3	90	
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	10.9	47	● ◆
6.1.5	Citable documents H-index	16.4	51	●
6.2	**Knowledge impact**	**20.8**	**81**	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.0	46	●
6.2.2	New businesses/th pop. 15–64	0.1	117	○
6.2.3	Computer software spending, % GDP	0.0	51	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.0	84	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**19.5**	**81**	
6.3.1	Intellectual property receipts, % total trade	0.0	80	
6.3.2	High-tech net exports, % total trade	0.8	72	
6.3.3	ICT services exports, % total trade	2.3	47	●
6.3.4	FDI net outflows, % GDP	0.0	115	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**11.6**	**108**	
7.1	**Intangible assets**	**18.6**	**98**	
7.1.1	Trademarks by origin/bn PPP$ GDP	26.7	83	
7.1.2	Global brand value, top 5,000, % GDP	4.4	69	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.4	87	
7.1.4	ICTs & organizational model creation†	51.6	76	
7.2	**Creative goods and services**	**0.8**	**128**	○ ◇
7.2.1	Cultural & creative services exports, % total trade ◷	0.1	83	
7.2.2	National feature films/mn pop. 15–69	0.1	108	○
7.2.3	Entertainment & Media market/th pop. 15–69	0.0	62	○ ◇
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.1	106	
7.3	**Online creativity**	**8.4**	**93**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.5	106	
7.3.2	Country-code TLDs/th pop. 15–69	0.2	111	
7.3.3	Wikipedia edits/mn pop. 15–69	20.3	106	
7.3.4	Mobile app creation/bn PPP$ GDP	16.9	29	●

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

PANAMA

GII 2020 rank

73

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
70	82	High	LCN	4.2	113.2	23,416.2	75

		Score/Value	Rank	
	INSTITUTIONS	**62.6**	**67**	◇
1.1	**Political environment**	**57.5**	**67**	◇
1.1.1	Political and operational stability*	73.2	49	◇
1.1.2	Government effectiveness*	49.7	73	◇
1.2	**Regulatory environment**	**64.3**	**65**	◇
1.2.1	Regulatory quality*	52.4	53	◇
1.2.2	Rule of law*	45.1	66	◇
1.2.3	Cost of redundancy dismissal, salary weeks	18.1	75	
1.3	**Business environment**	**65.8**	**82**	◇
1.3.1	Ease of starting a business*	92.0	46	
1.3.2	Ease of resolving insolvency*	39.5	99	◇

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**18.3**	**101**	◇
2.1	**Education**	**27.9**	**111**	◇
2.1.1	Expenditure on education, % GDP ◷	3.2	94	◇
2.1.2	Government funding/pupil, secondary, % GDP/cap ◷	9.2	97	○ ◇
2.1.3	School life expectancy, years ◷	12.9	82	◇
2.1.4	PISA scales in reading, maths, & science	364.8	76	○
2.1.5	Pupil-teacher ratio, secondary ◷	13.6	66	◇
2.2	**Tertiary education**	**25.3**	**81**	◇
2.2.1	Tertiary enrolment, % gross ◷	47.8	63	◇
2.2.2	Graduates in science & engineering, % ◷	15.4	94	◇
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**1.7**	**100**	◇
2.3.1	Researchers, FTE/mn pop. ◷	39.1	96	◇
2.3.2	Gross expenditure on R&D, % GDP ◷	0.1	98	◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	3.6	72	◇

		Score/Value	Rank	
	INFRASTRUCTURE	**46.8**	**47**	◇
3.1	**Information & communication technologies (ICTs)**	**63.6**	**73**	◇
3.1.1	ICT access*	63.8	69	◇
3.1.2	ICT use*	52.9	72	◇
3.1.3	Government's online service*	66.0	80	◇
3.1.4	E-participation*	71.9	65	◇
3.2	**General infrastructure**	**38.7**	**26**	●
3.2.1	Electricity output, kWh/mn pop.	2,695.5	68	◇
3.2.2	Logistics performance*	56.6	37	●
3.2.3	Gross capital formation, % GDP	38.5	12	● ◆
3.3	**Ecological sustainability**	**37.9**	**42**	
3.3.1	GDP/unit of energy use	19.2	7	● ◆
3.3.2	Environmental performance*	47.3	64	◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	99	◇

		Score/Value	Rank	
	MARKET SOPHISTICATION	**47.1**	**67**	
4.1	**Credit**	**48.4**	**40**	
4.1.1	Ease of getting credit*	80.0	23	●
4.1.2	Domestic credit to private sector, % GDP	86.7	32	●
4.1.3	Microfinance gross loans, % GDP	0.4	39	
4.2	**Investment**	**33.4**	**82**	
4.2.1	Ease of protecting minority investors*	56.0	82	
4.2.2	Market capitalization, % GDP	23.9	53	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**59.6**	**74**	◇
4.3.1	Applied tariff rate, weighted avg., % ◷	5.4	98	◇
4.3.2	Intensity of local competition†	70.7	53	
4.3.3	Domestic market scale, bn PPP$	113.2	77	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**15.9**	**123**	○ ◇
5.1	**Knowledge workers**	**13.7**	**113**	◇
5.1.1	Knowledge-intensive employment, %	24.0	63	◇
5.1.2	Firms offering formal training, % ◷	11.0	92	○ ◇
5.1.3	GERD performed by business, % GDP ◷	0.0	88	○ ◇
5.1.4	GERD financed by business, %	1.5	94	○ ◇
5.1.5	Females employed w/advanced degrees, %	10.6	63	◇
5.2	**Innovation linkages**	**18.3**	**84**	◇
5.2.1	University/industry research collaboration†	36.6	92	◇
5.2.2	State of cluster development†	45.8	74	
5.2.3	GERD financed by abroad, % GDP	0.1	50	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	79	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	39	
5.3	**Knowledge absorption**	**15.8**	**127**	○ ◇
5.3.1	Intellectual property payments, % total trade	0.2	93	◇
5.3.2	High-tech imports, % total trade ◷	2.9	126	○ ◇
5.3.3	ICT services imports, % total trade	0.3	114	◇
5.3.4	FDI net inflows, % GDP	8.2	14	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**13.7**	**91**	◇
6.1	**Knowledge creation**	**7.3**	**85**	◇
6.1.1	Patents by origin/bn PPP$ GDP	1.3	58	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.2	54	◇
6.1.3	Utility models by origin/bn PPP$ GDP	0.0	64	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.5	101	◇
6.1.5	Citable documents H-index	12.0	63	
6.2	**Knowledge impact**	**9.3**	**120**	○ ◇
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15-64	4.8	32	●
6.2.3	Computer software spending, % GDP	0.0	71	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.7	86	◇
6.2.5	High- and medium-high-tech manufacturing, % ◷	4.7	96	◇
6.3	**Knowledge diffusion**	**24.4**	**63**	
6.3.1	Intellectual property receipts, % total trade	0.0	73	
6.3.2	High-tech net exports, % total trade ◷	3.6	40	
6.3.3	ICT services exports, % total trade	1.1	81	
6.3.4	FDI net outflows, % GDP	0.6	69	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**26.2**	**55**	
7.1	**Intangible assets**	**23.8**	**79**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP	48.8	51	
7.1.2	Global brand value, top 5,000, % GDP	13.5	52	
7.1.3	Industrial designs by origin/bn PPP$ GDP ◷	0.0	115	○
7.1.4	ICTs & organizational model creation†	57.4	55	
7.2	**Creative goods and services**	**27.2**	**34**	●
7.2.1	Cultural & creative services exports, % total trade ◷	0.5	49	
7.2.2	National feature films/mn pop. 15-69 ◷	0.4	102	○ ◇
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing ◷	3.0	5	● ◆
7.2.5	Creative goods exports, % total trade ◷	2.5	22	●
7.3	**Online creativity**	**30.1**	**36**	●
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	66.7	9	● ◆
7.3.2	Country-code TLDs/th pop. 15-69	1.3	81	◇
7.3.3	Wikipedia edits/mn pop. 15-69	49.5	61	◇
7.3.4	Mobile app creation/bn PPP$ GDP	5.6	53	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

PARAGUAY

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
92	98	Upper middle	LCN	7.0	97.2	11,859.3	95

		Score/Value	Rank	
	INSTITUTIONS	**51.1**	**109**	◇
1.1	**Political environment**	**47.7**	**96**	
1.1.1	Political and operational stability*	66.1	76	
1.1.2	Government effectiveness*	38.6	99	◇
1.2	**Regulatory environment**	**46.6**	**111**	◇
1.2.1	Regulatory quality*	38.5	81	
1.2.2	Rule of law*	32.6	97	
1.2.3	Cost of redundancy dismissal, salary weeks	29.4	116	◇
1.3	**Business environment**	**59.0**	**107**	◇
1.3.1	Ease of starting a business*	76.0	117	◇
1.3.2	Ease of resolving insolvency*	42.1	94	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**18.7**	**98**	◇
2.1	**Education**	**29.4**	**108**	◇
2.1.1	Expenditure on education, % GDP ⊙	3.4	90	
2.1.2	Government funding/pupil, secondary, % GDP/cap	11.9	87	
2.1.3	School life expectancy, years ⊙	12.2	89	◇
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⊙	18.4	90	
2.2	**Tertiary education**	**24.9**	**[84]**	
2.2.1	Tertiary enrolment, % gross ⊙	34.6	77	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**1.9**	**96**	
2.3.1	Researchers, FTE/mn pop. ⊙	135.1	85	◇
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.1	97	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	3.5	74	

		Score/Value	Rank	
	INFRASTRUCTURE	**34.8**	**89**	
3.1	**Information & communication technologies (ICTs)**	**50.0**	**98**	◇
3.1.1	ICT access*	43.6	101	◇
3.1.2	ICT use*	43.4	92	◇
3.1.3	Government's online service*	55.6	99	
3.1.4	E-participation*	57.3	96	
3.2	**General infrastructure**	**26.8**	**66**	●
3.2.1	Electricity output, kWh/mn pop.	8,764.4	18	● ◆
3.2.2	Logistics performance*	33.4	73	
3.2.3	Gross capital formation, % GDP	22.4	74	
3.3	**Ecological sustainability**	**27.5**	**71**	
3.3.1	GDP/unit of energy use	11.2	42	●
3.3.2	Environmental performance*	46.4	67	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	98	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**42.3**	**93**	
4.1	**Credit**	**35.5**	**85**	
4.1.1	Ease of getting credit*	40.0	113	◇
4.1.2	Domestic credit to private sector, % GDP	42.9	77	
4.1.3	Microfinance gross loans, % GDP	4.2	9	● ◆
4.2	**Investment**	**34.0**	**[78]**	
4.2.1	Ease of protecting minority investors*	34.0	118	◇
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**57.5**	**88**	
4.3.1	Applied tariff rate, weighted avg., %	5.0	91	
4.3.2	Intensity of local competition†	65.6	78	
4.3.3	Domestic market scale, bn PPP$	97.2	82	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**22.2**	**84**	
5.1	**Knowledge workers**	**21.4**	**96**	
5.1.1	Knowledge-intensive employment, %	18.3	82	
5.1.2	Firms offering formal training, % ⊙	46.4	20	●
5.1.3	GERD performed by business, % GDP ⊙	0.0	88	○ ◇
5.1.4	GERD financed by business, %	0.2	99	○ ◇
5.1.5	Females employed w/advanced degrees, % ⊙	9.6	69	
5.2	**Innovation linkages**	**14.3**	**115**	
5.2.1	University/industry research collaboration†	23.3	125	○ ◇
5.2.2	State of cluster development†	35.6	111	◇
5.2.3	GERD financed by abroad, % GDP	0.0	67	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**30.7**	**58**	●
5.3.1	Intellectual property payments, % total trade	0.1	97	
5.3.2	High-tech imports, % total trade	16.6	11	● ◆
5.3.3	ICT services imports, % total trade	0.0	129	○ ◇
5.3.4	FDI net inflows, % GDP	1.3	103	
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**10.4**	**115**	◇
6.1	**Knowledge creation**	**2.7**	**[124]**	
6.1.1	Patents by origin/bn PPP$ GDP ⊙	0.3	88	
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	1.2	124	○ ◇
6.1.5	Citable documents H-index	4.2	113	
6.2	**Knowledge impact**	**14.3**	**104**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.5	76	
6.2.2	New businesses/th pop. 15–64	0.2	110	
6.2.3	Computer software spending, % GDP	0.0	100	◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.6	66	●
6.2.5	High- and medium-high-tech manufacturing, % ⊙	14.1	70	
6.3	**Knowledge diffusion**	**14.1**	**100**	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade	0.7	73	
6.3.3	ICT services exports, % total trade	0.1	123	○
6.3.4	FDI net outflows, % GDP	0.1	111	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**18.5**	**78**	
7.1	**Intangible assets**	**29.5**	**55**	●
7.1.1	Trademarks by origin/bn PPP$ GDP	127.9	6	● ◆
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.7	52	●
7.1.4	ICTs & organizational model creation†	41.8	110	◇
7.2	**Creative goods and services**	**5.8**	**100**	
7.2.1	Cultural & creative services exports, % total trade	0.0	109	○
7.2.2	National feature films/mn pop. 15–69 ⊙	1.3	80	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing ⊙	1.3	32	●
7.2.5	Creative goods exports, % total trade	0.0	118	
7.3	**Online creativity**	**9.3**	**87**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.7	84	
7.3.2	Country-code TLDs/th pop. 15–69	1.4	77	
7.3.3	Wikipedia edits/mn pop. 15–69	37.5	83	
7.3.4	Mobile app creation/bn PPP$ GDP	0.0	95	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

PERU

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
98	**55**	**Upper middle**	**LCN**	**32.5**	**478.3**	**12,850.2**	**69**

		Score/Value	Rank	
	INSTITUTIONS	**61.4**	**72**	
1.1	**Political environment**	**51.2**	**87**	
1.1.1	Political and operational stability*	64.3	83	
1.1.2	Government effectiveness*	44.7	85	
1.2	**Regulatory environment**	**68.8**	**51**	
1.2.1	Regulatory quality*	55.5	45	
1.2.2	Rule of law*	33.2	96	
1.2.3	Cost of redundancy dismissal, salary weeks	11.4	36	●
1.3	**Business environment**	**64.3**	**87**	
1.3.1	Ease of starting a business*	82.1	102	
1.3.2	Ease of resolving insolvency*	46.6	82	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**32.3**	**57**	
2.1	**Education**	**37.6**	**86**	
2.1.1	Expenditure on education, % GDP	3.7	83	
2.1.2	Government funding/pupil, secondary, % GDP/cap	14.6	81	
2.1.3	School life expectancy, years	15.0	53	
2.1.4	PISA scales in reading, maths, & science	401.5	66	○
2.1.5	Pupil-teacher ratio, secondary	14.2	69	
2.2	**Tertiary education**	**53.2**	**13**	● ◆
2.2.1	Tertiary enrolment, % gross	70.7	27	● ◆
2.2.2	Graduates in science & engineering, %	29.6	16	●
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**6.1**	**74**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	0.1	100	○
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	16.0	55	

		Score/Value	Rank	
	INFRASTRUCTURE	**39.7**	**68**	
3.1	**Information & communication technologies (ICTs)**	**65.7**	**70**	
3.1.1	ICT access*	50.9	89	◇
3.1.2	ICT use*	43.5	91	◇
3.1.3	Government's online service*	81.9	41	
3.1.4	E-participation*	86.5	36	●
3.2	**General infrastructure**	**19.1**	**105**	
3.2.1	Electricity output, kWh/mn pop.	1,645.0	85	
3.2.2	Logistics performance*	29.2	82	
3.2.3	Gross capital formation, % GDP	22.1	77	
3.3	**Ecological sustainability**	**34.2**	**50**	
3.3.1	GDP/unit of energy use	15.6	12	● ◆
3.3.2	Environmental performance*	44.0	79	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.0	61	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**51.9**	**38**	●
4.1	**Credit**	**53.9**	**23**	● ◆
4.1.1	Ease of getting credit*	75.0	34	
4.1.2	Domestic credit to private sector, % GDP	44.0	75	
4.1.3	Microfinance gross loans, % GDP	5.8	2	● ◆
4.2	**Investment**	**29.5**	**95**	
4.2.1	Ease of protecting minority investors*	68.0	44	
4.2.2	Market capitalization, % GDP	43.8	36	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	73	○
4.3	**Trade, competition, and market scale**	**72.2**	**31**	● ◆
4.3.1	Applied tariff rate, weighted avg., %	0.7	7	●
4.3.2	Intensity of local competition†	72.5	42	
4.3.3	Domestic market scale, bn PPP$	478.3	44	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**33.8**	**43**	◆
5.1	**Knowledge workers**	**57.4**	**[21]**	
5.1.1	Knowledge-intensive employment, %	24.4	61	
5.1.2	Firms offering formal training, % ⏱	65.9	5	● ◆
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, %	16.3	41	
5.2	**Innovation linkages**	**16.5**	**99**	
5.2.1	University/industry research collaboration†	30.9	106	○ ◇
5.2.2	State of cluster development†	40.1	96	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	114	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	85	
5.3	**Knowledge absorption**	**27.6**	**70**	
5.3.1	Intellectual property payments, % total trade ⏱	0.7	56	
5.3.2	High-tech imports, % total trade	8.1	57	
5.3.3	ICT services imports, % total trade ⏱	1.2	58	
5.3.4	FDI net inflows, % GDP	3.2	46	
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**10.9**	**112**	○ ◇
6.1	**Knowledge creation**	**6.7**	**92**	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	103	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	78	
6.1.3	Utility models by origin/bn PPP$ GDP	0.5	37	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.1	118	○
6.1.5	Citable documents H-index	13.8	57	
6.2	**Knowledge impact**	**15.3**	**99**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-0.8	104	○
6.2.2	New businesses/th pop. 15-64	3.8	37	●
6.2.3	Computer software spending, % GDP	0.0	67	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.9	74	
6.2.5	High- and medium-high-tech manufacturing, %	10.5	79	
6.3	**Knowledge diffusion**	**10.8**	**118**	○ ◇
6.3.1	Intellectual property receipts, % total trade ⏱	0.0	74	
6.3.2	High-tech net exports, % total trade	0.4	84	
6.3.3	ICT services exports, % total trade ⏱	0.3	113	○
6.3.4	FDI net outflows, % GDP	0.3	89	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**16.6**	**87**	
7.1	**Intangible assets**	**21.2**	**89**	
7.1.1	Trademarks by origin/bn PPP$ GDP	51.6	45	
7.1.2	Global brand value, top 5,000, % GDP	6.8	64	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.3	95	
7.1.4	ICTs & organizational model creation†	48.6	86	
7.2	**Creative goods and services**	**10.1**	**76**	
7.2.1	Cultural & creative services exports, % total trade	0.1	82	
7.2.2	National feature films/mn pop. 15-69	1.1	85	
7.2.3	Entertainment & Media market/th pop. 15-69	8.1	40	
7.2.4	Printing and other media, % manufacturing	2.0	15	● ◆
7.2.5	Creative goods exports, % total trade	0.3	71	
7.3	**Online creativity**	**14.0**	**72**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	5.2	53	
7.3.2	Country-code TLDs/th pop. 15-69	1.6	73	
7.3.3	Wikipedia edits/mn pop. 15-69	51.8	58	
7.3.4	Mobile app creation/bn PPP$ GDP	0.1	88	○

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⏱ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

PHILIPPINES

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
41	70	Lower middle	SEAO	108.1	1,025.8	8,268.3	54

		Score/Value	Rank	
	INSTITUTIONS	**56.3**	**91**	
1.1	**Political environment**	**55.6**	**72**	◆
1.1.1	Political and operational stability*	64.3	83	
1.1.2	Government effectiveness*	51.3	68	◆
1.2	**Regulatory environment**	**50.1**	**104**	
1.2.1	Regulatory quality*	43.0	67	◆
1.2.2	Rule of law*	34.2	94	
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	113	○
1.3	**Business environment**	**63.2**	**94**	
1.3.1	Ease of starting a business*	71.3	124	○ ◇
1.3.2	Ease of resolving insolvency*	55.1	60	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**23.9**	**86**	
2.1	**Education**	**26.6**	**114**	○
2.1.1	Expenditure on education, % GDP ⊙	2.7	106	○ ◇
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	13.1	79	
2.1.4	PISA scales in reading, maths, & science	349.7	78	○
2.1.5	Pupil-teacher ratio, secondary ⊙	23.9	106	
2.2	**Tertiary education**	**39.0**	**47**	◆
2.2.1	Tertiary enrolment, % gross	35.5	75	
2.2.2	Graduates in science & engineering, %	28.7	22	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**6.2**	**73**	
2.3.1	Researchers, FTE/mn pop. ⊙	105.7	87	
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.2	95	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	20.6	51	◆

		Score/Value	Rank	
	INFRASTRUCTURE	**41.1**	**63**	◆
3.1	**Information & communication technologies (ICTs)**	**68.9**	**62**	◆
3.1.1	ICT access*	48.8	91	
3.1.2	ICT use*	44.9	84	
3.1.3	Government's online service*	88.2	30	◆
3.1.4	E-participation*	93.8	19	● ◆
3.2	**General infrastructure**	**24.6**	**75**	
3.2.1	Electricity output, kWh/mn pop.	899.5	98	
3.2.2	Logistics performance*	39.1	59	
3.2.3	Gross capital formation, % GDP	27.2	37	
3.3	**Ecological sustainability**	**29.7**	**63**	◆
3.3.1	GDP/unit of energy use	13.5	19	● ◆
3.3.2	Environmental performance*	38.4	92	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.0	60	◆

		Score/Value	Rank	
	MARKET SOPHISTICATION	**43.9**	**86**	
4.1	**Credit**	**24.3**	**118**	○ ◇
4.1.1	Ease of getting credit*	40.0	113	○ ◇
4.1.2	Domestic credit to private sector, % GDP	49.9	71	
4.1.3	Microfinance gross loans, % GDP	0.0	70	○
4.2	**Investment**	**32.9**	**85**	
4.2.1	Ease of protecting minority investors*	60.0	71	
4.2.2	Market capitalization, % GDP	83.1	17	◆
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	69	
4.3	**Trade, competition, and market scale**	**74.4**	**20**	● ◆
4.3.1	Applied tariff rate, weighted avg., %	2.1	58	◆
4.3.2	Intensity of local competition†	75.0	27	◆
4.3.3	Domestic market scale, bn PPP$	1,025.8	26	●

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**38.6**	**29**	◆
5.1	**Knowledge workers**	**40.0**	**45**	◆
5.1.1	Knowledge-intensive employment, %	25.5	57	◆
5.1.2	Firms offering formal training, % ⊙	59.8	7	● ◆
5.1.3	GERD performed by business, % GDP ⊙	0.1	68	
5.1.4	GERD financed by business, % ⊙	38.0	47	◆
5.1.5	Females employed w/advanced degrees, % ⊙	12.4	58	
5.2	**Innovation linkages**	**21.3**	**64**	
5.2.1	University/industry research collaboration†	57.5	27	◆
5.2.2	State of cluster development†	48.1	60	
5.2.3	GERD financed by abroad, % GDP ⊙	0.0	91	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	32	◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	84	
5.3	**Knowledge absorption**	**54.5**	**7**	● ◆
5.3.1	Intellectual property payments, % total trade	0.7	55	
5.3.2	High-tech imports, % total trade	27.7	1	● ◆
5.3.3	ICT services imports, % total trade	0.9	77	
5.3.4	FDI net inflows, % GDP	3.0	57	
5.3.5	Research talent, % in business enterprise ⊙	51.8	21	◆

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**35.1**	**26**	● ◆
6.1	**Knowledge creation**	**14.9**	**65**	
6.1.1	Patents by origin/bn PPP$ GDP	0.6	81	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	91	
6.1.3	Utility models by origin/bn PPP$ GDP	2.4	8	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	1.1	125	○
6.1.5	Citable documents H-index	14.7	54	
6.2	**Knowledge impact**	**33.1**	**34**	◆
6.2.1	Growth rate of PPP$ GDP/worker, %	5.2	6	●
6.2.2	New businesses/th pop. 15–64	0.3	109	○
6.2.3	Computer software spending, % GDP	0.0	54	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.9	64	
6.2.5	High- and medium-high-tech manufacturing, % ⊙	38.6	25	◆
6.3	**Knowledge diffusion**	**57.2**	**8**	● ◆
6.3.1	Intellectual property receipts, % total trade	0.0	78	
6.3.2	High-tech net exports, % total trade	31.4	3	● ◆
6.3.3	ICT services exports, % total trade	5.5	8	● ◆
6.3.4	FDI net outflows, % GDP	1.0	56	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**24.2**	**57**	◆
7.1	**Intangible assets**	**28.2**	**64**	
7.1.1	Trademarks by origin/bn PPP$ GDP	32.4	75	
7.1.2	Global brand value, top 5,000, % GDP	58.3	33	◆
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.0	69	
7.1.4	ICTs & organizational model creation†	61.7	39	◆
7.2	**Creative goods and services**	**29.3**	**29**	◆
7.2.1	Cultural & creative services exports, % total trade	0.1	78	
7.2.2	National feature films/mn pop. 15–69 ⊙	0.8	91	
7.2.3	Entertainment & Media market/th pop. 15–69	3.3	50	◆
7.2.4	Printing and other media, % manufacturing ⊙	0.6	80	
7.2.5	Creative goods exports, % total trade	6.1	10	● ◆
7.3	**Online creativity**	**11.0**	**82**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.1	93	
7.3.2	Country-code TLDs/th pop. 15–69	0.4	104	
7.3.3	Wikipedia edits/mn pop. 15–69	44.1	72	◆
7.3.4	Mobile app creation/bn PPP$ GDP	1.5	67	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

POLAND

GII 2020 rank

38

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
40	38	High	EUR	37.9	1,286.9	29,587.4	39

		Score/Value	Rank	
	INSTITUTIONS	**73.1**	**39**	
1.1	**Political environment**	**69.5**	**40**	
1.1.1	Political and operational stability*	78.6	38	
1.1.2	Government effectiveness*	64.9	39	
1.2	**Regulatory environment**	**70.0**	**47**	
1.2.1	Regulatory quality*	65.1	36	
1.2.2	Rule of law*	57.8	46	◇
1.2.3	Cost of redundancy dismissal, salary weeks	18.8	77	○
1.3	**Business environment**	**79.7**	**35**	
1.3.1	Ease of starting a business*	82.9	99	○ ◇
1.3.2	Ease of resolving insolvency*	76.5	23	●
	HUMAN CAPITAL & RESEARCH	**41.6**	**35**	
2.1	**Education**	**54.1**	**41**	
2.1.1	Expenditure on education, % GDP	4.6	58	
2.1.2	Government funding/pupil, secondary, % GDP/cap	22.4	33	
2.1.3	School life expectancy, years	16.1	35	
2.1.4	PISA scales in reading, maths, & science	512.8	9	●
2.1.5	Pupil-teacher ratio, secondary	9.1	22	●
2.2	**Tertiary education**	**37.9**	**51**	
2.2.1	Tertiary enrolment, % gross	67.8	34	
2.2.2	Graduates in science & engineering, %	22.9	52	
2.2.3	Tertiary inbound mobility, %	4.1	57	
2.3	**Research & development (R&D)**	**32.8**	**36**	
2.3.1	Researchers, FTE/mn pop.	3,106.1	31	
2.3.2	Gross expenditure on R&D, % GDP	1.2	33	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	41.3	37	
2.3.4	QS university ranking, average score top 3*	28.5	41	
	INFRASTRUCTURE	**49.4**	**42**	
3.1	**Information & communication technologies (ICTs)**	**81.1**	**30**	
3.1.1	ICT access*	73.8	46	◇
3.1.2	ICT use*	68.1	45	
3.1.3	Government's online service*	93.1	17	●
3.1.4	E-participation*	89.3	31	
3.2	**General infrastructure**	**30.7**	**49**	
3.2.1	Electricity output, kWh/mn pop.	4,411.2	49	
3.2.2	Logistics performance*	68.9	27	
3.2.3	Gross capital formation, % GDP	21.0	89	○
3.3	**Ecological sustainability**	**36.4**	**45**	
3.3.1	GDP/unit of energy use	10.0	55	
3.3.2	Environmental performance*	60.9	37	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.4	34	
	MARKET SOPHISTICATION	**46.8**	**69**	
4.1	**Credit**	**39.2**	**76**	
4.1.1	Ease of getting credit*	75.0	34	
4.1.2	Domestic credit to private sector, % GDP	52.7	64	
4.1.3	Microfinance gross loans, % GDP	0.1	58	○
4.2	**Investment**	**27.4**	**107**	○
4.2.1	Ease of protecting minority investors*	66.0	50	
4.2.2	Market capitalization, % GDP	31.7	44	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	62	○
4.3	**Trade, competition, and market scale**	**73.9**	**22**	●
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	70.2	58	
4.3.3	Domestic market scale, bn PPP$	1,286.9	22	●

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**34.6**	**38**	
5.1	**Knowledge workers**	**44.7**	**37**	
5.1.1	Knowledge-intensive employment, %	39.5	28	
5.1.2	Firms offering formal training, %	21.7	70	○
5.1.3	GERD performed by business, % GDP	0.8	28	
5.1.4	GERD financed by business, %	52.5	22	
5.1.5	Females employed w/advanced degrees, %	21.1	25	
5.2	**Innovation linkages**	**19.6**	**72**	◇
5.2.1	University/industry research collaboration†	37.2	87	○ ◇
5.2.2	State of cluster development†	46.8	67	
5.2.3	GERD financed by abroad, % GDP	0.1	47	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	65	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.3	34	
5.3	**Knowledge absorption**	**39.4**	**33**	
5.3.1	Intellectual property payments, % total trade	1.1	32	
5.3.2	High-tech imports, % total trade	9.7	36	
5.3.3	ICT services imports, % total trade	1.4	49	
5.3.4	FDI net inflows, % GDP	3.0	55	
5.3.5	Research talent, % in business enterprise	48.2	28	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**32.7**	**36**	
6.1	**Knowledge creation**	**28.9**	**35**	
6.1.1	Patents by origin/bn PPP$ GDP	3.9	27	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.3	44	
6.1.3	Utility models by origin/bn PPP$ GDP	0.8	27	
6.1.4	Scientific & technical articles/bn PPP$ GDP	17.5	32	
6.1.5	Citable documents H-index	36.6	25	●
6.2	**Knowledge impact**	**33.8**	**31**	
6.2.1	Growth rate of PPP$ GDP/worker, %	4.2	18	● ◆
6.2.2	New businesses/th pop. 15–64	1.4	70	
6.2.3	Computer software spending, % GDP	0.0	43	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	9.3	30	
6.2.5	High- and medium-high-tech manufacturing, %	31.7	37	
6.3	**Knowledge diffusion**	**35.3**	**31**	
6.3.1	Intellectual property receipts, % total trade	0.2	38	
6.3.2	High-tech net exports, % total trade	7.0	24	●
6.3.3	ICT services exports, % total trade	2.5	42	
6.3.4	FDI net outflows, % GDP	1.3	46	
	CREATIVE OUTPUTS	**28.9**	**47**	
7.1	**Intangible assets**	**26.7**	**69**	
7.1.1	Trademarks by origin/bn PPP$ GDP	34.2	72	
7.1.2	Global brand value, top 5,000, % GDP	38.4	39	
7.1.3	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.4	ICTs & organizational model creation†	51.9	74	○ ◇
7.2	**Creative goods and services**	**31.8**	**22**	●
7.2.1	Cultural & creative services exports, % total trade	1.1	23	
7.2.2	National feature films/mn pop. 15–69	1.8	72	○ ◇
7.2.3	Entertainment & Media market/th pop. 15–69	12.6	34	◇
7.2.4	Printing and other media, % manufacturing	1.1	48	
7.2.5	Creative goods exports, % total trade	4.8	12	● ◆
7.3	**Online creativity**	**30.5**	**35**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	7.0	46	
7.3.2	Country-code TLDs/th pop. 15–69	26.8	25	●
7.3.3	Wikipedia edits/mn pop. 15–69	74.5	32	
7.3.4	Mobile app creation/bn PPP$ GDP	15.1	32	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊕ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

PORTUGAL

GII 2020 rank

31

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
29	32	High	EUR	10.2	345.6	29,390.9	32

		Score/Value	Rank	
	INSTITUTIONS	**80.7**	**24**	
1.1	**Political environment**	**80.0**	**22**	
1.1.1	Political and operational stability*	85.7	17	●
1.1.2	Government effectiveness*	77.2	23	
1.2	**Regulatory environment**	**76.5**	**34**	
1.2.1	Regulatory quality*	65.3	35	
1.2.2	Rule of law*	76.4	24	
1.2.3	Cost of redundancy dismissal, salary weeks	17.0	67	○
1.3	**Business environment**	**85.5**	**18**	●
1.3.1	Ease of starting a business*	90.9	53	
1.3.2	Ease of resolving insolvency*	80.2	14	●
	HUMAN CAPITAL & RESEARCH	**47.2**	**25**	
2.1	**Education**	**57.2**	**22**	
2.1.1	Expenditure on education, % GDP ⊙	4.9	46	
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	27.7	17	●
2.1.3	School life expectancy, years	16.5	22	
2.1.4	PISA scales in reading, maths, & science	492.0	26	
2.1.5	Pupil-teacher ratio, secondary ⊙	9.5	26	
2.2	**Tertiary education**	**45.5**	**23**	
2.2.1	Tertiary enrolment, % gross	63.9	40	
2.2.2	Graduates in science & engineering, %	29.1	19	
2.2.3	Tertiary inbound mobility, %	6.4	38	
2.3	**Research & development (R&D)**	**39.0**	**26**	
2.3.1	Researchers, FTE/mn pop.	4,537.6	21	
2.3.2	Gross expenditure on R&D, % GDP	1.4	28	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	44.1	35	
2.3.4	QS university ranking, average score top 3*	30.3	39	
	INFRASTRUCTURE	**54.2**	**26**	
3.1	**Information & communication technologies (ICTs)**	**83.8**	**24**	
3.1.1	ICT access*	82.1	18	●
3.1.2	ICT use*	70.0	41	
3.1.3	Government's online service*	93.1	17	●
3.1.4	E-participation*	89.9	30	
3.2	**General infrastructure**	**31.3**	**45**	
3.2.1	Electricity output, kWh/mn pop.	5,699.3	37	
3.2.2	Logistics performance*	73.8	23	
3.2.3	Gross capital formation, % GDP	18.6	107	○
3.3	**Ecological sustainability**	**47.6**	**22**	
3.3.1	GDP/unit of energy use	13.5	19	
3.3.2	Environmental performance*	67.0	27	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	4.1	24	
	MARKET SOPHISTICATION	**47.4**	**65**	
4.1	**Credit**	**44.3**	**54**	
4.1.1	Ease of getting credit*	45.0	101	○ ◇
4.1.2	Domestic credit to private sector, % GDP	98.7	26	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**29.2**	**96**	○
4.2.1	Ease of protecting minority investors*	62.0	60	○
4.2.2	Market capitalization, % GDP	29.2	49	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	30	
4.3	**Trade, competition, and market scale**	**68.8**	**37**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	70.3	55	
4.3.3	Domestic market scale, bn PPP$	345.6	52	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**33.0**	**45**	
5.1	**Knowledge workers**	**41.8**	**41**	
5.1.1	Knowledge-intensive employment, %	35.8	36	
5.1.2	Firms offering formal training, %	29.0	51	○
5.1.3	GERD performed by business, % GDP	0.7	32	
5.1.4	GERD financed by business, %	46.5	35	
5.1.5	Females employed w/advanced degrees, %	16.8	39	
5.2	**Innovation linkages**	**25.5**	**47**	
5.2.1	University/industry research collaboration†	53.6	32	
5.2.2	State of cluster development†	54.6	36	
5.2.3	GERD financed by abroad, % GDP	0.1	38	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	64	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.7	30	
5.3	**Knowledge absorption**	**31.7**	**55**	
5.3.1	Intellectual property payments, % total trade	0.9	39	
5.3.2	High-tech imports, % total trade	7.8	59	
5.3.3	ICT services imports, % total trade	1.1	65	
5.3.4	FDI net inflows, % GDP	3.6	43	
5.3.5	Research talent, % in business enterprise	34.1	37	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**33.7**	**32**	
6.1	**Knowledge creation**	**33.2**	**29**	
6.1.1	Patents by origin/bn PPP$ GDP	2.6	33	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.6	32	
6.1.3	Utility models by origin/bn PPP$ GDP	0.2	48	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	32.6	6	● ◆
6.1.5	Citable documents H-index	32.0	30	
6.2	**Knowledge impact**	**42.0**	**14**	●
6.2.1	Growth rate of PPP$ GDP/worker, %	0.6	73	○
6.2.2	New businesses/th pop. 15–64	6.5	24	
6.2.3	Computer software spending, % GDP	0.0	8	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	19.9	14	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	26.6	40	
6.3	**Knowledge diffusion**	**26.0**	**56**	
6.3.1	Intellectual property receipts, % total trade	0.1	47	
6.3.2	High-tech net exports, % total trade	2.9	46	
6.3.3	ICT services exports, % total trade	1.8	60	
6.3.4	FDI net outflows, % GDP	0.9	58	
	CREATIVE OUTPUTS	**35.3**	**29**	
7.1	**Intangible assets**	**40.9**	**26**	
7.1.1	Trademarks by origin/bn PPP$ GDP	99.1	13	● ◆
7.1.2	Global brand value, top 5,000, % GDP	43.5	38	
7.1.3	Industrial designs by origin/bn PPP$ GDP	7.2	18	●
7.1.4	ICTs & organizational model creation†	64.8	30	
7.2	**Creative goods and services**	**20.8**	**52**	
7.2.1	Cultural & creative services exports, % total trade	0.5	44	
7.2.2	National feature films/mn pop. 15–69	5.2	42	
7.2.3	Entertainment & Media market/th pop. 15–69	34.2	22	
7.2.4	Printing and other media, % manufacturing	1.2	38	
7.2.5	Creative goods exports, % total trade	1.5	36	
7.3	**Online creativity**	**38.5**	**30**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	19.2	29	
7.3.2	Country-code TLDs/th pop. 15–69	52.4	16	●
7.3.3	Wikipedia edits/mn pop. 15–69	80.9	23	
7.3.4	Mobile app creation/bn PPP$ GDP	2.4	63	○

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

QATAR

GII 2020 rank

70

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
72	64	High	NAWA	2.8	365.8	116,013.7	65

		Score/Value	Rank	
	INSTITUTIONS	**65.0**	**58**	◇
1.1	**Political environment**	**67.8**	**42**	
1.1.1	Political and operational stability*	75.0	44	
1.1.2	Government effectiveness*	64.2	40	
1.2	**Regulatory environment**	**65.2**	**63**	◇
1.2.1	Regulatory quality*	55.4	46	◇
1.2.2	Rule of law*	65.8	36	
1.2.3	Cost of redundancy dismissal, salary weeks	23.2	99	◇
1.3	**Business environment**	**62.0**	**98**	◇
1.3.1	Ease of starting a business*	86.1	84	◇
1.3.2	Ease of resolving insolvency*	38.0	107	○ ◇
	HUMAN CAPITAL & RESEARCH	**25.4**	**83**	◇
2.1	**Education**	**29.9**	**106**	◇
2.1.1	Expenditure on education, % GDP	2.9	102	○ ◇
2.1.2	Government funding/pupil, secondary, % GDP/cap	10.9	91	○ ◇
2.1.3	School life expectancy, years	12.0	93	◇
2.1.4	PISA scales in reading, maths, & science	413.5	60	
2.1.5	Pupil-teacher ratio, secondary	11.0	43	
2.2	**Tertiary education**	**39.2**	**46**	
2.2.1	Tertiary enrolment, % gross	17.9	97	◇
2.2.2	Graduates in science & engineering, %	22.5	54	
2.2.3	Tertiary inbound mobility, %	34.2	1	● ◆
2.3	**Research & development (R&D)**	**7.3**	**66**	◇
2.3.1	Researchers, FTE/mn pop.	584.0	64	◇
2.3.2	Gross expenditure on R&D, % GDP	0.5	65	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	11.9	62	
	INFRASTRUCTURE	**53.6**	**28**	●
3.1	**Information & communication technologies (ICTs)**	**75.2**	**46**	
3.1.1	ICT access*	78.6	33	
3.1.2	ICT use*	71.9	37	
3.1.3	Government's online service*	79.2	48	
3.1.4	E-participation*	71.4	66	◇
3.2	**General infrastructure**	**64.1**	**2**	● ◆
3.2.1	Electricity output, kWh/mn pop.	17,255.6	6	● ◆
3.2.2	Logistics performance*	65.9	29	
3.2.3	Gross capital formation, % GDP	n/a	n/a	
3.3	**Ecological sustainability**	**21.3**	**91**	◇
3.3.1	GDP/unit of energy use	7.0	89	
3.3.2	Environmental performance*	37.1	99	◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.2	56	
	MARKET SOPHISTICATION	**42.3**	**94**	◇
4.1	**Credit**	**39.2**	**75**	
4.1.1	Ease of getting credit*	45.0	101	○ ◇
4.1.2	Domestic credit to private sector, % GDP	76.8	41	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**23.3**	**122**	○ ◇
4.2.1	Ease of protecting minority investors*	28.0	123	○ ◇
4.2.2	Market capitalization, % GDP	88.5	16	●
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	60	
4.3	**Trade, competition, and market scale**	**64.5**	**54**	
4.3.1	Applied tariff rate, weighted avg., %	3.7	74	
4.3.2	Intensity of local competition†	65.6	79	◇
4.3.3	Domestic market scale, bn PPP$	365.8	49	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**23.6**	**77**	◇
5.1	**Knowledge workers**	**12.6**	**119**	○ ◇
5.1.1	Knowledge-intensive employment, %	18.1	83	◇
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	0.1	63	◇
5.1.4	GERD financed by business, %	7.1	80	◇
5.1.5	Females employed w/advanced degrees, %	4.5	92	◇
5.2	**Innovation linkages**	**25.7**	**46**	●
5.2.1	University/industry research collaboration†	66.1	16	●
5.2.2	State of cluster development†	65.5	16	●
5.2.3	GERD financed by abroad, % GDP	0.0	80	◇
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	41	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	69	
5.3	**Knowledge absorption**	**32.6**	**51**	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports, % total trade	7.8	61	
5.3.3	ICT services imports, % total trade	2.9	10	●
5.3.4	FDI net inflows, % GDP	0.0	124	○
5.3.5	Research talent, % in business enterprise	18.6	57	◇
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**15.4**	**85**	◇
6.1	**Knowledge creation**	**6.5**	**93**	◇
6.1.1	Patents by origin/bn PPP$ GDP	0.1	119	○ ◇
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	71	◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	4.9	88	◇
6.1.5	Citable documents H-index	9.0	81	◇
6.2	**Knowledge impact**	**26.4**	**59**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.5	77	
6.2.2	New businesses/th pop. 15-64	6.3	26	●
6.2.3	Computer software spending, % GDP	0.0	31	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.0	85	◇
6.2.5	High- and medium-high-tech manufacturing, %	31.8	36	
6.3	**Knowledge diffusion**	**13.3**	**104**	◇
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade	0.0	129	○ ◇
6.3.3	ICT services exports, % total trade	0.9	84	
6.3.4	FDI net outflows, % GDP	2.7	24	●
	CREATIVE OUTPUTS	**23.9**	**58**	◇
7.1	**Intangible assets**	**31.2**	**46**	
7.1.1	Trademarks by origin/bn PPP$ GDP	3.3	125	○ ◇
7.1.2	Global brand value, top 5,000, % GDP	82.1	24	●
7.1.3	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.4	ICTs & organizational model creation†	63.9	33	
7.2	**Creative goods and services**	**23.1**	**44**	
7.2.1	Cultural & creative services exports, % total trade	0.4	54	
7.2.2	National feature films/mn pop. 15-69	23.0	4	● ◆
7.2.3	Entertainment & Media market/th pop. 15-69	27.8	25	
7.2.4	Printing and other media, % manufacturing	0.9	62	
7.2.5	Creative goods exports, % total trade	0.2	83	
7.3	**Online creativity**	**9.8**	**84**	◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	3.5	60	◇
7.3.2	Country-code TLDs/th pop. 15-69	2.7	63	◇
7.3.3	Wikipedia edits/mn pop. 15-69	36.3	86	◇
7.3.4	Mobile app creation/bn PPP$ GDP	0.3	75	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

REPUBLIC OF KOREA

GII 2020 rank

10

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
10	10	High	SEAO	51.2	2,319.6	39,059.7	11

		Score/Value	Rank	
	INSTITUTIONS	**78.4**	**29**	◇
1.1	**Political environment**	**79.0**	**24**	
1.1.1	Political and operational stability*	83.9	21	
1.1.2	Government effectiveness*	76.6	26	◇
1.2	**Regulatory environment**	**68.2**	**52**	◇
1.2.1	Regulatory quality*	70.7	30	◇
1.2.2	Rule of law*	78.9	23	
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	109	○ ◇
1.3	**Business environment**	**88.1**	**10**	
1.3.1	Ease of starting a business*	93.4	31	
1.3.2	Ease of resolving insolvency*	82.9	10	
	HUMAN CAPITAL & RESEARCH	**65.2**	**1**	● ◆
2.1	**Education**	**56.4**	**28**	
2.1.1	Expenditure on education, % GDP ⊙	4.6	60	○
2.1.2	Government funding/pupil, secondary, % GDP/cap	28.2	15	◆
2.1.3	School life expectancy, years	16.5	23	
2.1.4	PISA scales in reading, maths, & science	519.7	6	
2.1.5	Pupil-teacher ratio, secondary ⊙	13.3	63	
2.2	**Tertiary education**	**51.1**	**16**	
2.2.1	Tertiary enrolment, % gross	94.3	3	● ◆
2.2.2	Graduates in science & engineering, %	29.3	18	
2.2.3	Tertiary inbound mobility, %	2.3	73	○ ◇
2.3	**Research & development (R&D)**	**88.1**	**1**	● ◆
2.3.1	Researchers, FTE/mn pop	7,980.4	3	● ◆
2.3.2	Gross expenditure on R&D, % GDP	4.5	2	● ◆
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	91.4	4	●
2.3.4	QS university ranking, average score top 3*	73.6	9	
	INFRASTRUCTURE	**57.7**	**14**	
3.1	**Information & communication technologies (ICTs)**	**93.5**	**2**	● ◆
3.1.1	ICT access*	87.8	8	
3.1.2	ICT use*	88.5	4	● ◆
3.1.3	Government's online service*	97.9	4	
3.1.4	E-participation*	100.0	1	●
3.2	**General infrastructure**	**45.2**	**10**	
3.2.1	Electricity output, kWh/mn pop	11,149.2	11	
3.2.2	Logistics performance*	72.4	25	
3.2.3	Gross capital formation, % GDP	31.4	22	◆
3.3	**Ecological sustainability**	**34.4**	**49**	◇
3.3.1	GDP/unit of energy use	6.6	95	○
3.3.2	Environmental performance*	66.5	28	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.6	31	
	MARKET SOPHISTICATION	**62.5**	**11**	
4.1	**Credit**	**66.4**	**10**	
4.1.1	Ease of getting credit*	65.0	61	○
4.1.2	Domestic credit to private sector, % GDP	150.3	8	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**43.5**	**42**	
4.2.1	Ease of protecting minority investors*	74.0	24	
4.2.2	Market capitalization, % GDP	97.2	12	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	31	◇
4.3	**Trade, competition, and market scale**	**77.6**	**12**	
4.3.1	Applied tariff rate, weighted avg., %	4.8	88	○ ◇
4.3.2	Intensity of local competition†	83.9	4	● ◆
4.3.3	Domestic market scale, bn PPP$	2,319.6	14	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**60.3**	**7**	
5.1	**Knowledge workers**	**77.7**	**2**	● ◆
5.1.1	Knowledge-intensive employment, %	39.5	29	◇
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	3.6	2	● ◆
5.1.4	GERD financed by business, %	76.6	3	● ◆
5.1.5	Females employed w/advanced degrees, %	19.3	31	
5.2	**Innovation linkages**	**48.8**	**16**	
5.2.1	University/industry research collaboration†	57.4	28	◇
5.2.2	State of cluster development†	60.0	24	
5.2.3	GERD financed by abroad, % GDP	0.1	43	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	37	◇
5.2.5	Patent families 2+ offices/bn PPP$ GDP	11.3	1	● ◆
5.3	**Knowledge absorption**	**54.3**	**8**	
5.3.1	Intellectual property payments, % total trade	1.5	20	
5.3.2	High-tech imports, % total trade	14.8	13	
5.3.3	ICT services imports, % total trade	0.4	108	○ ◇
5.3.4	FDI net inflows, % GDP	1.0	110	○
5.3.5	Research talent, % in business enterprise	82.0	2	● ◆
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**49.0**	**11**	
6.1	**Knowledge creation**	**65.8**	**7**	
6.1.1	Patents by origin/bn PPP$ GDP	72.7	1	● ◆
6.1.2	PCT patents by origin/bn PPP$ GDP	8.2	2	● ◆
6.1.3	Utility models by origin/bn PPP$ GDP	2.6	7	
6.1.4	Scientific & technical articles/bn PPP$ GDP	20.8	27	
6.1.5	Citable documents H-index	44.4	17	
6.2	**Knowledge impact**	**34.8**	**27**	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.7	50	
6.2.2	New businesses/th pop. 15-64 ⊙	2.6	51	
6.2.3	Computer software spending, % GDP	0.0	62	◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	6.3	45	
6.2.5	High- and medium-high-tech manufacturing, %	56.7	6	
6.3	**Knowledge diffusion**	**46.3**	**15**	
6.3.1	Intellectual property receipts, % total trade	1.1	18	
6.3.2	High-tech net exports, % total trade	28.4	4	● ◆
6.3.3	ICT services exports, % total trade	0.7	89	○
6.3.4	FDI net outflows, % GDP	2.2	33	
	CREATIVE OUTPUTS	**45.8**	**14**	
7.1	**Intangible assets**	**60.4**	**2**	● ◆
7.1.1	Trademarks by origin/bn PPP$ GDP	93.0	15	
7.1.2	Global brand value, top 5,000, % GDP	156.9	8	
7.1.3	Industrial designs by origin/bn PPP$ GDP	26.9	1	● ◆
7.1.4	ICTs & organizational model creation†	64.0	32	◇
7.2	**Creative goods and services**	**34.6**	**19**	
7.2.1	Cultural & creative services exports, % total trade	0.5	53	
7.2.2	National feature films/mn pop. 15-69	12.5	13	
7.2.3	Entertainment & Media market/th pop. 15-69	50.9	18	
7.2.4	Printing and other media, % manufacturing	0.3	98	○ ◇
7.2.5	Creative goods exports, % total trade	3.9	14	
7.3	**Online creativity**	**27.8**	**37**	◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	8.2	43	◇
7.3.2	Country-code TLDs/th pop. 15-69	8.5	42	◇
7.3.3	Wikipedia edits/mn pop. 15-69	58.8	54	◇
7.3.4	Mobile app creation/bn PPP$ GDP	37.9	13	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

REPUBLIC OF MOLDOVA

GII 2020 rank

59

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
48	75	Lower middle	EUR	4.0	27.3	6,725.2	58

		Score/Value	Rank	
	INSTITUTIONS	**59.1**	**81**	
1.1	**Political environment**	**48.5**	**92**	
1.1.1	Political and operational stability*	66.1	76	
1.1.2	Government effectiveness*	39.7	98	
1.2	**Regulatory environment**	**53.6**	**96**	
1.2.1	Regulatory quality*	40.5	75	◆
1.2.2	Rule of law*	35.9	90	
1.2.3	Cost of redundancy dismissal, salary weeks	23.7	100	
1.3	**Business environment**	**75.2**	**49**	◆
1.3.1	Ease of starting a business*	95.7	12	● ◆
1.3.2	Ease of resolving insolvency*	54.8	62	
	HUMAN CAPITAL & RESEARCH	**27.9**	**75**	
2.1	**Education**	**49.3**	**54**	
2.1.1	Expenditure on education, % GDP	5.5	20	● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap	30.8	11	● ◆
2.1.3	School life expectancy, years	11.5	96	
2.1.4	PISA scales in reading, maths, & science	424.4	51	
2.1.5	Pupil-teacher ratio, secondary	9.9	32	◆
2.2	**Tertiary education**	**31.1**	**71**	
2.2.1	Tertiary enrolment, % gross	39.8	71	
2.2.2	Graduates in science & engineering, %	23.5	45	
2.2.3	Tertiary inbound mobility, %	5.1	46	◆
2.3	**Research & development (R&D)**	**3.3**	**85**	
2.3.1	Researchers, FTE/mn pop.	696.1	60	
2.3.2	Gross expenditure on R&D, % GDP	0.3	86	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**35.4**	**88**	
3.1	**Information & communication technologies (ICTs)**	**69.0**	**61**	◆
3.1.1	ICT access*	61.3	72	◆
3.1.2	ICT use*	51.8	75	◆
3.1.3	Government's online service*	77.1	54	◆
3.1.4	E-participation*	86.0	37	◆
3.2	**General infrastructure**	**18.3**	**112**	○
3.2.1	Electricity output, kWh/mn pop.	1,398.6	90	
3.2.2	Logistics performance*	18.1	108	○
3.2.3	Gross capital formation, % GDP	25.2	50	
3.3	**Ecological sustainability**	**18.8**	**110**	
3.3.1	GDP/unit of energy use	4.7	112	○ ◇
3.3.2	Environmental performance*	44.4	76	◆
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.4	91	
	MARKET SOPHISTICATION	**51.5**	**42**	◆
4.1	**Credit**	**33.3**	**97**	
4.1.1	Ease of getting credit*	70.0	44	
4.1.2	Domestic credit to private sector, % GDP	23.5	108	○
4.1.3	Microfinance gross loans, % GDP	0.6	31	
4.2	**Investment**	**68.0**	**[10]**	
4.2.1	Ease of protecting minority investors*	68.0	44	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**53.3**	**100**	
4.3.1	Applied tariff rate, weighted avg., % ⏲	3.5	73	
4.3.2	Intensity of local competition†	63.8	86	
4.3.3	Domestic market scale, bn PPP$	27.3	123	○ ◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**22.0**	**88**	
5.1	**Knowledge workers**	**30.8**	**62**	
5.1.1	Knowledge-intensive employment, %	31.2	44	◆
5.1.2	Firms offering formal training, %	38.1	33	
5.1.3	GERD performed by business, % GDP	0.0	74	
5.1.4	GERD financed by business, %	15.5	72	
5.1.5	Females employed w/advanced degrees, %	16.3	40	◆
5.2	**Innovation linkages**	**13.1**	**122**	○
5.2.1	University/industry research collaboration†	28.7	116	○
5.2.2	State of cluster development†	26.1	126	○ ◇
5.2.3	GERD financed by abroad, % GDP	0.0	75	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	41	◆
5.3	**Knowledge absorption**	**22.2**	**93**	
5.3.1	Intellectual property payments, % total trade	0.5	63	
5.3.2	High-tech imports, % total trade	8.0	58	
5.3.3	ICT services imports, % total trade	1.8	34	◆
5.3.4	FDI net inflows, % GDP	1.8	87	
5.3.5	Research talent, % in business enterprise	6.2	71	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**26.3**	**51**	◆
6.1	**Knowledge creation**	**31.7**	**32**	◆
6.1.1	Patents by origin/bn PPP$ GDP	3.6	28	● ◆
6.1.2	PCT patents by origin/bn PPP$ GDP	0.3	46	◆
6.1.3	Utility models by origin/bn PPP$ GDP	4.5	4	● ◆
6.1.4	Scientific & technical articles/bn PPP$ GDP	7.4	64	
6.1.5	Citable documents H-index	5.9	96	
6.2	**Knowledge impact**	**21.8**	**74**	
6.2.1	Growth rate of PPP$ GDP/worker, %	4.4	14	●
6.2.2	New businesses/th pop. 15–64	1.9	59	
6.2.3	Computer software spending, % GDP	0.0	92	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.4	69	
6.2.5	High- and medium-high-tech manufacturing, %	14.5	66	
6.3	**Knowledge diffusion**	**25.4**	**58**	
6.3.1	Intellectual property receipts, % total trade	0.1	49	
6.3.2	High-tech net exports, % total trade	0.4	85	
6.3.3	ICT services exports, % total trade	4.5	13	● ◆
6.3.4	FDI net outflows, % GDP	0.2	93	
	CREATIVE OUTPUTS	**27.3**	**51**	◆
7.1	**Intangible assets**	**41.1**	**25**	● ◆
7.1.1	Trademarks by origin/bn PPP$ GDP	116.7	8	● ◆
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	16.7	5	● ◆
7.1.4	ICTs & organizational model creation†	48.3	87	
7.2	**Creative goods and services**	**9.0**	**82**	
7.2.1	Cultural & creative services exports, % total trade	0.9	27	◆
7.2.2	National feature films/mn pop. 15–69 ⏲	0.3	103	○
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	0.9	64	
7.2.5	Creative goods exports, % total trade	0.1	93	
7.3	**Online creativity**	**18.0**	**59**	◆
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.1	75	
7.3.2	Country-code TLDs/th pop. 15–69	2.2	68	◆
7.3.3	Wikipedia edits/mn pop. 15–69	43.0	77	◆
7.3.4	Mobile app creation/bn PPP$ GDP	27.7	20	● ◆

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⏲ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

ROMANIA

GII 2020 rank

46

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
46	51	Upper middle	EUR	19.4	546.6	24,442.9	50

		Score/Value	Rank	
	INSTITUTIONS	**68.0**	**53**	
1.1	**Political environment**	**53.5**	**78**	
1.1.1	Political and operational stability*	71.4	59	
1.1.2	Government effectiveness*	44.5	86	
1.2	**Regulatory environment**	**77.2**	**33**	◆
1.2.1	Regulatory quality*	53.5	52	
1.2.2	Rule of law*	55.1	49	◆
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	● ◆
1.3	**Business environment**	**73.4**	**57**	
1.3.1	Ease of starting a business*	87.7	73	
1.3.2	Ease of resolving insolvency*	59.1	51	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**27.7**	**76**	
2.1	**Education**	**36.4**	**91**	
2.1.1	Expenditure on education, % GDP ⊙	3.0	98	○
2.1.2	Government funding/pupil, secondary, % GDP/cap	15.2	77	○
2.1.3	School life expectancy, years	14.3	67	
2.1.4	PISA scales in reading, maths, & science	427.8	49	
2.1.5	Pupil-teacher ratio, secondary ⊙	12.1	55	
2.2	**Tertiary education**	**39.8**	**43**	
2.2.1	Tertiary enrolment, % gross	49.4	60	
2.2.2	Graduates in science & engineering, % ⊙	28.8	21	
2.2.3	Tertiary inbound mobility, %	5.2	45	
2.3	**Research & development (R&D)**	**7.0**	**68**	
2.3.1	Researchers, FTE/mn pop	882.4	54	
2.3.2	Gross expenditure on R&D, % GDP	0.5	67	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	7.7	66	

		Score/Value	Rank	
	INFRASTRUCTURE	**51.9**	**37**	◆
3.1	**Information & communication technologies (ICTs)**	**69.1**	**60**	
3.1.1	ICT access*	72.1	54	
3.1.2	ICT use*	67.4	48	◆
3.1.3	Government's online service*	66.0	80	
3.1.4	E-participation*	70.8	68	
3.2	**General infrastructure**	**26.6**	**68**	
3.2.1	Electricity output, kWh/mn pop	3,263.8	62	
3.2.2	Logistics performance*	49.2	47	◆
3.2.3	Gross capital formation, % GDP	23.6	62	
3.3	**Ecological sustainability**	**60.1**	**3**	● ◆
3.3.1	GDP/unit of energy use	13.3	23	
3.3.2	Environmental performance*	64.7	32	◆
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	9.2	8	● ◆

		Score/Value	Rank	
	MARKET SOPHISTICATION	**44.9**	**83**	
4.1	**Credit**	**35.8**	**84**	
4.1.1	Ease of getting credit*	80.0	23	
4.1.2	Domestic credit to private sector, % GDP	25.9	102	○
4.1.3	Microfinance gross loans, % GDP	0.0	72	○
4.2	**Investment**	**31.4**	**92**	
4.2.1	Ease of protecting minority investors*	62.0	60	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	71	○
4.3	**Trade, competition, and market scale**	**67.6**	**42**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	62.9	94	○
4.3.3	Domestic market scale, bn PPP$	546.6	39	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**29.6**	**53**	
5.1	**Knowledge workers**	**38.6**	**49**	
5.1.1	Knowledge-intensive employment, %	23.3	66	
5.1.2	Firms offering formal training, % ⊙	40.7	26	
5.1.3	GERD performed by business, % GDP	0.3	47	
5.1.4	GERD financed by business, %	54.4	18	● ◆
5.1.5	Females employed w/advanced degrees, %	11.0	61	
5.2	**Innovation linkages**	**15.6**	**106**	○
5.2.1	University/industry research collaboration†	40.9	69	
5.2.2	State of cluster development†	38.2	103	○
5.2.3	GERD financed by abroad, % GDP	0.0	55	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	94	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	57	
5.3	**Knowledge absorption**	**34.4**	**43**	
5.3.1	Intellectual property payments, % total trade	1.0	37	
5.3.2	High-tech imports, % total trade	10.2	27	
5.3.3	ICT services imports, % total trade	2.3	20	● ◆
5.3.4	FDI net inflows, % GDP	3.1	51	
5.3.5	Research talent, % in business enterprise	27.0	48	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**34.6**	**28**	◆
6.1	**Knowledge creation**	**15.3**	**62**	
6.1.1	Patents by origin/bn PPP$ GDP	2.2	38	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	65	
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	59	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	12.4	44	
6.1.5	Citable documents H-index	18.2	44	
6.2	**Knowledge impact**	**45.2**	**11**	● ◆
6.2.1	Growth rate of PPP$ GDP/worker, %	4.3	16	● ◆
6.2.2	New businesses/th pop. 15-64	7.3	21	●
6.2.3	Computer software spending, % GDP	0.0	45	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	18.8	16	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	42.5	19	● ◆
6.3	**Knowledge diffusion**	**43.3**	**23**	● ◆
6.3.1	Intellectual property receipts, % total trade	0.1	58	
6.3.2	High-tech net exports, % total trade	6.4	26	◆
6.3.3	ICT services exports, % total trade	5.3	10	● ◆
6.3.4	FDI net outflows, % GDP	0.5	77	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**20.3**	**67**	
7.1	**Intangible assets**	**22.7**	**85**	
7.1.1	Trademarks by origin/bn PPP$ GDP	41.8	63	
7.1.2	Global brand value, top 5,000, % GDP	20.1	47	
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.7	53	
7.1.4	ICTs & organizational model creation†	50.0	82	
7.2	**Creative goods and services**	**14.9**	**66**	
7.2.1	Cultural & creative services exports, % total trade	1.6	11	● ◆
7.2.2	National feature films/mn pop. 15-69	2.0	69	
7.2.3	Entertainment & Media market/th pop. 15-69	6.1	46	
7.2.4	Printing and other media, % manufacturing	0.9	65	
7.2.5	Creative goods exports, % total trade	0.7	56	
7.3	**Online creativity**	**21.0**	**52**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	4.5	55	
7.3.2	Country-code TLDs/th pop. 15-69	13.2	35	
7.3.3	Wikipedia edits/mn pop. 15-69	57.2	56	
7.3.4	Mobile app creation/bn PPP$ GDP	11.6	42	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

RUSSIAN FEDERATION

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
58	**42**	**Upper middle**	**EUR**	**145.9**	**4,349.4**	**25,878.7**	**46**

		Score/Value	Rank	
	INSTITUTIONS	**61.5**	**71**	
1.1	**Political environment**	**54.5**	**75**	
1.1.1	Political and operational stability*	66.1	76	
1.1.2	Government effectiveness*	48.8	75	
1.2	**Regulatory environment**	**54.0**	**95**	
1.2.1	Regulatory quality*	27.5	105	○ ◇
1.2.2	Rule of law*	25.4	114	○ ◇
1.2.3	Cost of redundancy dismissal, salary weeks	17.3	69	
1.3	**Business environment**	**76.1**	**45**	
1.3.1	Ease of starting a business*	93.1	38	
1.3.2	Ease of resolving insolvency*	59.1	52	
	HUMAN CAPITAL & RESEARCH	**45.6**	**30**	◆
2.1	**Education**	**51.9**	**46**	
2.1.1	Expenditure on education, % GDP ⊙	3.7	82	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	15.0	51	
2.1.4	PISA scales in reading, maths, & science	481.3	31	◆
2.1.5	Pupil-teacher ratio, secondary ⊙	8.8	19	●
2.2	**Tertiary education**	**49.9**	**17**	● ◆
2.2.1	Tertiary enrolment, % gross	81.9	17	● ◆
2.2.2	Graduates in science & engineering, %	30.0	15	●
2.2.3	Tertiary inbound mobility, %	4.3	56	
2.3	**Research & development (R&D)**	**34.9**	**33**	◆
2.3.1	Researchers, FTE/mn pop.	2,784.3	34	◆
2.3.2	Gross expenditure on R&D, % GDP	1.0	37	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	39.1	39	◆
2.3.4	QS university ranking, average score top 3*	47.5	21	● ◆
	INFRASTRUCTURE	**42.4**	**60**	
3.1	**Information & communication technologies (ICTs)**	**81.2**	**29**	◆
3.1.1	ICT access*	72.8	51	◆
3.1.2	ICT use*	68.3	44	◆
3.1.3	Government's online service*	91.7	25	◆
3.1.4	E-participation*	92.1	23	◆
3.2	**General infrastructure**	**25.9**	**72**	
3.2.1	Electricity output, kWh/mn pop.	7,558.3	28	◆
3.2.2	Logistics performance*	32.2	74	
3.2.3	Gross capital formation, % GDP	23.1	69	
3.3	**Ecological sustainability**	**20.0**	**100**	○ ◇
3.3.1	GDP/unit of energy use	4.4	115	○ ◇
3.3.2	Environmental performance*	50.5	56	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	106	○
	MARKET SOPHISTICATION	**49.7**	**55**	
4.1	**Credit**	**45.2**	**50**	
4.1.1	Ease of getting credit*	80.0	23	
4.1.2	Domestic credit to private sector, % GDP	76.0	42	
4.1.3	Microfinance gross loans, % GDP	0.0	77	○
4.2	**Investment**	**27.4**	**106**	○
4.2.1	Ease of protecting minority investors*	60.0	71	
4.2.2	Market capitalization, % GDP	40.9	37	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	52	
4.3	**Trade, competition, and market scale**	**76.5**	**18**	● ◆
4.3.1	Applied tariff rate, weighted avg., %	3.5	71	
4.3.2	Intensity of local competition†	70.9	51	
4.3.3	Domestic market scale, bn PPP$	4,349.4	6	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**34.0**	**42**	◆
5.1	**Knowledge workers**	**44.8**	**36**	◆
5.1.1	Knowledge-intensive employment, %	44.1	18	● ◆
5.1.2	Firms offering formal training, %	11.8	91	○ ◇
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	29.5	61	
5.1.5	Females employed w/advanced degrees, %	26.2	10	● ◆
5.2	**Innovation linkages**	**17.6**	**90**	
5.2.1	University/industry research collaboration†	46.8	49	
5.2.2	State of cluster development†	40.3	95	○
5.2.3	GERD financed by abroad, % GDP	0.0	62	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	60	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	51	
5.3	**Knowledge absorption**	**39.7**	**32**	◆
5.3.1	Intellectual property payments, % total trade	1.6	17	● ◆
5.3.2	High-tech imports, % total trade	9.1	44	
5.3.3	ICT services imports, % total trade	1.3	54	
5.3.4	FDI net inflows, % GDP	1.6	95	
5.3.5	Research talent, % in business enterprise	44.2	29	◆
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**26.4**	**50**	
6.1	**Knowledge creation**	**32.7**	**30**	◆
6.1.1	Patents by origin/bn PPP$ GDP	6.0	17	● ◆
6.1.2	PCT patents by origin/bn PPP$ GDP	0.3	45	
6.1.3	Utility models by origin/bn PPP$ GDP	2.2	9	● ◆
6.1.4	Scientific & technical articles/bn PPP$ GDP	7.3	66	
6.1.5	Citable documents H-index	38.2	22	◆
6.2	**Knowledge impact**	**23.0**	**68**	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.9	48	
6.2.2	New businesses/th pop. 15-64	3.3	43	
6.2.3	Computer software spending, % GDP	0.0	63	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.1	105	○
6.2.5	High- and medium-high-tech manufacturing, % ⊙	25.6	44	
6.3	**Knowledge diffusion**	**23.6**	**66**	
6.3.1	Intellectual property receipts, % total trade	0.2	39	◆
6.3.2	High-tech net exports, % total trade	2.4	51	
6.3.3	ICT services exports, % total trade	1.2	74	
6.3.4	FDI net outflows, % GDP	2.0	36	
	CREATIVE OUTPUTS	**22.8**	**60**	
7.1	**Intangible assets**	**28.4**	**61**	
7.1.1	Trademarks by origin/bn PPP$ GDP	48.2	52	
7.1.2	Global brand value, top 5,000, % GDP	49.6	35	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.9	72	
7.1.4	ICTs & organizational model creation†	58.4	49	
7.2	**Creative goods and services**	**9.1**	**81**	
7.2.1	Cultural & creative services exports, % total trade	0.9	28	
7.2.2	National feature films/mn pop. 15-69	1.2	81	○
7.2.3	Entertainment & Media market/th pop. 15-69	6.3	45	
7.2.4	Printing and other media, % manufacturing ⊙	0.8	76	○
7.2.5	Creative goods exports, % total trade	0.3	69	
7.3	**Online creativity**	**25.3**	**44**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	3.5	61	
7.3.2	Country-code TLDs/th pop. 15-69	14.2	33	
7.3.3	Wikipedia edits/mn pop. 15-69	65.9	47	
7.3.4	Mobile app creation/bn PPP$ GDP	19.4	25	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

RWANDA

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
112	79	Low	SSF	12.6	30.3	2,140.6	94

		Score/Value	Rank	
	INSTITUTIONS	**66.8**	**54**	◆
1.1	**Political environment**	**60.9**	**54**	◆
1.1.1	Political and operational stability*	73.2	49	◆
1.1.2	Government effectiveness*	54.8	57	◆
1.2	**Regulatory environment**	**64.2**	**66**	
1.2.1	Regulatory quality*	44.0	65	◆
1.2.2	Rule of law*	49.7	57	◆
1.2.3	Cost of redundancy dismissal, salary weeks	17.3	68	
1.3	**Business environment**	**75.2**	**48**	● ◆
1.3.1	Ease of starting a business*	93.2	33	● ◆
1.3.2	Ease of resolving insolvency*	57.2	57	◆
	HUMAN CAPITAL & RESEARCH	**14.7**	**112**	
2.1	**Education**	**28.1**	**110**	
2.1.1	Expenditure on education, % GDP	3.1	96	◇
2.1.2	Government funding/pupil, secondary, % GDP/cap	21.7	39	●
2.1.3	School life expectancy, years	11.2	100	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	28.2	116	○
2.2	**Tertiary education**	**12.5**	**111**	
2.2.1	Tertiary enrolment, % gross	6.7	116	○
2.2.2	Graduates in science & engineering, %	16.3	87	
2.2.3	Tertiary inbound mobility, %	4.0	59	
2.3	**Research & development (R&D)**	**3.3**	**84**	◆
2.3.1	Researchers, FTE/mn pop. ◷	12.4	107	○ ◇
2.3.2	Gross expenditure on R&D, % GDP ◷	0.7	53	◆
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**33.2**	**93**	◆
3.1	**Information & communication technologies (ICTs)**	**49.3**	**99**	◆
3.1.1	ICT access*	28.8	122	○
3.1.2	ICT use*	20.3	115	◆
3.1.3	Government's online service*	72.2	68	◆
3.1.4	E-participation*	75.8	59	◆
3.2	**General infrastructure**	**33.4**	**37**	●
3.2.1	Electricity output, kWh/mn pop.	n/a	n/a	
3.2.2	Logistics performance*	42.4	56	◆
3.2.3	Gross capital formation, % GDP	27.8	35	●
3.3	**Ecological sustainability**	**16.9**	**117**	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	33.8	107	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.0	130	○
	MARKET SOPHISTICATION	**51.9**	**37**	● ◆
4.1	**Credit**	**61.0**	**15**	● ◆
4.1.1	Ease of getting credit*	95.0	4	● ◆
4.1.2	Domestic credit to private sector, % GDP	21.7	111	
4.1.3	Microfinance gross loans, % GDP ◷	6.7	1	● ◆
4.2	**Investment**	**44.0**	**[37]**	
4.2.1	Ease of protecting minority investors*	44.0	98	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**50.7**	**112**	
4.3.1	Applied tariff rate, weighted avg., %	4.1	77	◆
4.3.2	Intensity of local competition†	57.9	114	
4.3.3	Domestic market scale, bn PPP$	30.3	120	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**26.4**	**63**	◆
5.1	**Knowledge workers**	**16.4**	**105**	
5.1.1	Knowledge-intensive employment, %	8.9	108	
5.1.2	Firms offering formal training, %	35.9	37	● ◆
5.1.3	GERD performed by business, % GDP ◷	0.0	73	◆
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, %	3.9	95	◆
5.2	**Innovation linkages**	**37.0**	**[28]**	
5.2.1	University/industry research collaboration†	38.1	81	
5.2.2	State of cluster development†	47.7	63	◆
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	24	● ◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	n/a	n/a	
5.3	**Knowledge absorption**	**25.8**	**75**	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports, % total trade ◷	10.0	31	●
5.3.3	ICT services imports, % total trade ◷	0.6	96	
5.3.4	FDI net inflows, % GDP	3.1	49	●
5.3.5	Research talent, % in business enterprise ◷	6.2	70	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**12.7**	**103**	
6.1	**Knowledge creation**	**5.1**	**106**	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	97	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	0.2	46	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.5	81	
6.1.5	Citable documents H-index	3.9	116	
6.2	**Knowledge impact**	**19.6**	**85**	◆
6.2.1	Growth rate of PPP$ GDP/worker, %	4.4	15	● ◆
6.2.2	New businesses/th pop. 15–64	1.5	67	◆
6.2.3	Computer software spending, % GDP	0.0	102	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.4	122	○
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**13.5**	**103**	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade ◷	0.2	96	
6.3.3	ICT services exports, % total trade ◷	0.8	86	
6.3.4	FDI net outflows, % GDP	0.3	87	
	CREATIVE OUTPUTS	**10.3**	**114**	
7.1	**Intangible assets**	**15.9**	**109**	
7.1.1	Trademarks by origin/bn PPP$ GDP	11.5	107	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.2	103	
7.1.4	ICTs & organizational model creation†	51.0	78	◆
7.2	**Creative goods and services**	**3.9**	**[108]**	
7.2.1	Cultural & creative services exports, % total trade	0.0	101	
7.2.2	National feature films/mn pop. 15–69	3.2	59	◆
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade ◷	0.2	81	
7.3	**Online creativity**	**5.7**	**106**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.1	121	
7.3.2	Country-code TLDs/th pop. 15–69	0.1	114	
7.3.3	Wikipedia edits/mn pop. 15–69	21.0	105	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

SAUDI ARABIA

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
77	50	High	NAWA	34.3	1,898.5	48,631.5	68

		Score/Value	Rank	
	INSTITUTIONS	**53.3**	**102**	◇
1.1	**Political environment**	**56.1**	**70**	◇
1.1.1	Political and operational stability*	53.6	120	○ ◇
1.1.2	Government effectiveness*	57.4	53	◇
1.2	**Regulatory environment**	**57.2**	**86**	◇
1.2.1	Regulatory quality*	40.6	73	◇
1.2.2	Rule of law*	50.4	56	◇
1.2.3	Cost of redundancy dismissal, salary weeks	23.7	101	◇
1.3	**Business environment**	**46.6**	**129**	○ ◇
1.3.1	Ease of starting a business*	93.1	36	
1.3.2	Ease of resolving insolvency*	0.0	129	○ ◇

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**43.9**	**31**	●
2.1	**Education**	**56.6**	**[26]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	15.7	38	
2.1.4	PISA scales in reading, maths, & science	386.2	71	○
2.1.5	Pupil-teacher ratio, secondary	11.5	51	
2.2	**Tertiary education**	**36.4**	**57**	
2.2.1	Tertiary enrolment, % gross	68.0	32	
2.2.2	Graduates in science & engineering, %	21.1	64	
2.2.3	Tertiary inbound mobility, %	4.6	50	
2.3	**Research & development (R&D)**	**38.8**	**27**	●
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.8	46	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	58.8	22	●
2.3.4	QS university ranking, average score top 3*	41.5	31	●

		Score/Value	Rank	
	INFRASTRUCTURE	**43.7**	**57**	◇
3.1	**Information & communication technologies (ICTs)**	**76.4**	**41**	
3.1.1	ICT access*	79.5	31	●
3.1.2	ICT use*	75.7	29	●
3.1.3	Government's online service*	79.2	48	
3.1.4	E-participation*	71.4	66	◇
3.2	**General infrastructure**	**32.9**	**39**	
3.2.1	Electricity output, kWh/mn pop.	10,560.2	12	●
3.2.2	Logistics performance*	44.2	54	◇
3.2.3	Gross capital formation, % GDP	24.9	53	
3.3	**Ecological sustainability**	**21.7**	**90**	◇
3.3.1	GDP/unit of energy use	7.5	84	
3.3.2	Environmental performance*	44.0	79	◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	113	○ ◇

		Score/Value	Rank	
	MARKET SOPHISTICATION	**51.3**	**44**	
4.1	**Credit**	**41.3**	**67**	
4.1.1	Ease of getting credit*	60.0	74	
4.1.2	Domestic credit to private sector, % GDP ⊙	54.0	63	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**39.6**	**62**	
4.2.1	Ease of protecting minority investors*	86.0	3	● ◆
4.2.2	Market capitalization, % GDP	66.1	22	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	56	
4.3	**Trade, competition, and market scale**	**73.1**	**26**	●
4.3.1	Applied tariff rate, weighted avg., % ⊙	4.9	89	◇
4.3.2	Intensity of local competition†	74.8	29	●
4.3.3	Domestic market scale, bn PPP$	1,898.5	17	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**30.2**	**[51]**	
5.1	**Knowledge workers**	**34.5**	**[58]**	
5.1.1	Knowledge-intensive employment, % ⊙	27.3	53	◇
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ⊙	5.5	86	◇
5.2	**Innovation linkages**	**28.4**	**36**	
5.2.1	University/industry research collaboration†	52.8	35	
5.2.2	State of cluster development†	66.1	13	●
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	84	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	54	
5.3	**Knowledge absorption**	**27.8**	**[69]**	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports, % total trade	6.3	90	
5.3.3	ICT services imports, % total trade	0.9	80	
5.3.4	FDI net inflows, % GDP	0.6	120	○
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**14.6**	**88**	◇
6.1	**Knowledge creation**	**14.9**	**64**	
6.1.1	Patents by origin/bn PPP$ GDP	0.9	67	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.3	42	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	7.8	62	◇
6.1.5	Citable documents H-index	21.0	39	
6.2	**Knowledge impact**	**18.3**	**87**	◇
6.2.1	Growth rate of PPP$ GDP/worker, %	-3.3	117	○ ◇
6.2.2	New businesses/th pop. 15–64	0.5	99	◇
6.2.3	Computer software spending, % GDP	0.0	29	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.0	109	◇
6.2.5	High- and medium-high-tech manufacturing, %	34.1	33	
6.3	**Knowledge diffusion**	**10.6**	**119**	○ ◇
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade	0.1	109	◇
6.3.3	ICT services exports, % total trade	0.2	119	○ ◇
6.3.4	FDI net outflows, % GDP	1.8	40	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**20.2**	**69**	◇
7.1	**Intangible assets**	**30.2**	**51**	
7.1.1	Trademarks by origin/bn PPP$ GDP	10.0	111	○ ◇
7.1.2	Global brand value, top 5,000, % GDP	111.8	18	●
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.2	102	○
7.1.4	ICTs & organizational model creation†	61.5	40	
7.2	**Creative goods and services**	**8.3**	**86**	◇
7.2.1	Cultural & creative services exports, % total trade	0.0	106	○ ◇
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15–69	15.4	30	◇
7.2.4	Printing and other media, % manufacturing	1.2	37	
7.2.5	Creative goods exports, % total trade	0.2	82	
7.3	**Online creativity**	**12.1**	**75**	◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.7	69	◇
7.3.2	Country-code TLDs/th pop. 15–69	0.8	93	◇
7.3.3	Wikipedia edits/mn pop. 15–69	47.3	65	◇
7.3.4	Mobile app creation/bn PPP$ GDP	0.3	77	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

SENEGAL

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
84	102	Lower middle	SSF	16.3	64.6	3,363.7	96

		Score/Value	Rank	
	INSTITUTIONS	**61.4**	**73**	◆
1.1	**Political environment**	**53.2**	**80**	
1.1.1	Political and operational stability*	71.4	59	◆
1.1.2	Government effectiveness*	44.2	88	
1.2	**Regulatory environment**	**63.3**	**71**	◆
1.2.1	Regulatory quality*	39.0	80	
1.2.2	Rule of law*	41.2	73	
1.2.3	Cost of redundancy dismissal, salary weeks	14.8	58	
1.3	**Business environment**	**67.7**	**76**	
1.3.1	Ease of starting a business*	91.2	51	●
1.3.2	Ease of resolving insolvency*	44.3	87	
	HUMAN CAPITAL & RESEARCH	**16.2**	**106**	
2.1	**Education**	**26.8**	**112**	
2.1.1	Expenditure on education, % GDP	4.7	57	
2.1.2	Government funding/pupil, secondary, % GDP/cap	11.4	89	
2.1.3	School life expectancy, years	8.6	115	○ ◇
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	18.9	93	
2.2	**Tertiary education**	**17.1**	**102**	
2.2.1	Tertiary enrolment, % gross	12.8	102	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	7.8	30	● ◆
2.3	**Research & development (R&D)**	**4.5**	**78**	
2.3.1	Researchers, FTE/mn pop.	564.3	65	
2.3.2	Gross expenditure on R&D, % GDP	0.6	58	◆
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**27.5**	**106**	
3.1	**Information & communication technologies (ICTs)**	**41.7**	**105**	
3.1.1	ICT access*	38.4	107	
3.1.2	ICT use*	29.8	104	
3.1.3	Government's online service*	47.9	108	
3.1.4	E-participation*	50.6	104	
3.2	**General infrastructure**	**18.6**	**110**	
3.2.1	Electricity output, kWh/mn pop.	301.3	113	
3.2.2	Logistics performance*	8.6	121	○ ◇
3.2.3	Gross capital formation, % GDP	30.3	26	●
3.3	**Ecological sustainability**	**22.3**	**88**	
3.3.1	GDP/unit of energy use	11.4	40	●
3.3.2	Environmental performance*	30.7	119	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	103	
	MARKET SOPHISTICATION	**42.3**	**95**	
4.1	**Credit**	**34.7**	**89**	
4.1.1	Ease of getting credit*	65.0	61	
4.1.2	Domestic credit to private sector, % GDP	28.3	96	
4.1.3	Microfinance gross loans, % GDP	1.5	22	●
4.2	**Investment**	**44.0**	**[37]**	
4.2.1	Ease of protecting minority investors*	44.0	98	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**48.2**	**120**	
4.3.1	Applied tariff rate, weighted avg., %	11.5	123	○ ◇
4.3.2	Intensity of local competition†	68.0	68	
4.3.3	Domestic market scale, bn PPP$	64.6	95	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**12.7**	**130**	○ ◇
5.1	**Knowledge workers**	**5.8**	**126**	○ ◇
5.1.1	Knowledge-intensive employment, %	6.4	111	◇
5.1.2	Firms offering formal training, %	17.4	81	◇
5.1.3	GERD performed by business, % GDP	0.0	88	○ ◇
5.1.4	GERD financed by business, %	2.1	91	
5.1.5	Females employed w/advanced degrees, %	1.8	104	
5.2	**Innovation linkages**	**15.6**	**107**	
5.2.1	University/industry research collaboration†	37.9	83	
5.2.2	State of cluster development†	42.4	85	
5.2.3	GERD financed by abroad, % GDP	0.0	52	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	115	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**16.7**	**120**	
5.3.1	Intellectual property payments, % total trade	0.1	99	
5.3.2	High-tech imports, % total trade	4.7	113	
5.3.3	ICT services imports, % total trade	2.6	12	● ◆
5.3.4	FDI net inflows, % GDP	2.6	66	
5.3.5	Research talent, % in business enterprise	0.1	87	○ ◇
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**17.7**	**74**	
6.1	**Knowledge creation**	**6.1**	**96**	
6.1.1	Patents by origin/bn PPP$ GDP	0.3	87	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	75	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	4.5	93	
6.1.5	Citable documents H-index	7.0	90	
6.2	**Knowledge impact**	**21.6**	**75**	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.7	33	●
6.2.2	New businesses/th pop. 15–64	0.5	100	
6.2.3	Computer software spending, % GDP	0.0	40	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.1	101	
6.2.5	High- and medium-high-tech manufacturing, %	15.5	64	
6.3	**Knowledge diffusion**	**25.2**	**61**	
6.3.1	Intellectual property receipts, % total trade	0.1	60	
6.3.2	High-tech net exports, % total trade	0.4	82	
6.3.3	ICT services exports, % total trade	4.4	16	● ◆
6.3.4	FDI net outflows, % GDP	0.6	72	
	CREATIVE OUTPUTS	**13.3**	**103**	
7.1	**Intangible assets**	**19.7**	**92**	
7.1.1	Trademarks by origin/bn PPP$ GDP	8.5	112	
7.1.2	Global brand value, top 5,000, % GDP	15.8	50	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.9	73	
7.1.4	ICTs & organizational model creation†	58.1	52	
7.2	**Creative goods and services**	**8.7**	**84**	
7.2.1	Cultural & creative services exports, % total trade	1.0	25	● ◆
7.2.2	National feature films/mn pop. 15–69	0.2	106	○
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	0.8	67	
7.2.5	Creative goods exports, % total trade	0.1	105	
7.3	**Online creativity**	**5.1**	**109**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.0	95	
7.3.2	Country-code TLDs/th pop. 15–69	0.1	113	
7.3.3	Wikipedia edits/mn pop. 15–69	18.5	110	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊕ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

SERBIA

GII 2020 rank

53

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
56	58	Upper middle	EUR	8.8	129.3	16,207.3	57

		Score/Value	Rank	
	INSTITUTIONS	**69.4**	**45**	
1.1	**Political environment**	**58.9**	**64**	
1.1.1	Political and operational stability*	71.4	59	
1.1.2	Government effectiveness*	52.6	65	
1.2	**Regulatory environment**	**71.2**	**44**	
1.2.1	Regulatory quality*	42.0	68	
1.2.2	Rule of law*	42.8	70	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	● ◆
1.3	**Business environment**	**78.1**	**38**	
1.3.1	Ease of starting a business*	89.3	60	
1.3.2	Ease of resolving insolvency*	67.0	38	
	HUMAN CAPITAL & RESEARCH	**31.7**	**59**	
2.1	**Education**	**39.8**	**81**	
2.1.1	Expenditure on education, % GDP ⏱	3.7	85	
2.1.2	Government funding/pupil, secondary, % GDP/cap ⏱	11.1	90	○
2.1.3	School life expectancy, years	14.7	57	
2.1.4	PISA scales in reading, maths, & science	442.5	44	
2.1.5	Pupil-teacher ratio, secondary	7.9	10	● ◆
2.2	**Tertiary education**	**43.7**	**34**	
2.2.1	Tertiary enrolment, % gross	67.2	35	
2.2.2	Graduates in science & engineering, %	28.1	23	
2.2.3	Tertiary inbound mobility, %	4.4	52	
2.3	**Research & development (R&D)**	**11.6**	**54**	
2.3.1	Researchers, FTE/mn pop.	2,087.2	39	◆
2.3.2	Gross expenditure on R&D, % GDP	0.9	40	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	3.0	76	
	INFRASTRUCTURE	**48.6**	**44**	◆
3.1	**Information & communication technologies (ICTs)**	**70.7**	**56**	
3.1.1	ICT access*	71.4	57	
3.1.2	ICT use*	56.3	64	
3.1.3	Government's online service*	73.6	58	
3.1.4	E-participation*	81.5	48	
3.2	**General infrastructure**	**25.0**	**74**	
3.2.1	Electricity output, kWh/mn pop.	5,191.8	39	◆
3.2.2	Logistics performance*	36.2	64	
3.2.3	Gross capital formation, % GDP	23.4	65	
3.3	**Ecological sustainability**	**50.0**	**20**	● ◆
3.3.1	GDP/unit of energy use	6.0	101	○ ◇
3.3.2	Environmental performance*	55.2	43	◆
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	10.1	4	● ◆
	MARKET SOPHISTICATION	**41.6**	**101**	○
4.1	**Credit**	**33.5**	**96**	
4.1.1	Ease of getting credit*	65.0	61	
4.1.2	Domestic credit to private sector, % GDP	41.5	78	
4.1.3	Microfinance gross loans, % GDP	0.2	45	
4.2	**Investment**	**35.8**	**71**	
4.2.1	Ease of protecting minority investors*	70.0	36	
4.2.2	Market capitalization, % GDP ⏱	3.7	72	○
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**55.7**	**96**	
4.3.1	Applied tariff rate, weighted avg., %	n/a	n/a	
4.3.2	Intensity of local competition†	64.1	84	
4.3.3	Domestic market scale, bn PPP$	129.3	75	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**25.8**	**64**	
5.1	**Knowledge workers**	**29.3**	**68**	
5.1.1	Knowledge-intensive employment, %	28.4	50	
5.1.2	Firms offering formal training, %	38.3	32	
5.1.3	GERD performed by business, % GDP	0.4	43	
5.1.4	GERD financed by business, %	10.0	77	○
5.1.5	Females employed w/advanced degrees, %	14.7	47	
5.2	**Innovation linkages**	**22.6**	**56**	
5.2.1	University/industry research collaboration†	39.6	77	
5.2.2	State of cluster development†	40.0	98	○
5.2.3	GERD financed by abroad, % GDP	0.2	17	● ◆
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	61	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	56	
5.3	**Knowledge absorption**	**25.4**	**77**	
5.3.1	Intellectual property payments, % total trade	1.0	36	
5.3.2	High-tech imports, % total trade	5.9	98	○
5.3.3	ICT services imports, % total trade	2.2	23	● ◆
5.3.4	FDI net inflows, % GDP	6.8	17	● ◆
5.3.5	Research talent, % in business enterprise	8.2	65	○
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**30.0**	**41**	◆
6.1	**Knowledge creation**	**27.8**	**36**	
6.1.1	Patents by origin/bn PPP$ GDP	1.4	53	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.3	41	
6.1.3	Utility models by origin/bn PPP$ GDP	0.6	35	
6.1.4	Scientific & technical articles/bn PPP$ GDP	32.3	7	● ◆
6.1.5	Citable documents H-index	14.4	55	
6.2	**Knowledge impact**	**29.1**	**43**	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.5	55	
6.2.2	New businesses/th pop. 15–64	1.9	58	
6.2.3	Computer software spending, % GDP	0.0	105	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	19.8	15	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	24.2	46	
6.3	**Knowledge diffusion**	**33.0**	**37**	
6.3.1	Intellectual property receipts, % total trade	0.2	36	◆
6.3.2	High-tech net exports, % total trade	1.7	61	
6.3.3	ICT services exports, % total trade	4.9	12	● ◆
6.3.4	FDI net outflows, % GDP	0.6	75	
	CREATIVE OUTPUTS	**20.5**	**66**	
7.1	**Intangible assets**	**19.4**	**94**	
7.1.1	Trademarks by origin/bn PPP$ GDP	28.8	78	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.6	55	
7.1.4	ICTs & organizational model creation†	51.7	75	
7.2	**Creative goods and services**	**19.0**	**56**	
7.2.1	Cultural & creative services exports, % total trade	1.6	12	● ◆
7.2.2	National feature films/mn pop. 15–69	5.6	39	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	1.1	50	
7.2.5	Creative goods exports, % total trade	0.6	58	
7.3	**Online creativity**	**24.3**	**47**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.3	91	
7.3.2	Country-code TLDs/th pop. 15–69	5.2	52	
7.3.3	Wikipedia edits/mn pop. 15–69	72.5	36	◆
7.3.4	Mobile app creation/bn PPP$ GDP	19.6	24	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⏱ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

SINGAPORE

GII 2020 rank

8

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
15	1	High	SEAO	5.8	585.1	90,080.2	8

		Score/Value	Rank		
	INSTITUTIONS	**94.8**	**1**	●	◆
1.1	**Political environment**	**100.0**	**1**	●	◆
1.1.1	Political and operational stability*	100.0	1	●	◆
1.1.2	Government effectiveness*	100.0	1	●	◆
1.2	**Regulatory environment**	**98.2**	**2**	●	◆
1.2.1	Regulatory quality*	98.0	2	●	◆
1.2.2	Rule of law*	94.8	7		
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●	
1.3	**Business environment**	**86.3**	**17**		
1.3.1	Ease of starting a business*	98.2	4	●	◆
1.3.2	Ease of resolving insolvency*	74.3	25		

		Score/Value	Rank		
	HUMAN CAPITAL & RESEARCH	**59.5**	**8**		
2.1	**Education**	**49.8**	**51**	○	◇
2.1.1	Expenditure on education, % GDP	2.9	103	○	◇
2.1.2	Government funding/pupil, secondary, % GDP/cap	21.6	40	○	
2.1.3	School life expectancy, years	16.4	25		
2.1.4	PISA scales in reading, maths, & science	556.5	2	●	◆
2.1.5	Pupil-teacher ratio, secondary	11.5	50	○	
2.2	**Tertiary education**	**69.1**	**1**	●	◆
2.2.1	Tertiary enrolment, % gross	84.8	13		
2.2.2	Graduates in science & engineering, %	34.9	8		◆
2.2.3	Tertiary inbound mobility, %	19.2	7		◆
2.3	**Research & development (R&D)**	**59.7**	**13**		
2.3.1	Researchers, FTE/mn pop.	6,802.5	6		
2.3.2	Gross expenditure on R&D, % GDP	1.9	17		
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	48.6	30		◇
2.3.4	QS university ranking, average score top 3*	69.5	12		

		Score/Value	Rank		
	INFRASTRUCTURE	**57.9**	**13**		
3.1	**Information & communication technologies (ICTs)**	**90.6**	**7**		
3.1.1	ICT access*	88.9	6		
3.1.2	ICT use*	78.3	23		
3.1.3	Government's online service*	98.6	2	●	
3.1.4	E-participation*	96.6	13		
3.2	**General infrastructure**	**45.0**	**11**		
3.2.1	Electricity output, kWh/mn pop.	9,338.0	15		
3.2.2	Logistics performance*	90.4	7		
3.2.3	Gross capital formation, % GDP	27.2	36		
3.3	**Ecological sustainability**	**38.2**	**40**		
3.3.1	GDP/unit of energy use	12.8	26		
3.3.2	Environmental performance*	58.1	38		◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.1	41		

		Score/Value	Rank		
	MARKET SOPHISTICATION	**78.0**	**4**	●	◆
4.1	**Credit**	**64.7**	**13**		
4.1.1	Ease of getting credit*	75.0	34		
4.1.2	Domestic credit to private sector, % GDP	121.9	17		
4.1.3	Microfinance gross loans, % GDP	n/a	n/a		
4.2	**Investment**	**93.4**	**2**	●	◆
4.2.1	Ease of protecting minority investors*	86.0	3	●	◆
4.2.2	Market capitalization, % GDP	207.6	4		◆
4.2.3	Venture capital deals/bn PPP$ GDP	0.6	1	●	◆
4.3	**Trade, competition, and market scale**	**76.0**	**19**		
4.3.1	Applied tariff rate, weighted avg., %	0.2	3	●	◆
4.3.2	Intensity of local competition†	78.4	15		
4.3.3	Domestic market scale, bn PPP$	585.1	35		

		Score/Value	Rank		
	BUSINESS SOPHISTICATION	**60.7**	**6**		
5.1	**Knowledge workers**	**68.5**	**7**		
5.1.1	Knowledge-intensive employment, %	56.9	2	●	◆
5.1.2	Firms offering formal training, %	n/a	n/a		
5.1.3	GERD performed by business, % GDP	1.2	19		
5.1.4	GERD financed by business, %	52.2	23		
5.1.5	Females employed w/advanced degrees, %	35.1	1	●	◆
5.2	**Innovation linkages**	**47.1**	**18**		
5.2.1	University/industry research collaboration†	71.3	6		
5.2.2	State of cluster development†	69.2	9		
5.2.3	GERD financed by abroad, % GDP	0.1	30		
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.2	11		
5.2.5	Patent families 2+ offices/bn PPP$ GDP	1.5	23		◇
5.3	**Knowledge absorption**	**66.5**	**2**	●	◆
5.3.1	Intellectual property payments, % total trade	2.9	6		
5.3.2	High-tech imports, % total trade	22.0	7		◆
5.3.3	ICT services imports, % total trade	2.6	14		
5.3.4	FDI net inflows, % GDP	24.6	4	●	◆
5.3.5	Research talent, % in business enterprise	49.9	23		

		Score/Value	Rank		
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**46.1**	**14**		
6.1	**Knowledge creation**	**35.8**	**28**		◇
6.1.1	Patents by origin/bn PPP$ GDP	2.8	32		◇
6.1.2	PCT patents by origin/bn PPP$ GDP	1.8	19		◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a		
6.1.4	Scientific & technical articles/bn PPP$ GDP	18.0	31		
6.1.5	Citable documents H-index	37.8	23		
6.2	**Knowledge impact**	**45.1**	**12**		
6.2.1	Growth rate of PPP$ GDP/worker, %	2.2	45	○	
6.2.2	New businesses/th pop. 15–69	10.0	15		
6.2.3	Computer software spending, % GDP	0.0	42		◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	5.4	51	○	
6.2.5	High- and medium-high-tech manufacturing, %	77.7	1	●	◆
6.3	**Knowledge diffusion**	**57.5**	**7**		
6.3.1	Intellectual property receipts, % total trade	1.5	16		
6.3.2	High-tech net exports, % total trade	26.4	6		◆
6.3.3	ICT services exports, % total trade	2.2	50	○	
6.3.4	FDI net outflows, % GDP	11.8	4	●	◆

		Score/Value	Rank		
	CREATIVE OUTPUTS	**39.9**	**18**		
7.1	**Intangible assets**	**37.6**	**34**		
7.1.1	Trademarks by origin/bn PPP$ GDP	20.1	94	○	◇
7.1.2	Global brand value, top 5,000, % GDP	132.3	13		
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.6	81	○	
7.1.4	ICTs & organizational model creation†	74.6	14		
7.2	**Creative goods and services**	**37.6**	**16**		
7.2.1	Cultural & creative services exports, % total trade	2.6	5		◆
7.2.2	National feature films/mn pop. 15–69	2.8	61	○	
7.2.3	Entertainment & Media market/th pop. 15–69	41.3	20		
7.2.4	Printing and other media, % manufacturing	0.6	84	○	
7.2.5	Creative goods exports, % total trade	3.8	16		
7.3	**Online creativity**	**46.8**	**24**		
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	24.7	23		
7.3.2	Country-code TLDs/th pop. 15–69	11.8	38		◇
7.3.3	Wikipedia edits/mn pop. 15–69	78.8	29		
7.3.4	Mobile app creation/bn PPP$ GDP	73.0	7		◆

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

SLOVAKIA

GII 2020 rank

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Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
34	43	High	EUR	5.5	199.7	31,988.0	37

		Score/Value	Rank	
	INSTITUTIONS	**72.0**	**41**	
1.1	**Political environment**	**70.8**	**38**	
1.1.1	Political and operational stability*	80.4	33	
1.1.2	Government effectiveness*	66.0	38	
1.2	**Regulatory environment**	**70.2**	**45**	
1.2.1	Regulatory quality*	63.2	37	
1.2.2	Rule of law*	60.5	41	
1.2.3	Cost of redundancy dismissal, salary weeks	18.8	78	
1.3	**Business environment**	**75.1**	**51**	
1.3.1	Ease of starting a business*	84.8	91	○ ◇
1.3.2	Ease of resolving insolvency*	65.5	42	
	HUMAN CAPITAL & RESEARCH	**31.2**	**62**	◇
2.1	**Education**	**44.9**	**69**	◇
2.1.1	Expenditure on education, % GDP ◷	3.9	76	○
2.1.2	Government funding/pupil, secondary, % GDP/cap	20.0	49	
2.1.3	School life expectancy, years	14.5	61	◇
2.1.4	PISA scales in reading, maths, & science	469.4	38	
2.1.5	Pupil-teacher ratio, secondary ◷	11.1	44	
2.2	**Tertiary education**	**32.2**	**67**	◇
2.2.1	Tertiary enrolment, % gross	46.6	64	◇
2.2.2	Graduates in science & engineering, %	21.2	63	
2.2.3	Tertiary inbound mobility, %	6.9	35	
2.3	**Research & development (R&D)**	**16.5**	**47**	
2.3.1	Researchers, FTE/mn pop.	2,996.0	33	
2.3.2	Gross expenditure on R&D, % GDP	0.8	43	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	13.5	59	
	INFRASTRUCTURE	**52.5**	**33**	
3.1	**Information & communication technologies (ICTs)**	**74.8**	**48**	
3.1.1	ICT access*	73.7	47	◇
3.1.2	ICT use*	70.9	39	
3.1.3	Government's online service*	73.6	58	◇
3.1.4	E-participation*	80.9	50	
3.2	**General infrastructure**	**27.0**	**65**	◇
3.2.1	Electricity output, kWh/mn pop.	4,599.3	47	
3.2.2	Logistics performance*	44.9	52	◇
3.2.3	Gross capital formation, % GDP	24.0	60	
3.3	**Ecological sustainability**	**55.8**	**10**	● ◆
3.3.1	GDP/unit of energy use	9.8	58	
3.3.2	Environmental performance*	68.3	26	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	8.8	9	● ◆
	MARKET SOPHISTICATION	**45.3**	**82**	
4.1	**Credit**	**48.1**	**44**	
4.1.1	Ease of getting credit*	70.0	44	
4.1.2	Domestic credit to private sector, % GDP	61.5	57	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**19.8**	**127**	○ ◇
4.2.1	Ease of protecting minority investors*	56.0	82	○
4.2.2	Market capitalization, % GDP ◷	5.1	70	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	67	○
4.3	**Trade, competition, and market scale**	**68.0**	**40**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	73.7	35	
4.3.3	Domestic market scale, bn PPP$	199.7	67	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**31.7**	**46**	
5.1	**Knowledge workers**	**43.6**	**38**	
5.1.1	Knowledge-intensive employment, %	32.6	42	
5.1.2	Firms offering formal training, % ◷	43.5	23	
5.1.3	GERD performed by business, % GDP	0.5	39	
5.1.4	GERD financed by business, %	48.8	31	
5.1.5	Females employed w/advanced degrees, %	14.5	48	
5.2	**Innovation linkages**	**19.0**	**77**	◇
5.2.1	University/industry research collaboration†	36.0	94	○ ◇
5.2.2	State of cluster development†	46.6	68	
5.2.3	GERD financed by abroad, % GDP	0.1	40	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	116	○ ◇
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.3	37	
5.3	**Knowledge absorption**	**32.5**	**52**	
5.3.1	Intellectual property payments, % total trade	0.8	53	
5.3.2	High-tech imports, % total trade	12.8	19	●
5.3.3	ICT services imports, % total trade	0.9	76	
5.3.4	FDI net inflows, % GDP	4.0	37	
5.3.5	Research talent, % in business enterprise	24.0	52	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**34.4**	**30**	
6.1	**Knowledge creation**	**23.0**	**45**	
6.1.1	Patents by origin/bn PPP$ GDP	1.4	54	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.2	47	◇
6.1.3	Utility models by origin/bn PPP$ GDP	1.7	14	● ◆
6.1.4	Scientific & technical articles/bn PPP$ GDP	15.3	37	
6.1.5	Citable documents H-index	17.6	45	
6.2	**Knowledge impact**	**45.8**	**9**	● ◆
6.2.1	Growth rate of PPP$ GDP/worker, %	1.3	58	
6.2.2	New businesses/th pop. 15-64	5.3	30	
6.2.3	Computer software spending, % GDP	0.0	39	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	21.0	12	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	58.1	4	● ◆
6.3	**Knowledge diffusion**	**34.3**	**35**	
6.3.1	Intellectual property receipts, % total trade	0.0	69	
6.3.2	High-tech net exports, % total trade	8.9	19	●
6.3.3	ICT services exports, % total trade	1.7	63	
6.3.4	FDI net outflows, % GDP	2.6	28	●
	CREATIVE OUTPUTS	**31.3**	**39**	
7.1	**Intangible assets**	**27.0**	**68**	
7.1.1	Trademarks by origin/bn PPP$ GDP	50.4	48	
7.1.2	Global brand value, top 5,000, % GDP	3.2	74	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	2.5	45	
7.1.4	ICTs & organizational model creation†	65.0	28	
7.2	**Creative goods and services**	**44.6**	**6**	● ◆
7.2.1	Cultural & creative services exports, % total trade	0.3	61	
7.2.2	National feature films/mn pop. 15-69	6.6	35	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	0.5	87	○
7.2.5	Creative goods exports, % total trade	7.2	7	● ◆
7.3	**Online creativity**	**26.7**	**40**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	3.0	64	◇
7.3.2	Country-code TLDs/th pop. 15-69	30.3	22	●
7.3.3	Wikipedia edits/mn pop. 15-69	67.9	42	
7.3.4	Mobile app creation/bn PPP$ GDP	7.5	49	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

SLOVENIA

GII 2020 rank

32

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
39	29	High	EUR	2.1	79.6	33,578.8	31

		Score/Value	Rank	
	INSTITUTIONS	**82.4**	**20**	
1.1	**Political environment**	**77.6**	**27**	
1.1.1	Political and operational stability*	82.1	29	
1.1.2	Government effectiveness*	75.3	28	
1.2	**Regulatory environment**	**80.9**	**27**	
1.2.1	Regulatory quality*	60.1	38	
1.2.2	Rule of law*	74.3	26	
1.2.3	Cost of redundancy dismissal, salary weeks	10.7	34	
1.3	**Business environment**	**88.7**	**7**	● ◆
1.3.1	Ease of starting a business*	93.0	39	
1.3.2	Ease of resolving insolvency*	84.4	8	●
	HUMAN CAPITAL & RESEARCH	**47.2**	**26**	
2.1	**Education**	**56.6**	**25**	
2.1.1	Expenditure on education, % GDP ⊕	4.8	49	
2.1.2	Government funding/pupil, secondary, % GDP/cap	22.9	29	
2.1.3	School life expectancy, years	17.6	15	●
2.1.4	PISA scales in reading, maths, & science	503.7	11	●
2.1.5	Pupil-teacher ratio, secondary ⊕	9.7	29	
2.2	**Tertiary education**	**44.9**	**29**	
2.2.1	Tertiary enrolment, % gross	78.6	20	
2.2.2	Graduates in science & engineering, %	26.6	29	
2.2.3	Tertiary inbound mobility, %	3.9	60	
2.3	**Research & development (R&D)**	**40.0**	**25**	
2.3.1	Researchers, FTE/mn pop.	4,854.6	18	
2.3.2	Gross expenditure on R&D, % GDP	1.9	18	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	51.3	28	
2.3.4	QS university ranking, average score top 3*	11.6	63	
	INFRASTRUCTURE	**52.5**	**32**	
3.1	**Information & communication technologies (ICTs)**	**77.9**	**37**	
3.1.1	ICT access*	81.5	22	
3.1.2	ICT use*	68.9	43	
3.1.3	Government's online service*	79.9	45	
3.1.4	E-participation*	81.5	48	
3.2	**General infrastructure**	**31.4**	**44**	
3.2.1	Electricity output, kWh/mn pop.	7,784.0	24	
3.2.2	Logistics performance*	58.4	34	
3.2.3	Gross capital formation, % GDP	21.4	83	○
3.3	**Ecological sustainability**	**48.3**	**21**	
3.3.1	GDP/unit of energy use	9.5	63	
3.3.2	Environmental performance*	72.0	18	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	5.7	18	●
	MARKET SOPHISTICATION	**45.7**	**77**	○
4.1	**Credit**	**31.3**	**103**	○ ◇
4.1.1	Ease of getting credit*	45.0	101	○ ◇
4.1.2	Domestic credit to private sector, % GDP	43.2	76	○ ◇
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**41.8**	**55**	
4.2.1	Ease of protecting minority investors*	78.0	18	
4.2.2	Market capitalization, % GDP	12.8	64	○
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**64.0**	**60**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	
4.3.2	Intensity of local competition†	73.0	38	
4.3.3	Domestic market scale, bn PPP$	79.6	89	○

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**42.6**	**27**	
5.1	**Knowledge workers**	**59.0**	**18**	●
5.1.1	Knowledge-intensive employment, %	42.6	22	
5.1.2	Firms offering formal training, %	44.0	22	
5.1.3	GERD performed by business, % GDP	1.4	14	
5.1.4	GERD financed by business, %	63.1	10	●
5.1.5	Females employed w/advanced degrees, %	21.1	26	
5.2	**Innovation linkages**	**31.7**	**32**	
5.2.1	University/industry research collaboration†	49.1	42	
5.2.2	State of cluster development†	45.9	73	○
5.2.3	GERD financed by abroad, % GDP	0.2	13	●
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	46	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	1.3	25	
5.3	**Knowledge absorption**	**37.2**	**36**	
5.3.1	Intellectual property payments, % total trade	0.6	60	
5.3.2	High-tech imports, % total trade	6.0	97	○
5.3.3	ICT services imports, % total trade	1.4	48	
5.3.4	FDI net inflows, % GDP	2.8	60	
5.3.5	Research talent, % in business enterprise	62.1	11	●
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**32.7**	**35**	
6.1	**Knowledge creation**	**37.9**	**26**	
6.1.1	Patents by origin/bn PPP$ GDP	4.7	23	
6.1.2	PCT patents by origin/bn PPP$ GDP	1.1	27	
6.1.3	Utility models by origin/bn PPP$ GDP ⊕	0.2	52	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	38.0	2	● ◆
6.1.5	Citable documents H-index	18.7	43	
6.2	**Knowledge impact**	**31.6**	**37**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.9	63	
6.2.2	New businesses/th pop. 15-64	3.1	45	
6.2.3	Computer software spending, % GDP	0.0	89	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	22.5	8	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	25.1	45	
6.3	**Knowledge diffusion**	**28.7**	**45**	
6.3.1	Intellectual property receipts, % total trade	0.2	41	
6.3.2	High-tech net exports, % total trade	4.8	35	
6.3.3	ICT services exports, % total trade	1.5	71	
6.3.4	FDI net outflows, % GDP	1.1	53	
	CREATIVE OUTPUTS	**30.7**	**41**	
7.1	**Intangible assets**	**29.6**	**54**	
7.1.1	Trademarks by origin/bn PPP$ GDP	72.7	28	
7.1.2	Global brand value, top 5,000, % GDP	6.4	65	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	2.8	40	
7.1.4	ICTs & organizational model creation†	61.9	38	
7.2	**Creative goods and services**	**23.5**	**42**	
7.2.1	Cultural & creative services exports, % total trade	0.8	36	
7.2.2	National feature films/mn pop. 15-69	14.1	9	●
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	1.5	29	
7.2.5	Creative goods exports, % total trade	0.8	53	
7.3	**Online creativity**	**40.3**	**29**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	20.4	28	
7.3.2	Country-code TLDs/th pop. 15-69	27.8	24	
7.3.3	Wikipedia edits/mn pop. 15-69	82.9	19	
7.3.4	Mobile app creation/bn PPP$ GDP	30.9	18	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊕ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

SOUTH AFRICA

GII 2020 rank

60

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
68	49	Upper middle	SSF	58.6	809.0	12,007.5	63

		Score/Value	Rank	
	INSTITUTIONS	**66.2**	**55**	
1.1	**Political environment**	**59.3**	**62**	
1.1.1	Political and operational stability*	62.5	92	○
1.1.2	Government effectiveness*	57.7	50	
1.2	**Regulatory environment**	**71.3**	**43**	
1.2.1	Regulatory quality*	46.3	61	
1.2.2	Rule of law*	44.0	67	
1.2.3	Cost of redundancy dismissal, salary weeks	9.3	25	●
1.3	**Business environment**	**67.9**	**75**	
1.3.1	Ease of starting a business*	81.2	107	○
1.3.2	Ease of resolving insolvency*	54.6	63	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**29.4**	**70**	
2.1	**Education**	**44.4**	**71**	
2.1.1	Expenditure on education, % GDP	6.2	13	● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap	21.4	42	
2.1.3	School life expectancy, years	13.8	72	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⊙	27.6	115	○ ◇
2.2	**Tertiary education**	**19.7**	**96**	○
2.2.1	Tertiary enrolment, % gross	22.4	91	○ ◇
2.2.2	Graduates in science & engineering, %	18.6	77	
2.2.3	Tertiary inbound mobility, %	4.1	58	
2.3	**Research & development (R&D)**	**24.2**	**42**	
2.3.1	Researchers, FTE/mn pop. ⊙	492.0	69	
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.8	45	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	41.4	36	◆
2.3.4	QS university ranking, average score top 3*	33.1	35	

		Score/Value	Rank	
	INFRASTRUCTURE	**37.9**	**79**	
3.1	**Information & communication technologies (ICTs)**	**66.5**	**67**	
3.1.1	ICT access*	52.1	87	
3.1.2	ICT use*	45.6	83	
3.1.3	Government's online service*	83.3	37	
3.1.4	E-participation*	84.8	39	
3.2	**General infrastructure**	**26.4**	**70**	
3.2.1	Electricity output, kWh/mn pop.	4,419.2	48	
3.2.2	Logistics performance*	61.3	32	◆
3.2.3	Gross capital formation, % GDP	17.6	112	○
3.3	**Ecological sustainability**	**20.8**	**96**	◇
3.3.1	GDP/unit of energy use	5.2	109	○ ◇
3.3.2	Environmental performance*	43.1	82	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.1	59	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**60.5**	**15**	● ◆
4.1	**Credit**	**50.6**	**32**	◆
4.1.1	Ease of getting credit*	60.0	74	
4.1.2	Domestic credit to private sector, % GDP ⊙	147.5	9	● ◆
4.1.3	Microfinance gross loans, % GDP	0.0	69	○
4.2	**Investment**	**62.0**	**14**	● ◆
4.2.1	Ease of protecting minority investors*	80.0	13	● ◆
4.2.2	Market capitalization, % GDP	302.7	1	● ◆
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	43	
4.3	**Trade, competition, and market scale**	**69.0**	**35**	
4.3.1	Applied tariff rate, weighted avg., %	4.3	81	
4.3.2	Intensity of local competition†	71.2	48	
4.3.3	Domestic market scale, bn PPP$	809.0	30	●

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**30.3**	**50**	
5.1	**Knowledge workers**	**30.9**	**61**	
5.1.1	Knowledge-intensive employment, %	23.4	65	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP ⊙	0.3	44	
5.1.4	GERD financed by business, % ⊙	39.4	46	
5.1.5	Females employed w/advanced degrees, %	10.5	64	
5.2	**Innovation linkages**	**25.9**	**43**	◆
5.2.1	University/industry research collaboration†	54.7	30	● ◆
5.2.2	State of cluster development†	55.1	34	◆
5.2.3	GERD financed by abroad, % GDP ⊙	0.1	39	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	40	◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	42	
5.3	**Knowledge absorption**	**34.0**	**45**	
5.3.1	Intellectual property payments, % total trade	2.0	13	● ◆
5.3.2	High-tech imports, % total trade	9.6	38	
5.3.3	ICT services imports, % total trade	1.2	63	
5.3.4	FDI net inflows, % GDP	0.9	112	○ ◇
5.3.5	Research talent, % in business enterprise ⊙	17.3	59	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**21.2**	**62**	
6.1	**Knowledge creation**	**20.4**	**49**	
6.1.1	Patents by origin/bn PPP$ GDP	0.8	70	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.4	39	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	11.6	46	
6.1.5	Citable documents H-index	29.5	32	◆
6.2	**Knowledge impact**	**23.3**	**66**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-0.4	101	○
6.2.2	New businesses/th pop. 15-64 ⊙	10.2	13	● ◆
6.2.3	Computer software spending, % GDP	0.0	48	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.1	61	
6.2.5	High- and medium-high-tech manufacturing, %	20.5	55	
6.3	**Knowledge diffusion**	**19.9**	**78**	
6.3.1	Intellectual property receipts, % total trade	0.1	52	
6.3.2	High-tech net exports, % total trade	2.0	54	
6.3.3	ICT services exports, % total trade	0.6	95	
6.3.4	FDI net outflows, % GDP	1.6	42	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**19.8**	**70**	
7.1	**Intangible assets**	**30.1**	**52**	
7.1.1	Trademarks by origin/bn PPP$ GDP	28.6	79	
7.1.2	Global brand value, top 5,000, % GDP	87.5	22	● ◆
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.2	61	
7.1.4	ICTs & organizational model creation†	58.7	48	
7.2	**Creative goods and services**	**7.3**	**92**	
7.2.1	Cultural & creative services exports, % total trade	0.2	68	
7.2.2	National feature films/mn pop. 15-69	0.6	98	○
7.2.3	Entertainment & Media market/th pop. 15-69	7.8	41	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.8	52	
7.3	**Online creativity**	**11.7**	**78**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	3.0	63	
7.3.2	Country-code TLDs/th pop. 15-69	9.6	41	
7.3.3	Wikipedia edits/mn pop. 15-69	37.3	84	
7.3.4	Mobile app creation/bn PPP$ GDP	0.3	74	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

SPAIN

GII 2020 rank

30

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
27	27	High	EUR	46.7	1,940.5	36,311.3	29

		Score/Value	Rank
	INSTITUTIONS	**77.3**	**31**
1.1	**Political environment**	**73.4**	**37**
1.1.1	Political and operational stability*	75.0	44
1.1.2	Government effectiveness*	72.5	33
1.2	**Regulatory environment**	**75.4**	**35**
1.2.1	Regulatory quality*	66.7	33
1.2.2	Rule of law*	71.9	30
1.2.3	Cost of redundancy dismissal, salary weeks	17.4	73 ○
1.3	**Business environment**	**83.1**	**25**
1.3.1	Ease of starting a business*	86.9	75 ○ ◇
1.3.2	Ease of resolving insolvency*	79.2	17
	HUMAN CAPITAL & RESEARCH	**46.5**	**27**
2.1	**Education**	**50.8**	**50**
2.1.1	Expenditure on education, % GDP ⊙	4.2	66 ○
2.1.2	Government funding/pupil, secondary, % GDP/cap	18.9	55 ○
2.1.3	School life expectancy, years	17.6	14 ●
2.1.4	PISA scales in reading, maths, & science	482.3	29
2.1.5	Pupil-teacher ratio, secondary ⊙	11.6	53
2.2	**Tertiary education**	**43.9**	**33**
2.2.1	Tertiary enrolment, % gross	88.9	5 ●
2.2.2	Graduates in science & engineering, %	23.5	46
2.2.3	Tertiary inbound mobility, %	3.2	63 ○
2.3	**Research & development (R&D)**	**44.9**	**22**
2.3.1	Researchers, FTE/mn pop.	3,000.9	32
2.3.2	Gross expenditure on R&D, % GDP	1.2	31
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	73.1	13 ●
2.3.4	QS university ranking, average score top 3*	45.9	24
	INFRASTRUCTURE	**60.1**	**7 ● ◆**
3.1	**Information & communication technologies (ICTs)**	**88.2**	**16**
3.1.1	ICT access*	81.3	23
3.1.2	ICT use*	79.6	21
3.1.3	Government's online service*	93.8	16
3.1.4	E-participation*	98.3	5 ● ◆
3.2	**General infrastructure**	**36.3**	**32**
3.2.1	Electricity output, kWh/mn pop.	5,816.0	35
3.2.2	Logistics performance*	82.6	17
3.2.3	Gross capital formation, % GDP	22.2	76 ○
3.3	**Ecological sustainability**	**55.7**	**11 ● ◆**
3.3.1	GDP/unit of energy use	13.0	24
3.3.2	Environmental performance*	74.3	14 ●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	6.5	13 ●
	MARKET SOPHISTICATION	**55.1**	**26**
4.1	**Credit**	**51.9**	**28**
4.1.1	Ease of getting credit*	60.0	74 ○
4.1.2	Domestic credit to private sector, % GDP	99.2	25
4.1.3	Microfinance gross loans, % GDP	n/a	n/a
4.2	**Investment**	**35.7**	**72 ○**
4.2.1	Ease of protecting minority investors*	72.0	27
4.2.2	Market capitalization, % GDP	58.7	28
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	36
4.3	**Trade, competition, and market scale**	**77.7**	**11 ●**
4.3.1	Applied tariff rate, weighted avg., %	1.7	22
4.3.2	Intensity of local competition†	75.8	22
4.3.3	Domestic market scale, bn PPP$	1,940.5	15 ● ◆

		Score/Value	Rank
	BUSINESS SOPHISTICATION	**35.3**	**37**
5.1	**Knowledge workers**	**46.3**	**31**
5.1.1	Knowledge-intensive employment, %	33.3	40
5.1.2	Firms offering formal training, %	n/a	n/a
5.1.3	GERD performed by business, % GDP	0.7	31
5.1.4	GERD financed by business, %	47.8	32
5.1.5	Females employed w/advanced degrees, %	22.4	22
5.2	**Innovation linkages**	**24.5**	**50**
5.2.1	University/industry research collaboration†	41.0	67 ○
5.2.2	State of cluster development†	55.3	33
5.2.3	GERD financed by abroad, % GDP	0.1	37
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	54
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.5	31
5.3	**Knowledge absorption**	**35.0**	**42**
5.3.1	Intellectual property payments, % total trade	1.3	25
5.3.2	High-tech imports, % total trade	6.6	81 ○
5.3.3	ICT services imports, % total trade	1.7	37
5.3.4	FDI net inflows, % GDP	3.0	56
5.3.5	Research talent, % in business enterprise	38.8	34
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**37.7**	**24**
6.1	**Knowledge creation**	**37.1**	**27**
6.1.1	Patents by origin/bn PPP$ GDP	1.8	41
6.1.2	PCT patents by origin/bn PPP$ GDP	0.8	30
6.1.3	Utility models by origin/bn PPP$ GDP	1.4	18
6.1.4	Scientific & technical articles/bn PPP$ GDP	21.6	25
6.1.5	Citable documents H-index	59.7	11 ●
6.2	**Knowledge impact**	**41.3**	**16**
6.2.1	Growth rate of PPP$ GDP/worker, %	0.1	88 ○
6.2.2	New businesses/th pop. 15–64	3.1	46
6.2.3	Computer software spending, % GDP	0.0	5 ● ◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	15.8	17
6.2.5	High- and medium-high-tech manufacturing, %	36.1	30
6.3	**Knowledge diffusion**	**34.7**	**34**
6.3.1	Intellectual property receipts, % total trade	0.5	26
6.3.2	High-tech net exports, % total trade	3.6	41
6.3.3	ICT services exports, % total trade	3.0	29
6.3.4	FDI net outflows, % GDP	3.2	19
	CREATIVE OUTPUTS	**35.0**	**31**
7.1	**Intangible assets**	**42.7**	**24**
7.1.1	Trademarks by origin/bn PPP$ GDP	51.3	46
7.1.2	Global brand value, top 5,000, % GDP	92.7	21
7.1.3	Industrial designs by origin/bn PPP$ GDP	11.8	12 ● ◆
7.1.4	ICTs & organizational model creation†	63.4	34
7.2	**Creative goods and services**	**20.0**	**54**
7.2.1	Cultural & creative services exports, % total trade	0.9	30
7.2.2	National feature films/mn pop. 15–69	7.3	28
7.2.3	Entertainment & Media market/th pop. 15–69	30.9	24
7.2.4	Printing and other media, % manufacturing	1.2	40
7.2.5	Creative goods exports, % total trade	0.8	55
7.3	**Online creativity**	**34.6**	**31**
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	27.6	22
7.3.2	Country-code TLDs/th pop. 15–69	17.7	32
7.3.3	Wikipedia edits/mn pop. 15–69	80.4	25
7.3.4	Mobile app creation/bn PPP$ GDP	13.7	34

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

SRI LANKA

GII 2020 rank

101

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
83	107	Upper middle	CSA	21.3	304.8	12,132.7	89

		Score/Value	Rank	
	INSTITUTIONS	**46.8**	**119**	○ ◇
1.1	**Political environment**	**52.5**	**85**	
1.1.1	Political and operational stability*	67.9	73	
1.1.2	Government effectiveness*	44.9	84	
1.2	**Regulatory environment**	**21.3**	**129**	○ ◇
1.2.1	Regulatory quality*	37.8	83	
1.2.2	Rule of law*	47.4	61	
1.2.3	Cost of redundancy dismissal, salary weeks	58.5	129	○ ◇
1.3	**Business environment**	**66.6**	**79**	
1.3.1	Ease of starting a business*	88.2	68	
1.3.2	Ease of resolving insolvency*	45.0	85	
	HUMAN CAPITAL & RESEARCH	**12.2**	**119**	○ ◇
2.1	**Education**	**25.2**	**116**	◇
2.1.1	Expenditure on education, % GDP	2.1	114	○ ◇
2.1.2	Government funding/pupil, secondary, % GDP/cap	6.7	101	○ ◇
2.1.3	School life expectancy, years	14.1	71	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	17.5	86	
2.2	**Tertiary education**	**9.8**	**115**	◇
2.2.1	Tertiary enrolment, % gross	19.6	94	◇
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	0.4	100	◇
2.3	**Research & development (R&D)**	**1.5**	**102**	
2.3.1	Researchers, FTE/mn pop. ◷	106.0	86	◇
2.3.2	Gross expenditure on R&D, % GDP ◷	0.1	103	○ ◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	3.2	75	
	INFRASTRUCTURE	**37.9**	**78**	
3.1	**Information & communication technologies (ICTs)**	**53.9**	**90**	
3.1.1	ICT access*	48.8	90	◇
3.1.2	ICT use*	37.1	101	◇
3.1.3	Government's online service*	66.7	76	
3.1.4	E-participation*	62.9	83	
3.2	**General infrastructure**	**21.7**	**90**	
3.2.1	Electricity output, kWh/mn pop.	737.1	102	◇
3.2.2	Logistics performance*	24.8	90	
3.2.3	Gross capital formation, % GDP	28.4	31	●
3.3	**Ecological sustainability**	**38.2**	**39**	●
3.3.1	GDP/unit of energy use	20.4	4	● ◆
3.3.2	Environmental performance*	39.0	90	◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.9	67	
	MARKET SOPHISTICATION	**34.9**	**118**	○ ◇
4.1	**Credit**	**25.0**	**116**	◇
4.1.1	Ease of getting credit*	40.0	113	○ ◇
4.1.2	Domestic credit to private sector, % GDP ◷	45.4	74	
4.1.3	Microfinance gross loans, % GDP	0.5	35	●
4.2	**Investment**	**27.1**	**108**	
4.2.1	Ease of protecting minority investors*	72.0	27	●
4.2.2	Market capitalization, % GDP	20.6	57	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	80	○
4.3	**Trade, competition, and market scale**	**52.6**	**106**	◇
4.3.1	Applied tariff rate, weighted avg., %	12.1	124	○ ◇
4.3.2	Intensity of local competition†	65.3	80	
4.3.3	Domestic market scale, bn PPP$	304.8	58	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**24.4**	**70**	
5.1	**Knowledge workers**	**21.3**	**97**	
5.1.1	Knowledge-intensive employment, % ◷	20.4	76	
5.1.2	Firms offering formal training, % ◷	18.4	78	◇
5.1.3	GERD performed by business, % GDP ◷	0.0	76	
5.1.4	GERD financed by business, % ◷	34.4	51	
5.1.5	Females employed w/advanced degrees, % ◷	2.9	98	◇
5.2	**Innovation linkages**	**19.5**	**73**	
5.2.1	University/industry research collaboration†	40.2	73	
5.2.2	State of cluster development†	48.7	56	
5.2.3	GERD financed by abroad, % GDP ◷	0.0	93	○
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	31	● ◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	80	
5.3	**Knowledge absorption**	**32.5**	**53**	●
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports, % total trade ◷	7.7	62	
5.3.3	ICT services imports, % total trade	2.1	27	● ◆
5.3.4	FDI net inflows, % GDP	1.5	99	
5.3.5	Research talent, % in business enterprise ◷	22.5	54	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**18.9**	**68**	
6.1	**Knowledge creation**	**7.1**	**89**	
6.1.1	Patents by origin/bn PPP$ GDP	1.2	62	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	76	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.4	111	
6.1.5	Citable documents H-index	10.1	75	
6.2	**Knowledge impact**	**21.3**	**77**	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.7	34	●
6.2.2	New businesses/th pop. 15-64	0.7	88	
6.2.3	Computer software spending, % GDP	0.0	30	● ◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.9	76	
6.2.5	High- and medium-high-tech manufacturing, %	7.2	92	
6.3	**Knowledge diffusion**	**28.3**	**49**	●
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade ◷	0.4	87	
6.3.3	ICT services exports, % total trade	4.2	19	● ◆
6.3.4	FDI net outflows, % GDP	0.1	99	
	CREATIVE OUTPUTS	**13.8**	**100**	◇
7.1	**Intangible assets**	**18.4**	**100**	
7.1.1	Trademarks by origin/bn PPP$ GDP	25.2	84	
7.1.2	Global brand value, top 5,000, % GDP	12.8	55	
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.8	77	
7.1.4	ICTs & organizational model creation†	47.5	91	
7.2	**Creative goods and services**	**11.2**	**74**	
7.2.1	Cultural & creative services exports, % total trade	0.0	114	○
7.2.2	National feature films/mn pop. 15-69 ◷	1.0	87	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	2.3	11	● ◆
7.2.5	Creative goods exports, % total trade ◷	0.4	67	
7.3	**Online creativity**	**7.0**	**98**	◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	0.7	101	
7.3.2	Country-code TLDs/th pop. 15-69	0.8	92	
7.3.3	Wikipedia edits/mn pop. 15-69	29.6	95	◇
7.3.4	Mobile app creation/bn PPP$ GDP	0.7	70	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

SWEDEN

GII 2020 rank

2

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
2	3	High	EUR	10.0	563.9	47,691.9	2

		Score/Value	Rank
	INSTITUTIONS	**88.7**	**11**
1.1	**Political environment**	**89.9**	**10**
1.1.1	Political and operational stability*	87.5	11
1.1.2	Government effectiveness*	91.1	8
1.2	**Regulatory environment**	**90.0**	**13**
1.2.1	Regulatory quality*	89.3	6
1.2.2	Rule of law*	96.1	4 ●
1.2.3	Cost of redundancy dismissal, salary weeks	14.4	55 ○
1.3	**Business environment**	**86.3**	**16**
1.3.1	Ease of starting a business*	93.1	37
1.3.2	Ease of resolving insolvency*	79.5	16
	HUMAN CAPITAL & RESEARCH	**62.4**	**3 ● ◆**
2.1	**Education**	**68.2**	**6 ◆**
2.1.1	Expenditure on education, % GDP ⊙	7.7	3 ● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap	23.8	24
2.1.3	School life expectancy, years	19.5	3 ● ◆
2.1.4	PISA scales in reading, maths, & science	502.5	14
2.1.5	Pupil-teacher ratio, secondary ⊙	13.1	61 ○
2.2	**Tertiary education**	**44.9**	**28**
2.2.1	Tertiary enrolment, % gross	67.0	36
2.2.2	Graduates in science & engineering, %	27.5	26
2.2.3	Tertiary inbound mobility, %	6.7	37
2.3	**Research & development (R&D)**	**74.0**	**6**
2.3.1	Researchers, FTE/mn pop.	7,536.5	4 ◆
2.3.2	Gross expenditure on R&D, % GDP	3.3	3 ●
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	79.0	10
2.3.4	QS university ranking, average score top 3*	59.3	14
	INFRASTRUCTURE	**64.6**	**2 ● ◆**
3.1	**Information & communication technologies (ICTs)**	**89.0**	**13**
3.1.1	ICT access*	81.7	20
3.1.2	ICT use*	86.2	7
3.1.3	Government's online service*	94.4	14
3.1.4	E-participation*	93.8	19
3.2	**General infrastructure**	**50.7**	**4 ● ◆**
3.2.1	Electricity output, kWh/mn pop.	15,643.3	7
3.2.2	Logistics performance*	93.0	2 ●
3.2.3	Gross capital formation, % GDP	26.2	42
3.3	**Ecological sustainability**	**54.0**	**15 ◆**
3.3.1	GDP/unit of energy use	9.7	61 ○
3.3.2	Environmental performance*	78.7	8
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	6.9	11 ◆
	MARKET SOPHISTICATION	**62.3**	**12**
4.1	**Credit**	**59.8**	**17**
4.1.1	Ease of getting credit*	60.0	74 ○
4.1.2	Domestic credit to private sector, % GDP	133.1	16
4.1.3	Microfinance gross loans, % GDP	n/a	n/a
4.2	**Investment**	**54.5**	**21**
4.2.1	Ease of protecting minority investors*	72.0	27
4.2.2	Market capitalization, % GDP	n/a	n/a
4.2.3	Venture capital deals/bn PPP$ GDP	0.2	14
4.3	**Trade, competition, and market scale**	**72.6**	**30**
4.3.1	Applied tariff rate, weighted avg., %	1.7	22 ○
4.3.2	Intensity of local competition†	75.1	25
4.3.3	Domestic market scale, bn PPP$	563.9	38

		Score/Value	Rank
	BUSINESS SOPHISTICATION	**68.0**	**1 ● ◆**
5.1	**Knowledge workers**	**76.8**	**3 ● ◆**
5.1.1	Knowledge-intensive employment, %	53.5	4
5.1.2	Firms offering formal training, % ⊙	70.3	3 ●
5.1.3	GERD performed by business, % GDP	2.3	4
5.1.4	GERD financed by business, %	60.8	12
5.1.5	Females employed w/advanced degrees, %	25.6	11
5.2	**Innovation linkages**	**76.2**	**2 ● ◆**
5.2.1	University/industry research collaboration†	71.0	7
5.2.2	State of cluster development†	64.8	18
5.2.3	GERD financed by abroad, % GDP	0.3	7
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.3	3 ● ◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	6.6	1 ● ◆
5.3	**Knowledge absorption**	**51.0**	**13**
5.3.1	Intellectual property payments, % total trade	1.5	22
5.3.2	High-tech imports, % total trade	8.6	51 ○
5.3.3	ICT services imports, % total trade	3.1	7 ◆
5.3.4	FDI net inflows, % GDP	2.9	59 ○
5.3.5	Research talent, % in business enterprise	72.8	5 ◆
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**59.8**	**2 ● ◆**
6.1	**Knowledge creation**	**76.0**	**2 ● ◆**
6.1.1	Patents by origin/bn PPP$ GDP	10.7	9
6.1.2	PCT patents by origin/bn PPP$ GDP	7.4	4 ◆
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a
6.1.4	Scientific & technical articles/bn PPP$ GDP	31.9	8 ◆
6.1.5	Citable documents H-index	59.3	12
6.2	**Knowledge impact**	**39.7**	**19**
6.2.1	Growth rate of PPP$ GDP/worker, %	0.4	80 ○
6.2.2	New businesses/th pop. 15–64	7.2	22
6.2.3	Computer software spending, % GDP	0.0	10
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.6	33
6.2.5	High- and medium-high-tech manufacturing, %	45.4	14
6.3	**Knowledge diffusion**	**63.9**	**4 ● ◆**
6.3.1	Intellectual property receipts, % total trade	3.3	6 ◆
6.3.2	High-tech net exports, % total trade	7.0	23
6.3.3	ICT services exports, % total trade	6.1	7 ◆
6.3.4	FDI net outflows, % GDP	3.5	18
	CREATIVE OUTPUTS	**51.7**	**7**
7.1	**Intangible assets**	**54.1**	**8**
7.1.1	Trademarks by origin/bn PPP$ GDP	45.9	56 ○
7.1.2	Global brand value, top 5,000, % GDP	214.0	3 ● ◆
7.1.3	Industrial designs by origin/bn PPP$ GDP	3.9	32
7.1.4	ICTs & organizational model creation†	82.7	2 ● ◆
7.2	**Creative goods and services**	**31.9**	**21**
7.2.1	Cultural & creative services exports, % total trade	1.0	26
7.2.2	National feature films/mn pop. 15–69	10.0	20
7.2.3	Entertainment & Media market/th pop. 15–69	66.8	6
7.2.4	Printing and other media, % manufacturing	1.1	54 ○
7.2.5	Creative goods exports, % total trade	1.8	31
7.3	**Online creativity**	**66.4**	**6**
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	42.9	17
7.3.2	Country-code TLDs/th pop. 15–69	68.6	8
7.3.3	Wikipedia edits/mn pop. 15–69	93.8	4 ● ◆
7.3.4	Mobile app creation/bn PPP$ GDP	60.7	9

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

SWITZERLAND

GII 2020 rank

1

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
1	2	High	EUR	8.6	565.6	57,791.1	1

		Score/Value	Rank	
	INSTITUTIONS	**88.0**	**13**	
1.1	**Political environment**	**94.2**	**2**	● ◆
1.1.1	Political and operational stability*	91.1	5	
1.1.2	Government effectiveness*	95.7	2	● ◆
1.2	**Regulatory environment**	**94.4**	**7**	
1.2.1	Regulatory quality*	88.8	8	
1.2.2	Rule of law*	97.0	3	●
1.2.3	Cost of redundancy dismissal, salary weeks	10.1	31	
1.3	**Business environment**	**75.5**	**47**	○ ◇
1.3.1	Ease of starting a business*	88.4	66	○ ◇
1.3.2	Ease of resolving insolvency*	62.6	44	◇
	HUMAN CAPITAL & RESEARCH	**60.7**	**6**	
2.1	**Education**	**56.1**	**31**	
2.1.1	Expenditure on education, % GDP ⊙	5.1	40	
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	24.5	22	
2.1.3	School life expectancy, years	16.3	26	
2.1.4	PISA scales in reading, maths, & science	498.2	21	
2.1.5	Pupil-teacher ratio, secondary ⊙	9.8	31	
2.2	**Tertiary education**	**49.4**	**18**	
2.2.1	Tertiary enrolment, % gross	59.6	48	○
2.2.2	Graduates in science & engineering, %	24.9	38	○
2.2.3	Tertiary inbound mobility, %	17.8	9	◆
2.3	**Research & development (R&D)**	**76.6**	**4**	◆
2.3.1	Researchers, FTE/mn pop. ⊙	5,450.5	12	
2.3.2	Gross expenditure on R&D, % GDP ⊙	3.3	4	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	91.3	5	
2.3.4	QS university ranking, average score top 3*	83.0	4	
	INFRASTRUCTURE	**62.0**	**3**	● ◆
3.1	**Information & communication technologies (ICTs)**	**85.8**	**21**	
3.1.1	ICT access*	85.2	14	
3.1.2	ICT use*	88.8	3	● ◆
3.1.3	Government's online service*	84.7	35	
3.1.4	E-participation*	84.3	41	
3.2	**General infrastructure**	**39.6**	**25**	
3.2.1	Electricity output, kWh/mn pop.	7,783.9	25	
3.2.2	Logistics performance*	85.9	13	
3.2.3	Gross capital formation, % GDP	23.3	67	○
3.3	**Ecological sustainability**	**60.7**	**2**	● ◆
3.3.1	GDP/unit of energy use	20.0	5	◆
3.3.2	Environmental performance*	81.5	3	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	4.2	23	
	MARKET SOPHISTICATION	**72.3**	**6**	
4.1	**Credit**	**72.1**	**6**	
4.1.1	Ease of getting credit*	65.0	61	○
4.1.2	Domestic credit to private sector, % GDP ⊙	174.9	3	● ◆
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**71.9**	**7**	◆
4.2.1	Ease of protecting minority investors*	50.0	92	○ ◇
4.2.2	Market capitalization, % GDP	220.5	1	● ◆
4.2.3	Venture capital deals/bn PPP$ GDP	0.4	7	
4.3	**Trade, competition, and market scale**	**72.8**	**27**	
4.3.1	Applied tariff rate, weighted avg., %	1.7	50	○
4.3.2	Intensity of local competition†	75.5	23	
4.3.3	Domestic market scale, bn PPP$	565.6	37	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**64.1**	**2**	● ◆
5.1	**Knowledge workers**	**74.0**	**4**	◆
5.1.1	Knowledge-intensive employment, %	53.8	3	● ◆
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP ⊙	2.3	5	
5.1.4	GERD financed by business, %	68.6	6	◆
5.1.5	Females employed w/advanced degrees, %	19.5	30	
5.2	**Innovation linkages**	**66.2**	**5**	
5.2.1	University/industry research collaboration†	77.5	2	● ◆
5.2.2	State of cluster development†	71.9	5	◆
5.2.3	GERD financed by abroad, % GDP	0.2	22	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.2	13	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	8.0	1	● ◆
5.3	**Knowledge absorption**	**52.0**	**12**	
5.3.1	Intellectual property payments, % total trade	3.0	5	
5.3.2	High-tech imports, % total trade	6.4	87	○
5.3.3	ICT services imports, % total trade	3.8	3	● ◆
5.3.4	FDI net inflows, % GDP	3.7	40	
5.3.5	Research talent, % in business enterprise ⊙	49.7	24	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**65.5**	**1**	● ◆
6.1	**Knowledge creation**	**87.9**	**1**	● ◆
6.1.1	Patents by origin/bn PPP$ GDP	16.7	1	● ◆
6.1.2	PCT patents by origin/bn PPP$ GDP	8.2	3	● ◆
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	35.8	3	● ◆
6.1.5	Citable documents H-index	66.3	9	
6.2	**Knowledge impact**	**50.8**	**5**	◆
6.2.1	Growth rate of PPP$ GDP/worker, %	0.8	67	○
6.2.2	New businesses/th pop. 15-64	4.5	33	
6.2.3	Computer software spending, % GDP	0.0	3	● ◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	15.1	19	◆
6.2.5	High- and medium-high-tech manufacturing, %	60.0	3	● ◆
6.3	**Knowledge diffusion**	**57.9**	**6**	
6.3.1	Intellectual property receipts, % total trade	5.6	1	● ◆
6.3.2	High-tech net exports, % total trade	7.2	22	
6.3.3	ICT services exports, % total trade	3.0	33	
6.3.4	FDI net outflows, % GDP	10.9	6	
	CREATIVE OUTPUTS	**60.0**	**2**	● ◆
7.1	**Intangible assets**	**60.3**	**3**	● ◆
7.1.1	Trademarks by origin/bn PPP$ GDP	75.2	27	
7.1.2	Global brand value, top 5,000, % GDP	234.5	2	● ◆
7.1.3	Industrial designs by origin/bn PPP$ GDP	6.2	22	
7.1.4	ICTs & organizational model creation†	77.4	9	
7.2	**Creative goods and services**	**51.1**	**3**	● ◆
7.2.1	Cultural & creative services exports, % total trade	0.8	37	
7.2.2	National feature films/mn pop. 15-69	19.4	6	◆
7.2.3	Entertainment & Media market/th pop. 15-69	100.0	1	● ◆
7.2.4	Printing and other media, % manufacturing ⊙	1.2	36	○
7.2.5	Creative goods exports, % total trade	3.9	15	
7.3	**Online creativity**	**68.3**	**5**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	58.4	13	
7.3.2	Country-code TLDs/th pop. 15-69	100.0	1	● ◆
7.3.3	Wikipedia edits/mn pop. 15-69	84.0	16	
7.3.4	Mobile app creation/bn PPP$ GDP	31.8	17	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

TAJIKISTAN

GII 2020 rank

109

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
99	108	Low	CSA	9.3	33.4	3,133.4	100

		Score/Value	Rank	
	INSTITUTIONS	**47.0**	**118**	
1.1	**Political environment**	**36.7**	**126**	
1.1.1	Political and operational stability*	58.9	104	
1.1.2	Government effectiveness*	25.6	128	
1.2	**Regulatory environment**	**43.3**	**118**	◇
1.2.1	Regulatory quality*	14.1	126	◇
1.2.2	Rule of law*	13.2	130	○ ◇
1.2.3	Cost of redundancy dismissal, salary weeks	21.7	92	
1.3	**Business environment**	**60.8**	**105**	
1.3.1	Ease of starting a business*	93.2	34	● ◆
1.3.2	Ease of resolving insolvency*	28.4	122	◇
	HUMAN CAPITAL & RESEARCH	**22.8**	**87**	◆
2.1	**Education**	**44.7**	**[70]**	
2.1.1	Expenditure on education, % GDP ⊙	5.2	35	●
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years ⊙	11.4	98	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⊙	15.4	78	◆
2.2	**Tertiary education**	**23.3**	**86**	◆
2.2.1	Tertiary enrolment, % gross	31.3	81	◆
2.2.2	Graduates in science & engineering, %	22.0	57	●
2.2.3	Tertiary inbound mobility, %	0.8	91	
2.3	**Research & development (R&D)**	**0.6**	**112**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	0.1	107	◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**21.8**	**123**	
3.1	**Information & communication technologies (ICTs)**	**31.2**	**119**	
3.1.1	ICT access* ⊙	37.0	111	◆
3.1.2	ICT use* ⊙	15.0	120	
3.1.3	Government's online service*	34.0	116	
3.1.4	E-participation*	38.8	114	
3.2	**General infrastructure**	**13.4**	**122**	
3.2.1	Electricity output, kWh/mn pop.	2,030.7	77	◆
3.2.2	Logistics performance*	12.6	118	
3.2.3	Gross capital formation, % GDP	19.6	99	
3.3	**Ecological sustainability**	**20.8**	**95**	
3.3.1	GDP/unit of energy use	7.8	82	
3.3.2	Environmental performance*	38.2	95	◆
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.4	85	◆
	MARKET SOPHISTICATION	**48.4**	**60**	● ◆
4.1	**Credit**	**54.0**	**22**	● ◆
4.1.1	Ease of getting credit*	90.0	10	● ◆
4.1.2	Domestic credit to private sector, % GDP	12.3	123	
4.1.3	Microfinance gross loans, % GDP	5.7	2	● ◆
4.2	**Investment**	**40.0**	**[60]**	
4.2.1	Ease of protecting minority investors*	40.0	110	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**51.3**	**109**	
4.3.1	Applied tariff rate, weighted avg., % ⊙	5.0	91	◆
4.3.2	Intensity of local competition†	61.2	104	
4.3.3	Domestic market scale, bn PPP$	33.4	116	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**15.1**	**[128]**	
5.1	**Knowledge workers**	**13.1**	**[117]**	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, %	24.3	63	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, % ⊙	1.6	93	
5.1.5	Females employed w/advanced degrees, % ⊙	4.0	93	◆
5.2	**Innovation linkages**	**15.0**	**112**	
5.2.1	University/industry research collaboration†	49.0	43	●
5.2.2	State of cluster development†	36.8	107	
5.2.3	GERD financed by abroad, % GDP	0.0	100	◇
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	78	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**17.4**	**[116]**	
5.3.1	Intellectual property payments, % total trade	0.0	118	○ ◇
5.3.2	High-tech imports, % total trade	n/a	n/a	
5.3.3	ICT services imports, % total trade	0.3	119	
5.3.4	FDI net inflows, % GDP	3.0	53	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**16.4**	**77**	◆
6.1	**Knowledge creation**	**17.7**	**55**	● ◆
6.1.1	Patents by origin/bn PPP$ GDP ⊙	0.1	118	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP ⊙	3.7	5	● ◆
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.4	112	◇
6.1.5	Citable documents H-index	1.2	130	○ ◇
6.2	**Knowledge impact**	**15.8**	**95**	
6.2.1	Growth rate of PPP$ GDP/worker, %	4.6	13	● ◆
6.2.2	New businesses/th pop. 15–64	0.2	114	
6.2.3	Computer software spending, % GDP	0.0	93	◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.1	131	○ ◇
6.2.5	High- and medium-high-tech manufacturing, %	2.8	104	◇
6.3	**Knowledge diffusion**	**15.7**	**[90]**	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade	n/a	n/a	
6.3.3	ICT services exports, % total trade	0.3	112	
6.3.4	FDI net outflows, % GDP	0.6	71	
	CREATIVE OUTPUTS	**10.4**	**113**	
7.1	**Intangible assets**	**13.2**	**120**	
7.1.1	Trademarks by origin/bn PPP$ GDP ⊙	6.1	114	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP ⊙	0.0	120	○ ◇
7.1.4	ICTs & organizational model creation†	44.4	99	
7.2	**Creative goods and services**	**8.6**	**[85]**	
7.2.1	Cultural & creative services exports, % total trade	0.0	95	
7.2.2	National feature films/mn pop. 15–69 ⊙	1.8	73	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	1.1	52	●
7.2.5	Creative goods exports, % total trade	n/a	n/a	
7.3	**Online creativity**	**6.9**	**99**	◆
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.0	128	
7.3.2	Country-code TLDs/th pop. 15–69	0.4	103	
7.3.3	Wikipedia edits/mn pop. 15–69	24.4	100	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

THAILAND

GII 2020 rank

44

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
44	**48**	**Upper middle**	**SEAO**	**69.6**	**1,383.0**	**17,778.8**	**43**

		Score/Value	Rank	
	INSTITUTIONS	**64.1**	**65**	
1.1	**Political environment**	**62.5**	**51**	
1.1.1	Political and operational stability*	71.4	59	
1.1.2	Government effectiveness*	58.0	49	
1.2	**Regulatory environment**	**45.3**	**113**	○ ◇
1.2.1	Regulatory quality*	44.7	64	
1.2.2	Rule of law*	47.3	63	
1.2.3	Cost of redundancy dismissal, salary weeks	36.0	123	○ ◇
1.3	**Business environment**	**84.6**	**20**	◆
1.3.1	Ease of starting a business*	92.4	43	
1.3.2	Ease of resolving insolvency*	76.8	22	◆
	HUMAN CAPITAL & RESEARCH	**29.9**	**67**	
2.1	**Education**	**37.6**	**87**	
2.1.1	Expenditure on education, % GDP ⊙	4.1	68	
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	18.0	61	
2.1.3	School life expectancy, years ⊙	15.4	41	
2.1.4	PISA scales in reading, maths, & science	412.4	61	
2.1.5	Pupil-teacher ratio, secondary	25.9	109	○ ◇
2.2	**Tertiary education**	**35.4**	**58**	
2.2.1	Tertiary enrolment, % gross ⊙	49.3	61	
2.2.2	Graduates in science & engineering, % ⊙	27.9	24	
2.2.3	Tertiary inbound mobility, % ⊙	1.3	85	
2.3	**Research & development (R&D)**	**16.7**	**46**	
2.3.1	Researchers, FTE/mn pop. ⊙	1,350.3	47	
2.3.2	Gross expenditure on R&D, % GDP ⊙	1.0	36	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	30.6	38	
	INFRASTRUCTURE	**40.1**	**67**	
3.1	**Information & communication technologies (ICTs)**	**61.3**	**79**	
3.1.1	ICT access*	56.4	80	
3.1.2	ICT use*	59.6	59	
3.1.3	Government's online service*	63.9	86	
3.1.4	E-participation*	65.2	81	
3.2	**General infrastructure**	**30.5**	**50**	
3.2.1	Electricity output, kWh/mn pop.	2,702.0	67	
3.2.2	Logistics performance*	62.9	31	◆
3.2.3	Gross capital formation, % GDP	24.9	52	
3.3	**Ecological sustainability**	**28.4**	**67**	
3.3.1	GDP/unit of energy use	8.0	78	
3.3.2	Environmental performance*	45.4	70	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.3	36	
	MARKET SOPHISTICATION	**57.8**	**22**	◆
4.1	**Credit**	**54.0**	**21**	◆
4.1.1	Ease of getting credit*	70.0	44	
4.1.2	Domestic credit to private sector, % GDP	144.6	10	● ◆
4.1.3	Microfinance gross loans, % GDP ⊙	0.0	80	○
4.2	**Investment**	**45.9**	**31**	
4.2.1	Ease of protecting minority investors*	86.0	3	● ◆
4.2.2	Market capitalization, % GDP	108.2	10	● ◆
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	57	
4.3	**Trade, competition, and market scale**	**73.4**	**25**	◆
4.3.1	Applied tariff rate, weighted avg., % ⊙	3.5	72	
4.3.2	Intensity of local competition†	74.2	34	
4.3.3	Domestic market scale, bn PPP$	1,383.0	20	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**35.4**	**36**	◆
5.1	**Knowledge workers**	**37.3**	**51**	
5.1.1	Knowledge-intensive employment, %	13.8	95	○ ◇
5.1.2	Firms offering formal training, % ⊙	18.0	79	○ ◇
5.1.3	GERD performed by business, % GDP ⊙	0.8	27	◆
5.1.4	GERD financed by business, %	80.8	1	● ◆
5.1.5	Females employed w/advanced degrees, %	9.8	68	
5.2	**Innovation linkages**	**20.0**	**68**	
5.2.1	University/industry research collaboration†	54.1	31	◆
5.2.2	State of cluster development†	51.4	45	
5.2.3	GERD financed by abroad, % GDP	0.0	83	○
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	58	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	66	
5.3	**Knowledge absorption**	**49.0**	**15**	● ◆
5.3.1	Intellectual property payments, % total trade	1.6	16	● ◆
5.3.2	High-tech imports, % total trade	15.6	12	● ◆
5.3.3	ICT services imports, % total trade	0.2	123	○ ◇
5.3.4	FDI net inflows, % GDP	1.7	90	
5.3.5	Research talent, % in business enterprise ⊙	60.8	13	◆
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**28.6**	**44**	
6.1	**Knowledge creation**	**18.1**	**54**	
6.1.1	Patents by origin/bn PPP$ GDP	0.7	76	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	60	
6.1.3	Utility models by origin/bn PPP$ GDP	2.1	10	● ◆
6.1.4	Scientific & technical articles/bn PPP$ GDP	4.8	90	
6.1.5	Citable documents H-index	21.2	38	
6.2	**Knowledge impact**	**33.5**	**32**	
6.2.1	Growth rate of PPP$ GDP/worker, %	3.6	21	
6.2.2	New businesses/th pop. 15-64	1.1	80	
6.2.3	Computer software spending, % GDP	0.0	61	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	6.4	43	
6.2.5	High- and medium-high-tech manufacturing, % ⊙	43.8	15	◆
6.3	**Knowledge diffusion**	**34.0**	**36**	◆
6.3.1	Intellectual property receipts, % total trade	0.0	71	
6.3.2	High-tech net exports, % total trade	14.4	9	● ◆
6.3.3	ICT services exports, % total trade	0.2	117	○
6.3.4	FDI net outflows, % GDP	3.8	15	● ◆
	CREATIVE OUTPUTS	**27.3**	**52**	
7.1	**Intangible assets**	**29.0**	**57**	
7.1.1	Trademarks by origin/bn PPP$ GDP	24.9	85	
7.1.2	Global brand value, top 5,000, % GDP	63.9	29	
7.1.3	Industrial designs by origin/bn PPP$ GDP	3.1	37	
7.1.4	ICTs & organizational model creation†	60.3	43	◆
7.2	**Creative goods and services**	**37.9**	**14**	● ◆
7.2.1	Cultural & creative services exports, % total trade	0.0	103	○
7.2.2	National feature films/mn pop. 15-69	1.5	75	
7.2.3	Entertainment & Media market/th pop. 15-69	9.3	38	
7.2.4	Printing and other media, % manufacturing ⊙	0.8	75	
7.2.5	Creative goods exports, % total trade	7.8	1	● ◆
7.3	**Online creativity**	**13.2**	**73**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	5.4	52	
7.3.2	Country-code TLDs/th pop. 15-69	0.4	100	
7.3.3	Wikipedia edits/mn pop. 15-69	46.3	68	
7.3.4	Mobile app creation/bn PPP$ GDP	3.8	58	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

TOGO

GII 2020 rank

125

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
127	121	Low	SSF	8.1	15.0	1,594.0	126

		Score/Value	Rank	
	INSTITUTIONS	**56.3**	**90**	
1.1	**Political environment**	**39.1**	**122**	
1.1.1	Political and operational stability*	64.3	83	
1.1.2	Government effectiveness*	26.5	126	
1.2	**Regulatory environment**	**58.9**	**81**	
1.2.1	Regulatory quality*	24.6	110	
1.2.2	Rule of law*	31.3	101	
1.2.3	Cost of redundancy dismissal, salary weeks	13.1	47	●
1.3	**Business environment**	**71.1**	**67**	◆
1.3.1	Ease of starting a business*	95.1	14	● ◆
1.3.2	Ease of resolving insolvency*	47.0	80	
	HUMAN CAPITAL & RESEARCH	**16.0**	**109**	
2.1	**Education**	**36.4**	**90**	
2.1.1	Expenditure on education, % GDP	5.4	25	● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	15.3	76	
2.1.3	School life expectancy, years	12.7	85	◆
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⊙	26.2	110	
2.2	**Tertiary education**	**10.1**	**[114]**	
2.2.1	Tertiary enrolment, % gross	14.5	100	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**1.4**	**104**	
2.3.1	Researchers, FTE/mn pop. ⊙	38.8	97	
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.3	84	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**24.3**	**116**	
3.1	**Information & communication technologies (ICTs)**	**40.3**	**108**	
3.1.1	ICT access*	36.3	114	◆
3.1.2	ICT use*	15.0	119	
3.1.3	Government's online service*	55.6	99	
3.1.4	E-participation*	54.5	99	
3.2	**General infrastructure**	**19.2**	**102**	
3.2.1	Electricity output, kWh/mn pop.	29.7	120	○
3.2.2	Logistics performance*	17.7	110	
3.2.3	Gross capital formation, % GDP	28.3	32	●
3.3	**Ecological sustainability**	**13.2**	**130**	○
3.3.1	GDP/unit of energy use	3.2	118	○
3.3.2	Environmental performance*	29.5	121	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.9	65	◆
	MARKET SOPHISTICATION	**34.3**	**121**	
4.1	**Credit**	**39.8**	**71**	
4.1.1	Ease of getting credit*	70.0	44	
4.1.2	Domestic credit to private sector, % GDP	36.9	83	
4.1.3	Microfinance gross loans, % GDP	2.0	13	●
4.2	**Investment**	**42.0**	**[47]**	
4.2.1	Ease of protecting minority investors*	42.0	102	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**21.3**	**131**	○ ◇
4.3.1	Applied tariff rate, weighted avg., %	12.9	128	○ ◇
4.3.2	Intensity of local competition†	n/a	n/a	
4.3.3	Domestic market scale, bn PPP$	15.0	129	○ ◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**14.2**	**[129]**	
5.1	**Knowledge workers**	**23.5**	**[89]**	
5.1.1	Knowledge-intensive employment, % ⊙	14.1	94	◆
5.1.2	Firms offering formal training, % ⊙	33.7	42	● ◆
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ⊙	0.9	110	
5.2	**Innovation linkages**	**3.1**	**[129]**	
5.2.1	University/industry research collaboration†	n/a	n/a	
5.2.2	State of cluster development†	n/a	n/a	
5.2.3	GERD financed by abroad, % GDP ⊙	0.0	71	◇
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	67	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**16.2**	**123**	
5.3.1	Intellectual property payments, % total trade ⊙	0.0	110	
5.3.2	High-tech imports, % total trade ⊙	4.4	116	
5.3.3	ICT services imports, % total trade ⊙	0.8	89	
5.3.4	FDI net inflows, % GDP	0.9	113	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**7.8**	**126**	
6.1	**Knowledge creation**	**4.6**	**110**	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	99	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.3	85	
6.1.5	Citable documents H-index	1.8	129	○ ◇
6.2	**Knowledge impact**	**4.0**	**[126]**	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15-64	0.6	92	
6.2.3	Computer software spending, % GDP	0.0	95	◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.1	99	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**14.8**	**95**	
6.3.1	Intellectual property receipts, % total trade ⊙	0.0	104	○
6.3.2	High-tech net exports, % total trade ⊙	0.0	125	
6.3.3	ICT services exports, % total trade ⊙	2.0	54	●
6.3.4	FDI net outflows, % GDP	2.3	30	● ◆
	CREATIVE OUTPUTS	**8.3**	**[121]**	
7.1	**Intangible assets**	**11.7**	**125**	
7.1.1	Trademarks by origin/bn PPP$ GDP	43.0	60	◆
7.1.2	Global brand value, top 5,000, % GDP	28.3	45	● ◆
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.2	99	
7.1.4	ICTs & organizational model creation†	n/a	n/a	
7.2	**Creative goods and services**	**9.6**	**[79]**	
7.2.1	Cultural & creative services exports, % total trade	1.3	18	● ◆
7.2.2	National feature films/mn pop. 15-69	0.7	95	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade ⊙	0.0	114	
7.3	**Online creativity**	**0.3**	**[125]**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	0.6	102	◆
7.3.2	Country-code TLDs/th pop. 15-69	0.1	120	
7.3.3	Wikipedia edits/mn pop. 15-69	n/a	n/a	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

TRINIDAD AND TOBAGO

GII 2020 rank

98

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
111	87	High	LCN	1.4	45.2	28,561.4	91

		Score/Value	Rank	
	INSTITUTIONS	**62.5**	**68**	◇
1.1	**Political environment**	**60.1**	**58**	● ◇
1.1.1	Political and operational stability*	71.4	59	◇
1.1.2	Government effectiveness*	54.4	58	● ◇
1.2	**Regulatory environment**	**58.8**	**82**	◇
1.2.1	Regulatory quality*	41.2	69	◇
1.2.2	Rule of law*	43.5	68	◇
1.2.3	Cost of redundancy dismissal, salary weeks	20.5	86	
1.3	**Business environment**	**68.5**	**74**	◇
1.3.1	Ease of starting a business*	88.6	64	●
1.3.2	Ease of resolving insolvency*	48.4	75	◇
	HUMAN CAPITAL & RESEARCH	**30.0**	**[65]**	
2.1	**Education**	**58.1**	**[20]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science ⊙	423.0	54	
2.1.5	Pupil-teacher ratio, secondary ⊙	13.5	64	◇
2.2	**Tertiary education**	**n/a**	**[n/a]**	
2.2.1	Tertiary enrolment, % gross	n/a	n/a	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**1.9**	**98**	◇
2.3.1	Researchers, FTE/mn pop. ⊙	517.3	66	◇
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.1	109	○ ◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**34.1**	**91**	◇
3.1	**Information & communication technologies (ICTs)**	**62.6**	**77**	◇
3.1.1	ICT access*	75.7	41	●
3.1.2	ICT use*	53.0	71	◇
3.1.3	Government's online service*	63.9	86	◇
3.1.4	E-participation*	57.9	94	◇
3.2	**General infrastructure**	**22.6**	**83**	◇
3.2.1	Electricity output, kWh/mn pop.	8,053.5	22	●
3.2.2	Logistics performance*	16.2	113	○ ◇
3.2.3	Gross capital formation, % GDP	n/a	n/a	
3.3	**Ecological sustainability**	**17.1**	**114**	◇
3.3.1	GDP/unit of energy use	2.3	122	○ ◇
3.3.2	Environmental performance*	47.5	63	● ◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.5	81	◇
	MARKET SOPHISTICATION	**38.7**	**109**	◇
4.1	**Credit**	**32.4**	**101**	◇
4.1.1	Ease of getting credit*	65.0	61	
4.1.2	Domestic credit to private sector, % GDP	39.7	81	◇
4.1.3	Microfinance gross loans, % GDP ⊙	0.0	74	
4.2	**Investment**	**33.7**	**81**	
4.2.1	Ease of protecting minority investors*	64.0	56	●
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	54	
4.3	**Trade, competition, and market scale**	**50.1**	**116**	◇
4.3.1	Applied tariff rate, weighted avg., % ⊙	8.6	108	◇
4.3.2	Intensity of local competition†	66.9	74	
4.3.3	Domestic market scale, bn PPP$	45.2	106	◇

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**18.0**	**109**	◇
5.1	**Knowledge workers**	**23.8**	**87**	◇
5.1.1	Knowledge-intensive employment, % ⊙	29.8	47	●
5.1.2	Firms offering formal training, % ⊙	28.0	54	
5.1.3	GERD performed by business, % GDP ⊙	0.0	85	◇
5.1.4	GERD financed by business, %	8.2	78	◇
5.1.5	Females employed w/advanced degrees, % ⊙	12.8	55	●
5.2	**Innovation linkages**	**14.4**	**114**	◇
5.2.1	University/industry research collaboration†	32.3	103	◇
5.2.2	State of cluster development†	42.3	86	◇
5.2.3	GERD financed by abroad, % GDP	0.0	70	◇
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	107	◇
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	58	●
5.3	**Knowledge absorption**	**15.9**	**126**	○ ◇
5.3.1	Intellectual property payments, % total trade	0.5	62	
5.3.2	High-tech imports, % total trade ⊙	6.5	85	
5.3.3	ICT services imports, % total trade	0.4	112	◇
5.3.4	FDI net inflows, % GDP	-1.6	127	○
5.3.5	Research talent, % in business enterprise ⊙	1.1	78	◇
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**9.2**	**121**	○ ◇
6.1	**Knowledge creation**	**3.1**	**122**	○ ◇
6.1.1	Patents by origin/bn PPP$ GDP	0.1	116	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	72	◇
6.1.3	Utility models by origin/bn PPP$ GDP	0.0	66	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.9	107	◇
6.1.5	Citable documents H-index	5.0	105	◇
6.2	**Knowledge impact**	**17.2**	**[91]**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.1	89	
6.2.2	New businesses/th pop. 15-64	n/a	n/a	
6.2.3	Computer software spending, % GDP	n/a	n/a	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.6	91	◇
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**7.4**	**130**	○ ◇
6.3.1	Intellectual property receipts, % total trade	0.0	83	
6.3.2	High-tech net exports, % total trade ⊙	0.0	121	○ ◇
6.3.3	ICT services exports, % total trade	0.1	122	○ ◇
6.3.4	FDI net outflows, % GDP	0.0	113	
	CREATIVE OUTPUTS	**14.0**	**99**	◇
7.1	**Intangible assets**	**18.4**	**101**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP	14.0	104	◇
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	3.6	35	●
7.1.4	ICTs & organizational model creation†	49.8	83	◇
7.2	**Creative goods and services**	**1.8**	**[120]**	
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15-69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade ⊙	0.1	89	
7.3	**Online creativity**	**17.3**	**62**	● ◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	4.1	59	● ◇
7.3.2	Country-code TLDs/th pop. 15-69	1.5	74	◇
7.3.3	Wikipedia edits/mn pop. 15-69	49.0	62	◇
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

TUNISIA

GII 2020 rank

65

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
59	78	Lower middle	NAWA	11.7	149.2	11,053.7	70

		Score/Value	Rank	
	INSTITUTIONS	**61.1**	**75**	◆
1.1	**Political environment**	**52.7**	**84**	
1.1.1	Political and operational stability*	62.5	92	
1.1.2	Government effectiveness*	47.8	79	
1.2	**Regulatory environment**	**56.2**	**90**	
1.2.1	Regulatory quality*	30.9	101	
1.2.2	Rule of law*	47.7	60	◆
1.2.3	Cost of redundancy dismissal, salary weeks	21.6	91	
1.3	**Business environment**	**74.4**	**54**	◆
1.3.1	Ease of starting a business*	94.6	18	● ◆
1.3.2	Ease of resolving insolvency*	54.2	64	
	HUMAN CAPITAL & RESEARCH	**40.7**	**38**	● ◆
2.1	**Education**	**66.0**	**9**	● ◆
2.1.1	Expenditure on education, % GDP	6.6	8	● ◆
2.1.2	Government funding/pupil, secondary, % GDP/cap	52.4	1	● ◆
2.1.3	School life expectancy, years	15.1	49	◆
2.1.4	PISA scales in reading, maths, & science	371.4	74	○
2.1.5	Pupil-teacher ratio, secondary	13.6	67	
2.2	**Tertiary education**	**47.8**	**21**	● ◆
2.2.1	Tertiary enrolment, % gross	31.7	79	
2.2.2	Graduates in science & engineering, %	43.3	2	● ◆
2.2.3	Tertiary inbound mobility, %	2.2	75	
2.3	**Research & development (R&D)**	**8.3**	**64**	
2.3.1	Researchers, FTE/mn pop	1,771.6	43	◆
2.3.2	Gross expenditure on R&D, % GDP	0.6	56	◆
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**38.2**	**74**	◆
3.1	**Information & communication technologies (ICTs)**	**67.5**	**65**	◆
3.1.1	ICT access*	58.0	78	◆
3.1.2	ICT use*	51.6	76	◆
3.1.3	Government's online service*	80.6	44	◆
3.1.4	E-participation*	79.8	53	◆
3.2	**General infrastructure**	**16.5**	**117**	○
3.2.1	Electricity output, kWh/mn pop	1,785.7	82	
3.2.2	Logistics performance*	23.4	100	
3.2.3	Gross capital formation, % GDP	20.3	96	
3.3	**Ecological sustainability**	**30.5**	**61**	◆
3.3.1	GDP/unit of energy use	10.9	45	
3.3.2	Environmental performance*	46.7	65	◆
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.6	52	◆
	MARKET SOPHISTICATION	**37.0**	**112**	○
4.1	**Credit**	**33.2**	**98**	
4.1.1	Ease of getting credit*	50.0	94	
4.1.2	Domestic credit to private sector, % GDP	68.0	47	
4.1.3	Microfinance gross loans, % GDP	0.5	34	
4.2	**Investment**	**24.5**	**117**	○
4.2.1	Ease of protecting minority investors*	62.0	60	
4.2.2	Market capitalization, % GDP	21.2	55	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	61	
4.3	**Trade, competition, and market scale**	**53.3**	**102**	
4.3.1	Applied tariff rate, weighted avg., %	9.4	110	○
4.3.2	Intensity of local competition†	65.0	82	
4.3.3	Domestic market scale, bn PPP$	149.2	74	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**18.0**	**110**	○
5.1	**Knowledge workers**	**22.3**	**93**	
5.1.1	Knowledge-intensive employment, %	20.9	75	
5.1.2	Firms offering formal training, %	28.9	52	
5.1.3	GERD performed by business, % GDP	0.1	58	
5.1.4	GERD financed by business, %	18.9	66	
5.1.5	Females employed w/advanced degrees, %	7.6	80	
5.2	**Innovation linkages**	**13.7**	**118**	○
5.2.1	University/industry research collaboration†	35.7	95	
5.2.2	State of cluster development†	38.1	104	○
5.2.3	GERD financed by abroad, % GDP	0.0	64	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	117	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	92	
5.3	**Knowledge absorption**	**17.9**	**114**	○
5.3.1	Intellectual property payments, % total trade	0.1	103	○ ◇
5.3.2	High-tech imports, % total trade	8.9	48	
5.3.3	ICT services imports, % total trade	0.4	107	
5.3.4	FDI net inflows, % GDP	2.0	83	
5.3.5	Research talent, % in business enterprise	5.2	72	○
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**25.8**	**52**	◆
6.1	**Knowledge creation**	**25.8**	**38**	● ◆
6.1.1	Patents by origin/bn PPP$ GDP	1.2	60	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	70	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	26.5	13	● ◆
6.1.5	Citable documents H-index	11.0	69	
6.2	**Knowledge impact**	**23.3**	**67**	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.4	56	
6.2.2	New businesses/th pop. 15-64	1.7	60	
6.2.3	Computer software spending, % GDP	0.0	34	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	6.5	41	● ◆
6.2.5	High- and medium-high-tech manufacturing, %	14.1	68	
6.3	**Knowledge diffusion**	**28.3**	**47**	
6.3.1	Intellectual property receipts, % total trade	0.1	55	
6.3.2	High-tech net exports, % total trade	4.3	37	●
6.3.3	ICT services exports, % total trade	1.5	68	
6.3.4	FDI net outflows, % GDP	2.3	31	● ◆
	CREATIVE OUTPUTS	**21.1**	**[63]**	
7.1	**Intangible assets**	**30.4**	**[50]**	
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.1	63	
7.1.4	ICTs & organizational model creation†	42.7	105	○
7.2	**Creative goods and services**	**14.4**	**[67]**	
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15-69	1.4	78	
7.2.3	Entertainment & Media market/th pop. 15-69	1.2	57	○
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	2.0	29	●
7.3	**Online creativity**	**9.1**	**89**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	2.8	68	◆
7.3.2	Country-code TLDs/th pop. 15-69	1.6	72	
7.3.3	Wikipedia edits/mn pop. 15-69	35.3	89	
7.3.4	Mobile app creation/bn PPP$ GDP	0.1	82	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

TURKEY

GII 2020 rank

51

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
53	52	Upper middle	NAWA	83.4	2,346.6	24,675.5	49

		Score/Value	Rank	
	INSTITUTIONS	**55.4**	**94**	
1.1	**Political environment**	**54.4**	**77**	
1.1.1	Political and operational stability*	62.5	92	
1.1.2	Government effectiveness*	50.3	71	
1.2	**Regulatory environment**	**48.2**	**108**	○
1.2.1	Regulatory quality*	40.5	74	
1.2.2	Rule of law*	38.3	82	
1.2.3	Cost of redundancy dismissal, salary weeks	29.8	117	○ ◇
1.3	**Business environment**	**63.6**	**91**	
1.3.1	Ease of starting a business*	88.8	62	
1.3.2	Ease of resolving insolvency*	38.5	104	○ ◇
	HUMAN CAPITAL & RESEARCH	**38.4**	**42**	◆
2.1	**Education**	**67.4**	**[7]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	18.0	12	● ◆
2.1.4	PISA scales in reading, maths, & science	462.5	41	
2.1.5	Pupil-teacher ratio, secondary ◷	17.3	84	
2.2	**Tertiary education**	**21.5**	**91**	
2.2.1	Tertiary enrolment, % gross	n/a	n/a	
2.2.2	Graduates in science & engineering, % ◷	20.2	73	
2.2.3	Tertiary inbound mobility, %	1.5	80	
2.3	**Research & development (R&D)**	**26.4**	**40**	◆
2.3.1	Researchers, FTE/mn pop. ◷	1,379.4	46	
2.3.2	Gross expenditure on R&D, % GDP ◷	1.0	39	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	45.9	33	◆
2.3.4	QS university ranking, average score top 3*	23.9	45	
	INFRASTRUCTURE	**45.0**	**54**	
3.1	**Information & communication technologies (ICTs)**	**74.5**	**49**	
3.1.1	ICT access*	65.8	66	
3.1.2	ICT use*	57.5	61	
3.1.3	Government's online service*	88.9	27	◆
3.1.4	E-participation*	86.0	37	
3.2	**General infrastructure**	**28.8**	**57**	
3.2.1	Electricity output, kWh/mn pop.	3,729.6	54	
3.2.2	Logistics performance*	50.5	46	◆
3.2.3	Gross capital formation, % GDP	25.6	47	
3.3	**Ecological sustainability**	**31.8**	**55**	
3.3.1	GDP/unit of energy use	13.9	16	●
3.3.2	Environmental performance*	42.6	84	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.1	57	
	MARKET SOPHISTICATION	**54.7**	**28**	
4.1	**Credit**	**41.8**	**66**	
4.1.1	Ease of getting credit*	75.0	34	
4.1.2	Domestic credit to private sector, % GDP	68.5	46	
4.1.3	Microfinance gross loans, % GDP ◷	0.0	76	○
4.2	**Investment**	**42.9**	**44**	
4.2.1	Ease of protecting minority investors*	76.0	21	●
4.2.2	Market capitalization, % GDP	22.0	54	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**79.3**	**7**	● ◆
4.3.1	Applied tariff rate, weighted avg., %	2.5	62	
4.3.2	Intensity of local competition†	80.5	6	● ◆
4.3.3	Domestic market scale, bn PPP$	2,346.6	13	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**28.2**	**57**	
5.1	**Knowledge workers**	**34.2**	**59**	
5.1.1	Knowledge-intensive employment, %	21.6	73	
5.1.2	Firms offering formal training, %	30.7	48	
5.1.3	GERD performed by business, % GDP ◷	0.5	36	
5.1.4	GERD financed by business, %	49.4	28	
5.1.5	Females employed w/advanced degrees, %	9.3	71	
5.2	**Innovation linkages**	**17.4**	**91**	
5.2.1	University/industry research collaboration†	40.6	70	
5.2.2	State of cluster development†	47.5	64	
5.2.3	GERD financed by abroad, % GDP	0.0	59	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	106	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	50	
5.3	**Knowledge absorption**	**33.1**	**48**	
5.3.1	Intellectual property payments, % total trade	0.3	76	
5.3.2	High-tech imports, % total trade	8.2	55	
5.3.3	ICT services imports, % total trade	0.2	124	○ ◇
5.3.4	FDI net inflows, % GDP	1.6	97	
5.3.5	Research talent, % in business enterprise ◷	55.7	19	◆
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**23.2**	**57**	
6.1	**Knowledge creation**	**24.9**	**40**	
6.1.1	Patents by origin/bn PPP$ GDP	3.4	30	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.9	28	◆
6.1.3	Utility models by origin/bn PPP$ GDP	1.2	20	
6.1.4	Scientific & technical articles/bn PPP$ GDP	9.5	54	
6.1.5	Citable documents H-index	27.9	35	◆
6.2	**Knowledge impact**	**30.1**	**42**	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.6	37	
6.2.2	New businesses/th pop. 15-64	1.6	65	
6.2.3	Computer software spending, % GDP	0.0	20	● ◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.5	67	
6.2.5	High- and medium-high-tech manufacturing, %	25.8	42	
6.3	**Knowledge diffusion**	**14.7**	**96**	
6.3.1	Intellectual property receipts, % total trade	0.0	90	○
6.3.2	High-tech net exports, % total trade	1.3	64	
6.3.3	ICT services exports, % total trade	0.1	124	○
6.3.4	FDI net outflows, % GDP	0.4	81	
	CREATIVE OUTPUTS	**27.7**	**50**	
7.1	**Intangible assets**	**38.8**	**31**	
7.1.1	Trademarks by origin/bn PPP$ GDP	91.8	17	●
7.1.2	Global brand value, top 5,000, % GDP	30.4	44	
7.1.3	Industrial designs by origin/bn PPP$ GDP	15.4	6	● ◆
7.1.4	ICTs & organizational model creation†	44.2	100	○
7.2	**Creative goods and services**	**17.2**	**60**	
7.2.1	Cultural & creative services exports, % total trade ◷	0.0	92	○
7.2.2	National feature films/mn pop. 15-69	2.6	62	
7.2.3	Entertainment & Media market/th pop. 15-69	4.5	48	
7.2.4	Printing and other media, % manufacturing	0.8	73	
7.2.5	Creative goods exports, % total trade	3.0	19	●
7.3	**Online creativity**	**15.8**	**69**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	11.5	36	◆
7.3.2	Country-code TLDs/th pop. 15-69	2.1	69	
7.3.3	Wikipedia edits/mn pop. 15-69	23.8	101	○ ◇
7.3.4	Mobile app creation/bn PPP$ GDP	29.9	19	● ◆

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

UGANDA

GII 2020 rank

114

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
123	103	Low	SSF	44.3	104.8	2,296.5	102

		Score/Value	Rank	
	INSTITUTIONS	**56.5**	**89**	
1.1	**Political environment**	**44.0**	**107**	
1.1.1	Political and operational stability*	58.9	104	
1.1.2	Government effectiveness*	36.6	107	
1.2	**Regulatory environment**	**67.9**	**55**	● ◆
1.2.1	Regulatory quality*	35.2	93	◆
1.2.2	Rule of law*	39.0	80	
1.2.3	Cost of redundancy dismissal, salary weeks	8.7	20	● ◆
1.3	**Business environment**	**57.5**	**111**	
1.3.1	Ease of starting a business*	71.4	122	◇
1.3.2	Ease of resolving insolvency*	43.6	89	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**8.5**	**130**	○ ◇
2.1	**Education**	**7.2**	**[131]**	
2.1.1	Expenditure on education, % GDP	2.5	108	◇
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	**Tertiary education**	**17.4**	**101**	◆
2.2.1	Tertiary enrolment, % gross ⊙	4.8	119	○
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, % ⊙	10.7	18	● ◆
2.3	**Research & development (R&D)**	**0.8**	**108**	
2.3.1	Researchers, FTE/mn pop. ⊙	27.8	104	○
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.2	94	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**29.7**	**102**	
3.1	**Information & communication technologies (ICTs)**	**41.2**	**106**	
3.1.1	ICT access*	26.6	124	○
3.1.2	ICT use*	19.1	116	
3.1.3	Government's online service*	56.9	93	
3.1.4	E-participation*	62.4	85	
3.2	**General infrastructure**	**28.7**	**60**	●
3.2.1	Electricity output, kWh/mn pop.	n/a	n/a	
3.2.2	Logistics performance*	23.7	98	
3.2.3	Gross capital formation, % GDP	29.4	27	●
3.3	**Ecological sustainability**	**19.1**	**108**	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	35.6	101	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	94	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**47.9**	**63**	◆
4.1	**Credit**	**31.1**	**104**	
4.1.1	Ease of getting credit*	60.0	74	
4.1.2	Domestic credit to private sector, % GDP	16.2	115	
4.1.3	Microfinance gross loans, % GDP	1.7	19	●
4.2	**Investment**	**56.0**	**[19]**	
4.2.1	Ease of protecting minority investors*	56.0	82	◆
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**56.5**	**91**	◆
4.3.1	Applied tariff rate, weighted avg., %	8.0	104	
4.3.2	Intensity of local competition†	72.4	44	● ◆
4.3.3	Domestic market scale, bn PPP$	104.8	79	◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**17.6**	**115**	
5.1	**Knowledge workers**	**12.5**	**120**	
5.1.1	Knowledge-intensive employment, % ⊙	10.3	105	
5.1.2	Firms offering formal training, % ⊙	34.7	41	● ◆
5.1.3	GERD performed by business, % GDP ⊙	0.0	86	
5.1.4	GERD financed by business, % ⊙	3.4	89	
5.1.5	Females employed w/advanced degrees, % ⊙	0.2	120	○ ◇
5.2	**Innovation linkages**	**24.1**	**52**	●
5.2.1	University/industry research collaboration†	42.9	60	●
5.2.2	State of cluster development†	42.0	89	
5.2.3	GERD financed by abroad, % GDP ⊙	0.1	42	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	73	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	n/a	n/a	
5.3	**Knowledge absorption**	**16.1**	**124**	○
5.3.1	Intellectual property payments, % total trade	0.3	83	
5.3.2	High-tech imports, % total trade	6.2	93	
5.3.3	ICT services imports, % total trade	0.4	110	
5.3.4	FDI net inflows, % GDP	3.5	44	●
5.3.5	Research talent, % in business enterprise ⊙	4.0	74	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**10.5**	**113**	
6.1	**Knowledge creation**	**7.1**	**87**	
6.1.1	Patents by origin/bn PPP$ GDP	0.1	123	○
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	92	◆
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.6	80	
6.1.5	Citable documents H-index	10.6	74	◆
6.2	**Knowledge impact**	**12.7**	**113**	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.3	57	●
6.2.2	New businesses/th pop. 15–64	0.9	86	
6.2.3	Computer software spending, % GDP	0.0	121	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.0	107	
6.2.5	High- and medium-high-tech manufacturing, %	n/a	n/a	
6.3	**Knowledge diffusion**	**11.6**	**113**	
6.3.1	Intellectual property receipts, % total trade	0.1	64	
6.3.2	High-tech net exports, % total trade	0.3	91	
6.3.3	ICT services exports, % total trade	0.8	88	
6.3.4	FDI net outflows, % GDP	0.0	118	

		Score/Value	Rank	
	CREATIVE OUTPUTS	**7.6**	**125**	○
7.1	**Intangible assets**	**14.1**	**114**	
7.1.1	Trademarks by origin/bn PPP$ GDP ⊙	15.2	101	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.3	93	
7.1.4	ICTs & organizational model creation†	42.7	104	
7.2	**Creative goods and services**	**1.3**	**[122]**	
7.2.1	Cultural & creative services exports, % total trade	0.1	86	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.1	102	
7.3	**Online creativity**	**1.1**	**123**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.2	116	
7.3.2	Country-code TLDs/th pop. 15–69	0.1	119	
7.3.3	Wikipedia edits/mn pop. 15–69	8.0	120	○ ◇
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

UKRAINE

GII 2020 rank

45

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
37	71	Lower middle	EUR	44.0	409.3	8,533.5	47

		Score/Value	Rank	
	INSTITUTIONS	**55.6**	**93**	
1.1	**Political environment**	**44.5**	**105**	○
1.1.1	Political and operational stability*	51.8	123	○ ◇
1.1.2	Government effectiveness*	40.9	93	
1.2	**Regulatory environment**	**61.0**	**76**	
1.2.1	Regulatory quality*	36.0	88	
1.2.2	Rule of law*	28.0	109	○
1.2.3	Cost of redundancy dismissal, salary weeks	13.0	41	
1.3	**Business environment**	**61.2**	**104**	○
1.3.1	Ease of starting a business*	91.1	52	
1.3.2	Ease of resolving insolvency*	31.4	117	○
	HUMAN CAPITAL & RESEARCH	**40.5**	**39**	◆
2.1	**Education**	**56.9**	**23**	◆
2.1.1	Expenditure on education, % GDP ◷	5.4	26	
2.1.2	Government funding/pupil, secondary, % GDP/cap	30.3	12	● ◆
2.1.3	School life expectancy, years ◷	14.9	54	◆
2.1.4	PISA scales in reading, maths, & science	462.7	40	◆
2.1.5	Pupil-teacher ratio, secondary	7.3	3	● ◆
2.2	**Tertiary education**	**43.9**	**32**	◆
2.2.1	Tertiary enrolment, % gross ◷	82.7	14	● ◆
2.2.2	Graduates in science & engineering, %	25.3	35	
2.2.3	Tertiary inbound mobility, %	3.1	65	
2.3	**Research & development (R&D)**	**20.5**	**44**	◆
2.3.1	Researchers, FTE/mn pop.	988.1	52	◆
2.3.2	Gross expenditure on R&D, % GDP	0.5	69	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	39.8	38	◆
2.3.4	QS university ranking, average score top 3*	21.2	49	◆
	INFRASTRUCTURE	**33.1**	**94**	
3.1	**Information & communication technologies (ICTs)**	**58.8**	**82**	
3.1.1	ICT access*	65.9	65	◆
3.1.2	ICT use*	43.7	89	
3.1.3	Government's online service*	56.9	93	
3.1.4	E-participation*	68.5	74	
3.2	**General infrastructure**	**20.2**	**95**	
3.2.1	Electricity output, kWh/mn pop.	3,445.5	58	◆
3.2.2	Logistics performance*	35.7	65	
3.2.3	Gross capital formation, % GDP	19.3	102	○
3.3	**Ecological sustainability**	**20.2**	**99**	
3.3.1	GDP/unit of energy use	3.7	117	○ ◇
3.3.2	Environmental performance*	49.5	57	◆
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.7	68	
	MARKET SOPHISTICATION	**42.1**	**99**	
4.1	**Credit**	**35.3**	**86**	
4.1.1	Ease of getting credit*	75.0	34	
4.1.2	Domestic credit to private sector, % GDP	34.1	88	
4.1.3	Microfinance gross loans, % GDP ◷	0.0	78	○
4.2	**Investment**	**23.8**	**121**	○
4.2.1	Ease of protecting minority investors*	68.0	44	
4.2.2	Market capitalization, % GDP	4.0	71	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	64	○
4.3	**Trade, competition, and market scale**	**67.2**	**45**	
4.3.1	Applied tariff rate, weighted avg., %	1.6	18	● ◆
4.3.2	Intensity of local competition†	64.4	83	
4.3.3	Domestic market scale, bn PPP$	409.3	48	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**29.5**	**54**	◆
5.1	**Knowledge workers**	**39.0**	**47**	◆
5.1.1	Knowledge-intensive employment, %	37.7	32	◆
5.1.2	Firms offering formal training, %	24.3	63	
5.1.3	GERD performed by business, % GDP	0.3	48	◆
5.1.4	GERD financed by business, %	30.5	58	
5.1.5	Females employed w/advanced degrees, %	30.4	3	● ◆
5.2	**Innovation linkages**	**18.8**	**81**	
5.2.1	University/industry research collaboration†	45.5	50	
5.2.2	State of cluster development†	40.9	91	
5.2.3	GERD financed by abroad, % GDP	0.1	36	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	113	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	52	◆
5.3	**Knowledge absorption**	**30.6**	**59**	
5.3.1	Intellectual property payments, % total trade	0.8	48	
5.3.2	High-tech imports, % total trade	9.9	33	
5.3.3	ICT services imports, % total trade	1.0	74	
5.3.4	FDI net inflows, % GDP	2.7	63	
5.3.5	Research talent, % in business enterprise	27.3	47	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**35.1**	**25**	◆
6.1	**Knowledge creation**	**41.6**	**23**	◆
6.1.1	Patents by origin/bn PPP$ GDP	5.4	20	◆
6.1.2	PCT patents by origin/bn PPP$ GDP	0.5	36	◆
6.1.3	Utility models by origin/bn PPP$ GDP	23.0	1	● ◆
6.1.4	Scientific & technical articles/bn PPP$ GDP	9.5	55	
6.1.5	Citable documents H-index	16.8	50	
6.2	**Knowledge impact**	**28.7**	**45**	◆
6.2.1	Growth rate of PPP$ GDP/worker, %	2.4	39	
6.2.2	New businesses/th pop. 15–64 ◷	1.7	61	
6.2.3	Computer software spending, % GDP	0.0	19	◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.5	58	◆
6.2.5	High- and medium-high-tech manufacturing, %	16.8	61	
6.3	**Knowledge diffusion**	**35.0**	**32**	◆
6.3.1	Intellectual property receipts, % total trade	0.1	46	
6.3.2	High-tech net exports, % total trade	1.9	56	
6.3.3	ICT services exports, % total trade	5.4	9	● ◆
6.3.4	FDI net outflows, % GDP	0.2	96	
	CREATIVE OUTPUTS	**29.9**	**44**	◆
7.1	**Intangible assets**	**42.8**	**23**	◆
7.1.1	Trademarks by origin/bn PPP$ GDP	131.1	5	● ◆
7.1.2	Global brand value, top 5,000, % GDP	1.3	79	
7.1.3	Industrial designs by origin/bn PPP$ GDP	13.5	8	● ◆
7.1.4	ICTs & organizational model creation†	55.6	58	
7.2	**Creative goods and services**	**6.6**	**95**	
7.2.1	Cultural & creative services exports, % total trade	0.5	48	
7.2.2	National feature films/mn pop. 15–69	0.6	99	○
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	0.8	70	
7.2.5	Creative goods exports, % total trade	0.2	80	
7.3	**Online creativity**	**27.3**	**39**	◆
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	4.5	56	◆
7.3.2	Country-code TLDs/th pop. 15–69	5.1	54	◆
7.3.3	Wikipedia edits/mn pop. 15–69	67.7	43	◆
7.3.4	Mobile app creation/bn PPP$ GDP	33.8	15	● ◆

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

UNITED ARAB EMIRATES

GII 2020 rank

34

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
55	22	High	NAWA	9.8	746.4	60,618.6	36

		Score/Value	Rank	
	INSTITUTIONS	**78.8**	**28**	
1.1	**Political environment**	**80.9**	**21**	
1.1.1	Political and operational stability*	78.6	38	
1.1.2	Government effectiveness*	82.1	19	
1.2	**Regulatory environment**	**83.5**	**22**	
1.2.1	Regulatory quality*	66.4	34	
1.2.2	Rule of law*	67.7	33	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	● ◆
1.3	**Business environment**	**72.0**	**61**	
1.3.1	Ease of starting a business*	94.8	16	
1.3.2	Ease of resolving insolvency*	49.3	72	
	HUMAN CAPITAL & RESEARCH	**54.6**	**17**	
2.1	**Education**	**58.6**	**[17]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	14.3	64	◇
2.1.4	PISA scales in reading, maths, & science	433.5	47	○
2.1.5	Pupil-teacher ratio, secondary ⊙	9.5	27	
2.2	**Tertiary education**	**66.4**	**2**	● ◆
2.2.1	Tertiary enrolment, % gross	n/a	n/a	
2.2.2	Graduates in science & engineering, %	27.7	25	
2.2.3	Tertiary inbound mobility, % ⊙	48.6	1	● ◆
2.3	**Research & development (R&D)**	**38.7**	**28**	
2.3.1	Researchers, FTE/mn pop.	2,378.9	36	
2.3.2	Gross expenditure on R&D, % GDP	1.3	29	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	67.6	18	
2.3.4	QS university ranking, average score top 3*	32.8	36	
	INFRASTRUCTURE	**57.5**	**17**	
3.1	**Information & communication technologies (ICTs)**	**89.5**	**11**	●
3.1.1	ICT access*	85.5	13	●
3.1.2	ICT use*	83.6	12	●
3.1.3	Government's online service*	94.4	14	●
3.1.4	E-participation*	94.4	17	
3.2	**General infrastructure**	**50.1**	**5**	● ◆
3.2.1	Electricity output, kWh/mn pop.	14,314.2	8	●
3.2.2	Logistics performance*	88.5	11	● ◆
3.2.3	Gross capital formation, % GDP	28.7	30	
3.3	**Ecological sustainability**	**32.9**	**53**	
3.3.1	GDP/unit of energy use	9.2	66	
3.3.2	Environmental performance*	55.6	40	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.1	39	
	MARKET SOPHISTICATION	**54.2**	**30**	
4.1	**Credit**	**52.1**	**27**	
4.1.1	Ease of getting credit*	70.0	44	
4.1.2	Domestic credit to private sector, % GDP	78.7	36	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**42.0**	**45**	
4.2.1	Ease of protecting minority investors*	80.0	13	◆
4.2.2	Market capitalization, % GDP	60.7	26	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	25	
4.3	**Trade, competition, and market scale**	**68.5**	**39**	
4.3.1	Applied tariff rate, weighted avg., %	4.4	83	○ ◇
4.3.2	Intensity of local competition†	71.0	49	
4.3.3	Domestic market scale, bn PPP$	746.4	33	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**46.3**	**22**	
5.1	**Knowledge workers**	**50.4**	**27**	
5.1.1	Knowledge-intensive employment, %	32.6	41	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	0.8	26	
5.1.4	GERD financed by business, % ⊙	74.3	5	● ◆
5.1.5	Females employed w/advanced degrees, %	8.6	78	○ ◇
5.2	**Innovation linkages**	**39.9**	**26**	
5.2.1	University/industry research collaboration†	59.9	22	
5.2.2	State of cluster development†	69.5	8	● ◆
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.1	18	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	62	
5.3	**Knowledge absorption**	**48.7**	**16**	
5.3.1	Intellectual property payments, % total trade	0.8	54	
5.3.2	High-tech imports, % total trade	13.2	18	
5.3.3	ICT services imports, % total trade	1.0	72	
5.3.4	FDI net inflows, % GDP	2.6	65	
5.3.5	Research talent, % in business enterprise	77.9	3	● ◆
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**16.2**	**78**	○ ◇
6.1	**Knowledge creation**	**5.6**	**104**	○ ◇
6.1.1	Patents by origin/bn PPP$ GDP	0.1	112	○
6.1.2	PCT patents by origin/bn PPP$ GDP	0.1	55	◇
6.1.3	Utility models by origin/bn PPP$ GDP	0.0	71	○ ◇
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.9	97	○ ◇
6.1.5	Citable documents H-index	12.2	61	
6.2	**Knowledge impact**	**21.9**	**72**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.7	70	○
6.2.2	New businesses/th pop. 15-64	3.0	48	
6.2.3	Computer software spending, % GDP	0.0	49	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.6	57	
6.2.5	High- and medium-high-tech manufacturing, %	18.5	58	
6.3	**Knowledge diffusion**	**21.1**	**71**	
6.3.1	Intellectual property receipts, % total trade	1.0	19	
6.3.2	High-tech net exports, % total trade	0.2	100	○ ◇
6.3.3	ICT services exports, % total trade	1.9	56	
6.3.4	FDI net outflows, % GDP	2.6	26	
	CREATIVE OUTPUTS	**34.4**	**34**	
7.1	**Intangible assets**	**33.1**	**42**	
7.1.1	Trademarks by origin/bn PPP$ GDP	6.5	113	○ ◇
7.1.2	Global brand value, top 5,000, % GDP	128.9	16	
7.1.3	Industrial designs by origin/bn PPP$ GDP ⊙	0.1	107	○
7.1.4	ICTs & organizational model creation†	67.3	24	
7.2	**Creative goods and services**	**53.8**	**2**	● ◆
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15-69	10.6	18	
7.2.3	Entertainment & Media market/th pop. 15-69	24.9	27	
7.2.4	Printing and other media, % manufacturing	1.6	26	
7.2.5	Creative goods exports, % total trade	7.0	8	● ◆
7.3	**Online creativity**	**17.5**	**61**	◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	10.6	38	
7.3.2	Country-code TLDs/th pop. 15-69	7.8	44	
7.3.3	Wikipedia edits/mn pop. 15-69	47.9	64	◇
7.3.4	Mobile app creation/bn PPP$ GDP	6.4	51	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

UNITED KINGDOM

GII 2020 rank

4

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
3	6	High	EUR	67.5	3,131.2	40,881.3	5

		Score/Value	Rank	
	INSTITUTIONS	**86.1**	**16**	
1.1	**Political environment**	**77.8**	**25**	◇
1.1.1	Political and operational stability*	73.2	49	○ ◇
1.1.2	Government effectiveness*	80.1	21	
1.2	**Regulatory environment**	**93.1**	**8**	
1.2.1	Regulatory quality*	88.3	9	
1.2.2	Rule of law*	89.4	15	
1.2.3	Cost of redundancy dismissal, salary weeks	9.3	25	
1.3	**Business environment**	**87.4**	**12**	
1.3.1	Ease of starting a business*	94.6	17	
1.3.2	Ease of resolving insolvency*	80.3	13	
	HUMAN CAPITAL & RESEARCH	**58.0**	**10**	
2.1	**Education**	**55.2**	**35**	
2.1.1	Expenditure on education, % GDP	5.5	22	
2.1.2	Government funding/pupil, secondary, % GDP/cap	21.2	44	○
2.1.3	School life expectancy, years	17.5	16	
2.1.4	PISA scales in reading, maths, & science	503.5	12	
2.1.5	Pupil-teacher ratio, secondary	16.6	79	○ ◇
2.2	**Tertiary education**	**51.3**	**15**	
2.2.1	Tertiary enrolment, % gross	60.0	46	○
2.2.2	Graduates in science & engineering, %	26.3	31	
2.2.3	Tertiary inbound mobility, %	17.9	8	◆
2.3	**Research & development (R&D)**	**67.6**	**9**	
2.3.1	Researchers, FTE/mn pop.	4,603.3	20	
2.3.2	Gross expenditure on R&D, % GDP	1.7	21	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	84.8	8	
2.3.4	QS university ranking, average score top 3*	95.7	2	● ◆
	INFRASTRUCTURE	**60.3**	**6**	●
3.1	**Information & communication technologies (ICTs)**	**93.6**	**1**	● ◆
3.1.1	ICT access*	91.5	4	● ◆
3.1.2	ICT use*	86.5	6	●
3.1.3	Government's online service*	97.9	4	●
3.1.4	E-participation*	98.3	5	
3.2	**General infrastructure**	**33.1**	**38**	◇
3.2.1	Electricity output, kWh/mn pop.	4,986.0	42	○
3.2.2	Logistics performance*	89.9	9	
3.2.3	Gross capital formation, % GDP	16.4	117	○ ◇
3.3	**Ecological sustainability**	**54.2**	**14**	◆
3.3.1	GDP/unit of energy use	14.9	13	
3.3.2	Environmental performance*	81.3	4	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	4.2	22	
	MARKET SOPHISTICATION	**74.4**	**5**	● ◆
4.1	**Credit**	**68.1**	**8**	
4.1.1	Ease of getting credit*	75.0	34	
4.1.2	Domestic credit to private sector, % GDP	136.2	14	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**73.9**	**5**	● ◆
4.2.1	Ease of protecting minority investors*	84.0	7	◆
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.4	9	
4.3	**Trade, competition, and market scale**	**81.3**	**4**	●
4.3.1	Applied tariff rate, weighted avg., %	1.7	22	○
4.3.2	Intensity of local competition†	79.9	9	
4.3.3	Domestic market scale, bn PPP$	3,131.2	9	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**51.0**	**19**	
5.1	**Knowledge workers**	**59.6**	**16**	
5.1.1	Knowledge-intensive employment, %	49.2	7	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	1.2	18	
5.1.4	GERD financed by business, %	51.8	25	
5.1.5	Females employed w/advanced degrees, %	23.4	16	
5.2	**Innovation linkages**	**51.0**	**14**	
5.2.1	University/industry research collaboration†	69.0	11	
5.2.2	State of cluster development†	65.9	14	
5.2.3	GERD financed by abroad, % GDP	0.3	12	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.2	16	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	2.3	17	
5.3	**Knowledge absorption**	**42.5**	**27**	
5.3.1	Intellectual property payments, % total trade	1.5	21	
5.3.2	High-tech imports, % total trade	11.5	21	
5.3.3	ICT services imports, % total trade	1.9	31	
5.3.4	FDI net inflows, % GDP	5.9	20	
5.3.5	Research talent, % in business enterprise	40.6	33	○ ◇
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**54.4**	**9**	
6.1	**Knowledge creation**	**66.2**	**6**	●
6.1.1	Patents by origin/bn PPP$ GDP	6.1	15	
6.1.2	PCT patents by origin/bn PPP$ GDP	1.8	18	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	25.2	15	
6.1.5	Citable documents H-index	100.0	1	● ◆
6.2	**Knowledge impact**	**45.3**	**10**	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.4	79	○
6.2.2	New businesses/th pop. 15–64	15.6	8	◆
6.2.3	Computer software spending, % GDP	0.0	4	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	9.7	28	
6.2.5	High- and medium-high-tech manufacturing, %	42.8	18	
6.3	**Knowledge diffusion**	**51.8**	**11**	
6.3.1	Intellectual property receipts, % total trade	2.5	8	
6.3.2	High-tech net exports, % total trade	8.8	20	
6.3.3	ICT services exports, % total trade	3.3	27	
6.3.4	FDI net outflows, % GDP	2.8	23	
	CREATIVE OUTPUTS	**52.7**	**5**	●
7.1	**Intangible assets**	**53.9**	**9**	
7.1.1	Trademarks by origin/bn PPP$ GDP	56.9	41	
7.1.2	Global brand value, top 5,000, % GDP	167.2	6	●
7.1.3	Industrial designs by origin/bn PPP$ GDP	9.5	13	
7.1.4	ICTs & organizational model creation†	79.1	6	●
7.2	**Creative goods and services**	**41.6**	**10**	
7.2.1	Cultural & creative services exports, % total trade	2.1	6	● ◆
7.2.2	National feature films/mn pop. 15–69	6.2	36	○
7.2.3	Entertainment & Media market/th pop. 15–69	63.4	8	
7.2.4	Printing and other media, % manufacturing	1.9	17	
7.2.5	Creative goods exports, % total trade	2.9	20	
7.3	**Online creativity**	**61.6**	**10**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	60.3	11	
7.3.2	Country-code TLDs/th pop. 15–69	77.6	7	
7.3.3	Wikipedia edits/mn pop. 15–69	84.9	15	
7.3.4	Mobile app creation/bn PPP$ GDP	24.3	22	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

UNITED REPUBLIC OF TANZANIA

GII 2020 rank

88

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
67	112	Low	SSF	58.0	191.6	2,970.4	97

		Score/Value	Rank	
	INSTITUTIONS	**53.3**	**101**	
1.1	**Political environment**	**40.0**	**120**	
1.1.1	Political and operational stability*	53.6	120	
1.1.2	Government effectiveness*	33.2	118	
1.2	**Regulatory environment**	**63.1**	**72**	
1.2.1	Regulatory quality*	25.6	107	
1.2.2	Rule of law*	32.2	98	
1.2.3	Cost of redundancy dismissal, salary weeks	9.3	25	● ◆
1.3	**Business environment**	**56.7**	**114**	
1.3.1	Ease of starting a business*	74.4	118	◇
1.3.2	Ease of resolving insolvency*	39.1	102	
	HUMAN CAPITAL & RESEARCH	**9.5**	**126**	
2.1	**Education**	**23.7**	**120**	
2.1.1	Expenditure on education, % GDP	3.7	86	
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊙	14.9	80	
2.1.3	School life expectancy, years	8.1	118	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	20.9	100	
2.2	**Tertiary education**	**2.3**	**[127]**	
2.2.1	Tertiary enrolment, % gross ⊙	4.0	123	○
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**2.6**	**89**	◆
2.3.1	Researchers, FTE/mn pop. ⊙	19.2	105	◇
2.3.2	Gross expenditure on R&D, % GDP ⊙	0.5	66	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**28.4**	**105**	
3.1	**Information & communication technologies (ICTs)**	**39.2**	**110**	
3.1.1	ICT access*	26.6	125	
3.1.2	ICT use*	12.2	126	
3.1.3	Government's online service*	56.3	96	
3.1.4	E-participation*	61.8	89	
3.2	**General infrastructure**	**28.8**	**58**	
3.2.1	Electricity output, kWh/mn pop.	139.2	118	
3.2.2	Logistics performance*	n/a	n/a	
3.2.3	Gross capital formation, % GDP	37.5	13	●
3.3	**Ecological sustainability**	**17.1**	**115**	
3.3.1	GDP/unit of energy use	7.1	87	
3.3.2	Environmental performance*	31.1	116	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	102	
	MARKET SOPHISTICATION	**43.6**	**87**	
4.1	**Credit**	**27.8**	**113**	
4.1.1	Ease of getting credit*	65.0	61	
4.1.2	Domestic credit to private sector, % GDP ⊙	13.1	122	
4.1.3	Microfinance gross loans, % GDP	0.1	56	
4.2	**Investment**	**50.0**	**[23]**	
4.2.1	Ease of protecting minority investors*	50.0	92	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**53.0**	**103**	
4.3.1	Applied tariff rate, weighted avg., %	8.6	107	
4.3.2	Intensity of local competition†	59.4	109	
4.3.3	Domestic market scale, bn PPP$	191.6	69	◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**17.3**	**118**	
5.1	**Knowledge workers**	**9.8**	**124**	
5.1.1	Knowledge-intensive employment, % ⊙	3.4	120	○ ◇
5.1.2	Firms offering formal training, % ⊙	30.7	48	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, % ⊙	0.1	102	○
5.1.5	Females employed w/advanced degrees, % ⊙	0.4	118	
5.2	**Innovation linkages**	**22.7**	**55**	●
5.2.1	University/industry research collaboration†	47.7	47	●
5.2.2	State of cluster development†	49.4	51	● ◆
5.2.3	GERD financed by abroad, % GDP ⊙	0.2	26	● ◆
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	97	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**19.3**	**105**	
5.3.1	Intellectual property payments, % total trade ⊙	0.0	114	
5.3.2	High-tech imports, % total trade	7.7	63	
5.3.3	ICT services imports, % total trade ⊙	0.3	117	
5.3.4	FDI net inflows, % GDP	1.8	88	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**12.1**	**106**	
6.1	**Knowledge creation**	**4.4**	**113**	
6.1.1	Patents by origin/bn PPP$ GDP	0.1	110	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	0.0	68	
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.6	100	
6.1.5	Citable documents H-index	10.0	76	◆
6.2	**Knowledge impact**	**13.8**	**105**	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.9	31	●
6.2.2	New businesses/th pop. 15–64	0.2	112	
6.2.3	Computer software spending, % GDP	0.0	124	○ ◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.7	115	
6.2.5	High- and medium-high-tech manufacturing, % ⊙	8.4	89	
6.3	**Knowledge diffusion**	**18.0**	**84**	
6.3.1	Intellectual property receipts, % total trade ⊙	0.0	101	
6.3.2	High-tech net exports, % total trade	2.0	55	● ◆
6.3.3	ICT services exports, % total trade ⊙	0.2	118	
6.3.4	FDI net outflows, % GDP ⊙	1.8	39	●
	CREATIVE OUTPUTS	**29.4**	**[45]**	
7.1	**Intangible assets**	**47.2**	**[18]**	
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.4	ICTs & organizational model creation†	47.2	94	
7.2	**Creative goods and services**	**23.0**	**[45]**	
7.2.1	Cultural & creative services exports, % total trade	0.0	115	○ ◇
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing ⊙	1.7	23	●
7.2.5	Creative goods exports, % total trade	2.3	24	● ◆
7.3	**Online creativity**	**0.1**	**128**	◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.2	120	
7.3.2	Country-code TLDs/th pop. 15–69	0.2	112	
7.3.3	Wikipedia edits/mn pop. 15–69	5.1	122	○ ◇
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

UNITED STATES OF AMERICA

GII 2020 rank

3

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
5	**4**	**High**	**NAC**	**329.1**	**21,439.5**	**56,844.3**	**3**

		Score/Value	Rank	
	INSTITUTIONS	**88.9**	**9**	
1.1	**Political environment**	**83.7**	**16**	
1.1.1	Political and operational stability*	80.4	33	
1.1.2	Government effectiveness*	85.4	15	
1.2	**Regulatory environment**	**92.0**	**11**	
1.2.1	Regulatory quality*	83.4	16	
1.2.2	Rule of law*	84.5	19	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	**Business environment**	**91.0**	**2**	● ◆
1.3.1	Ease of starting a business*	91.6	48	
1.3.2	Ease of resolving insolvency*	90.5	2	● ◆
	HUMAN CAPITAL & RESEARCH	**56.3**	**12**	
2.1	**Education**	**52.4**	**45**	
2.1.1	Expenditure on education, % GDP ⊙	5.0	43	
2.1.2	Government funding/pupil, secondary, % GDP/cap	22.1	36	
2.1.3	School life expectancy, years	16.3	27	
2.1.4	PISA scales in reading, maths, & science	495.3	24	
2.1.5	Pupil-teacher ratio, secondary ⊙	14.6	73	○ ◇
2.2	**Tertiary education**	**39.3**	**45**	
2.2.1	Tertiary enrolment, % gross	88.2	8	
2.2.2	Graduates in science & engineering, % ⊙	17.9	79	○ ◇
2.2.3	Tertiary inbound mobility, %	5.2	44	
2.3	**Research & development (R&D)**	**77.1**	**2**	● ◆
2.3.1	Researchers, FTE/mn pop. ⊙	4,412.4	23	
2.3.2	Gross expenditure on R&D, % GDP	2.8	9	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	100.0	1	● ◆
2.3.4	QS university ranking, average score top 3*	98.6	1	● ◆
	INFRASTRUCTURE	**54.7**	**24**	
3.1	**Information & communication technologies (ICTs)**	**90.4**	**9**	
3.1.1	ICT access*	83.5	16	
3.1.2	ICT use*	81.2	18	
3.1.3	Government's online service*	98.6	2	●
3.1.4	E-participation*	98.3	5	
3.2	**General infrastructure**	**43.0**	**15**	
3.2.1	Electricity output, kWh/mn pop.	13,455.1	9	
3.2.2	Logistics performance*	85.2	14	
3.2.3	Gross capital formation, % GDP	21.1	88	○
3.3	**Ecological sustainability**	**30.8**	**59**	◇
3.3.1	GDP/unit of energy use	8.0	78	○
3.3.2	Environmental performance*	69.3	24	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	114	○ ◇
	MARKET SOPHISTICATION	**81.4**	**2**	● ◆
4.1	**Credit**	**89.7**	**1**	● ◆
4.1.1	Ease of getting credit*	95.0	4	◆
4.1.2	Domestic credit to private sector, % GDP	186.0	2	● ◆
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	**Investment**	**63.8**	**13**	
4.2.1	Ease of protecting minority investors*	71.6	35	
4.2.2	Market capitalization, % GDP	153.1	5	
4.2.3	Venture capital deals/bn PPP$ GDP	0.3	10	
4.3	**Trade, competition, and market scale**	**90.7**	**1**	● ◆
4.3.1	Applied tariff rate, weighted avg., %	1.6	20	
4.3.2	Intensity of local competition†	84.3	3	● ◆
4.3.3	Domestic market scale, bn PPP$	21,439.5	2	● ◆

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**62.8**	**5**	◆
5.1	**Knowledge workers**	**69.8**	**5**	
5.1.1	Knowledge-intensive employment, %	48.0	9	
5.1.2	Firms offering formal training, %	n/a	n/a	
5.1.3	GERD performed by business, % GDP	2.1	8	
5.1.4	GERD financed by business, %	62.4	11	
5.1.5	Females employed w/advanced degrees, %	26.8	6	
5.2	**Innovation linkages**	**60.6**	**8**	
5.2.1	University/industry research collaboration†	75.7	4	◆
5.2.2	State of cluster development†	74.8	2	● ◆
5.2.3	GERD financed by abroad, % GDP	0.2	16	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.2	7	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	3.5	14	
5.3	**Knowledge absorption**	**58.0**	**5**	
5.3.1	Intellectual property payments, % total trade	1.9	14	
5.3.2	High-tech imports, % total trade	17.3	10	
5.3.3	ICT services imports, % total trade	1.4	46	
5.3.4	FDI net inflows, % GDP	1.9	84	○
5.3.5	Research talent, % in business enterprise ⊙	71.3	6	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**56.8**	**3**	●
6.1	**Knowledge creation**	**72.8**	**3**	● ◆
6.1.1	Patents by origin/bn PPP$ GDP	13.9	1	● ◆
6.1.2	PCT patents by origin/bn PPP$ GDP	2.7	12	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	10.7	48	◇
6.1.5	Citable documents H-index	100.0	1	● ◆
6.2	**Knowledge impact**	**51.8**	**3**	● ◆
6.2.1	Growth rate of PPP$ GDP/worker, %	1.1	60	
6.2.2	New businesses/th pop. 15-64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	1	● ◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.1	106	○ ◇
6.2.5	High- and medium-high-tech manufacturing, %	52.0	11	
6.3	**Knowledge diffusion**	**45.9**	**16**	
6.3.1	Intellectual property receipts, % total trade	4.9	1	● ◆
6.3.2	High-tech net exports, % total trade	5.5	29	
6.3.3	ICT services exports, % total trade	1.6	66	
6.3.4	FDI net outflows, % GDP	1.1	51	
	CREATIVE OUTPUTS	**47.7**	**11**	
7.1	**Intangible assets**	**48.1**	**15**	
7.1.1	Trademarks by origin/bn PPP$ GDP	21.7	90	○ ◇
7.1.2	Global brand value, top 5,000, % GDP	203.3	4	◆
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.1	65	○
7.1.4	ICTs & organizational model creation†	83.7	1	● ◆
7.2	**Creative goods and services**	**44.2**	**7**	◆
7.2.1	Cultural & creative services exports, % total trade	1.7	10	
7.2.2	National feature films/mn pop. 15-69	2.9	60	○
7.2.3	Entertainment & Media market/th pop. 15-69	99.7	2	● ◆
7.2.4	Printing and other media, % manufacturing	1.4	30	
7.2.5	Creative goods exports, % total trade	3.3	18	
7.3	**Online creativity**	**50.4**	**18**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	100.0	1	● ◆
7.3.2	Country-code TLDs/th pop. 15-69	2.1	70	◇
7.3.3	Wikipedia edits/mn pop. 15-69	73.9	34	◇
7.3.4	Mobile app creation/bn PPP$ GDP	27.1	21	

NOTES: ● indicates a strength; ○ a weakness; ◆ a strength relative to the other top 25-ranked GII economies; ◇ a weakness relative to the other top 25-ranked GII economies; * an index; † a survey question. ⊙ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

URUGUAY

GII 2020 rank

69

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
65	69	High	LCN	3.5	83.0	20,586.5	62

		Score/Value	Rank	
	INSTITUTIONS	**69.3**	**46**	
1.1	**Political environment**	**69.7**	**39**	
1.1.1	Political and operational stability*	83.9	21	●
1.1.2	Government effectiveness*	62.6	42	
1.2	**Regulatory environment**	**66.6**	**60**	◇
1.2.1	Regulatory quality*	55.0	47	◇
1.2.2	Rule of law*	62.3	39	
1.2.3	Cost of redundancy dismissal, salary weeks	20.8	88	
1.3	**Business environment**	**71.6**	**65**	
1.3.1	Ease of starting a business*	89.6	56	
1.3.2	Ease of resolving insolvency*	53.6	65	

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**29.3**	**71**	◇
2.1	**Education**	**46.8**	**64**	
2.1.1	Expenditure on education, % GDP ◷	4.8	47	
2.1.2	Government funding/pupil, secondary, % GDP/cap	16.2	70	◇
2.1.3	School life expectancy, years	16.8	19	●
2.1.4	PISA scales in reading, maths, & science	423.5	52	
2.1.5	Pupil-teacher ratio, secondary ◷	12.7	59	
2.2	**Tertiary education**	**33.7**	**62**	◇
2.2.1	Tertiary enrolment, % gross	63.1	43	
2.2.2	Graduates in science & engineering, %	17.5	82	○ ◇
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**7.5**	**65**	◇
2.3.1	Researchers, FTE/mn pop.	696.4	59	◇
2.3.2	Gross expenditure on R&D, % GDP ◷	0.5	68	◇
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	12.4	61	

		Score/Value	Rank	
	INFRASTRUCTURE	**46.2**	**52**	◇
3.1	**Information & communication technologies (ICTs)**	**82.4**	**26**	●
3.1.1	ICT access*	75.1	43	
3.1.2	ICT use*	74.0	32	
3.1.3	Government's online service*	88.9	27	●
3.1.4	E-participation*	91.6	26	●
3.2	**General infrastructure**	**19.0**	**107**	○ ◇
3.2.1	Electricity output, kWh/mn pop.	3,941.1	52	
3.2.2	Logistics performance*	28.9	84	◇
3.2.3	Gross capital formation, % GDP	19.3	101	○
3.3	**Ecological sustainability**	**37.1**	**43**	
3.3.1	GDP/unit of energy use	13.5	19	●
3.3.2	Environmental performance*	49.1	58	◇
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.5	33	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**36.9**	**114**	○ ◇
4.1	**Credit**	**28.1**	**111**	○ ◇
4.1.1	Ease of getting credit*	60.0	74	
4.1.2	Domestic credit to private sector, % GDP	27.4	99	○ ◇
4.1.3	Microfinance gross loans, % GDP ◷	0.0	68	○
4.2	**Investment**	**27.8**	**104**	○
4.2.1	Ease of protecting minority investors*	30.0	121	○ ◇
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	19	
4.3	**Trade, competition, and market scale**	**54.7**	**98**	◇
4.3.1	Applied tariff rate, weighted avg., %	5.4	97	◇
4.3.2	Intensity of local competition†	61.5	102	○ ◇
4.3.3	Domestic market scale, bn PPP$	83.0	88	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**22.1**	**85**	◇
5.1	**Knowledge workers**	**27.1**	**79**	◇
5.1.1	Knowledge-intensive employment, %	22.1	69	◇
5.1.2	Firms offering formal training, % ◷	53.3	13	● ◆
5.1.3	GERD performed by business, % GDP ◷	0.1	59	◇
5.1.4	GERD financed by business, %	4.6	85	○ ◇
5.1.5	Females employed w/advanced degrees, %	10.2	66	◇
5.2	**Innovation linkages**	**16.8**	**97**	◇
5.2.1	University/industry research collaboration†	36.2	93	◇
5.2.2	State of cluster development†	40.8	94	◇
5.2.3	GERD financed by abroad, % GDP	0.0	57	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	66	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	40	
5.3	**Knowledge absorption**	**22.4**	**92**	◇
5.3.1	Intellectual property payments, % total trade	0.8	46	
5.3.2	High-tech imports, % total trade	6.8	77	
5.3.3	ICT services imports, % total trade	2.5	18	●
5.3.4	FDI net inflows, % GDP	2.3	72	
5.3.5	Research talent, % in business enterprise	0.6	81	○ ◇

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**20.6**	**63**	
6.1	**Knowledge creation**	**11.7**	**73**	◇
6.1.1	Patents by origin/bn PPP$ GDP ◷	0.3	89	
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP ◷	0.3	39	
6.1.4	Scientific & technical articles/bn PPP$ GDP	10.7	49	
6.1.5	Citable documents H-index	11.4	66	
6.2	**Knowledge impact**	**24.7**	**65**	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.6	52	
6.2.2	New businesses/th pop. 15–64	1.3	78	
6.2.3	Computer software spending, % GDP	0.0	68	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	12.6	23	●
6.2.5	High- and medium-high-tech manufacturing, % ◷	13.9	71	
6.3	**Knowledge diffusion**	**25.3**	**60**	
6.3.1	Intellectual property receipts, % total trade	0.2	33	
6.3.2	High-tech net exports, % total trade	0.8	70	
6.3.3	ICT services exports, % total trade	2.9	35	
6.3.4	FDI net outflows, % GDP	4.7	11	●

		Score/Value	Rank	
	CREATIVE OUTPUTS	**21.3**	**62**	◇
7.1	**Intangible assets**	**23.0**	**84**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP ◷	47.5	54	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP ◷	0.7	79	
7.1.4	ICTs & organizational model creation†	58.4	50	
7.2	**Creative goods and services**	**14.9**	**65**	
7.2.1	Cultural & creative services exports, % total trade	1.4	15	●
7.2.2	National feature films/mn pop. 15–69 ◷	4.7	46	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing ◷	1.1	49	
7.2.5	Creative goods exports, % total trade	0.1	111	○
7.3	**Online creativity**	**24.1**	**50**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	6.4	49	
7.3.2	Country-code TLDs/th pop. 15–69	11.0	40	
7.3.3	Wikipedia edits/mn pop. 15–69	70.3	39	
7.3.4	Mobile app creation/bn PPP$ GDP	10.5	44	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

UZBEKISTAN

GII 2020 rank

93

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
118	81	Lower middle	CSA	33.0	297.2	7,856.9	n/a

		Score/Value	Rank	
	INSTITUTIONS	**55.1**	**95**	
1.1	**Political environment**	**46.7**	**98**	
1.1.1	Political and operational stability*	64.3	83	
1.1.2	Government effectiveness*	37.9	100	
1.2	**Regulatory environment**	**48.6**	**107**	
1.2.1	Regulatory quality*	12.7	127	○ ◇
1.2.2	Rule of law*	18.7	124	○ ◇
1.2.3	Cost of redundancy dismissal, salary weeks	17.3	69	
1.3	**Business environment**	**69.8**	**72**	
1.3.1	Ease of starting a business*	96.2	8	● ◆
1.3.2	Ease of resolving insolvency*	43.5	90	
	HUMAN CAPITAL & RESEARCH	**27.5**	**77**	
2.1	**Education**	**49.7**	**[52]**	
2.1.1	Expenditure on education, % GDP ◷	5.3	31	●
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	12.1	92	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ◷	10.3	38	● ◆
2.2	**Tertiary education**	**30.9**	**73**	
2.2.1	Tertiary enrolment, % gross	10.1	110	
2.2.2	Graduates in science & engineering, %	35.2	7	● ◆
2.2.3	Tertiary inbound mobility, %	0.2	106	
2.3	**Research & development (R&D)**	**2.0**	**94**	
2.3.1	Researchers, FTE/mn pop.	476.2	70	
2.3.2	Gross expenditure on R&D, % GDP	0.1	99	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**38.5**	**72**	◆
3.1	**Information & communication technologies (ICTs)**	**63.9**	**72**	◆
3.1.1	ICT access*	54.3	83	
3.1.2	ICT use*	46.2	82	
3.1.3	Government's online service*	79.2	48	● ◆
3.1.4	E-participation*	75.8	59	
3.2	**General infrastructure**	**32.0**	**41**	● ◆
3.2.1	Electricity output, kWh/mn pop.	1,907.7	80	◆
3.2.2	Logistics performance*	23.8	95	
3.2.3	Gross capital formation, % GDP	41.4	8	● ◆
3.3	**Ecological sustainability**	**19.6**	**101**	
3.3.1	GDP/unit of energy use	5.9	102	
3.3.2	Environmental performance*	44.3	77	◆
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	118	
	MARKET SOPHISTICATION	**54.9**	**27**	● ◆
4.1	**Credit**	**43.3**	**57**	
4.1.1	Ease of getting credit*	65.0	61	
4.1.2	Domestic credit to private sector, % GDP	n/a	n/a	
4.1.3	Microfinance gross loans, % GDP	0.0	79	○
4.2	**Investment**	**70.0**	**[8]**	
4.2.1	Ease of protecting minority investors*	70.0	36	●
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**51.3**	**108**	
4.3.1	Applied tariff rate, weighted avg., % ◷	8.7	109	
4.3.2	Intensity of local competition†	n/a	n/a	
4.3.3	Domestic market scale, bn PPP$	297.2	59	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**15.2**	**[127]**	
5.1	**Knowledge workers**	**22.9**	**[91]**	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, %	16.9	82	◇
5.1.3	GERD performed by business, % GDP	0.1	72	
5.1.4	GERD financed by business, %	42.4	43	◆
5.1.5	Females employed w/advanced degrees, %	n/a	n/a	
5.2	**Innovation linkages**	**3.9**	**[128]**	
5.2.1	University/industry research collaboration†	n/a	n/a	
5.2.2	State of cluster development†	n/a	n/a	
5.2.3	GERD financed by abroad, % GDP	0.0	96	○
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	0.0	48	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	96	
5.3	**Knowledge absorption**	**18.9**	**109**	
5.3.1	Intellectual property payments, % total trade	0.2	90	
5.3.2	High-tech imports, % total trade	7.8	60	
5.3.3	ICT services imports, % total trade	0.0	130	○ ◇
5.3.4	FDI net inflows, % GDP	2.1	80	
5.3.5	Research talent, % in business enterprise	12.9	60	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**14.1**	**90**	
6.1	**Knowledge creation**	**7.3**	**84**	
6.1.1	Patents by origin/bn PPP$ GDP	1.7	45	●
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	97	
6.1.3	Utility models by origin/bn PPP$ GDP	0.7	30	
6.1.4	Scientific & technical articles/bn PPP$ GDP	1.2	123	
6.1.5	Citable documents H-index	4.5	112	
6.2	**Knowledge impact**	**28.0**	**49**	●
6.2.1	Growth rate of PPP$ GDP/worker, %	4.7	12	●
6.2.2	New businesses/th pop. 15-64	1.6	63	
6.2.3	Computer software spending, % GDP	n/a	n/a	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.4	93	
6.2.5	High- and medium-high-tech manufacturing, %	22.8	49	
6.3	**Knowledge diffusion**	**7.1**	**131**	○ ◇
6.3.1	Intellectual property receipts, % total trade	0.0	95	
6.3.2	High-tech net exports, % total trade	0.1	117	
6.3.3	ICT services exports, % total trade	0.0	129	○
6.3.4	FDI net outflows, % GDP	0.0	116	
	CREATIVE OUTPUTS	**7.5**	**127**	○ ◇
7.1	**Intangible assets**	**9.3**	**[128]**	
7.1.1	Trademarks by origin/bn PPP$ GDP	26.8	82	
7.1.2	Global brand value, top 5,000, % GDP	n/a	n/a	
7.1.3	Industrial designs by origin/bn PPP$ GDP	1.1	64	
7.1.4	ICTs & organizational model creation†	n/a	n/a	
7.2	**Creative goods and services**	**11.2**	**75**	
7.2.1	Cultural & creative services exports, % total trade	0.8	33	● ◆
7.2.2	National feature films/mn pop. 15-69	4.2	47	
7.2.3	Entertainment & Media market/th pop. 15-69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	0.9	63	
7.2.5	Creative goods exports, % total trade	0.1	92	
7.3	**Online creativity**	**0.3**	**126**	○ ◇
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	0.0	131	○ ◇
7.3.2	Country-code TLDs/th pop. 15-69	1.0	85	
7.3.3	Wikipedia edits/mn pop. 15-69	n/a	n/a	
7.3.4	Mobile app creation/bn PPP$ GDP	0.0	98	○

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

VIET NAM

GII 2020 rank

42

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
38	62	Lower middle	SEAO	96.5	770.2	7,041.6	42

		Score/Value	Rank	
1	**INSTITUTIONS**	**58.5**	**83**	
1.1	**Political environment**	**60.8**	**55**	◆
1.1.1	Political and operational stability*	82.1	29	◆
1.1.2	Government effectiveness*	50.1	72	◆
1.2	**Regulatory environment**	**53.2**	**98**	
1.2.1	Regulatory quality*	31.6	99	
1.2.2	Rule of law*	46.6	64	◆
1.2.3	Cost of redundancy dismissal, salary weeks	24.6	103	○
1.3	**Business environment**	**61.6**	**101**	
1.3.1	Ease of starting a business*	85.1	88	
1.3.2	Ease of resolving insolvency*	38.0	106	○

		Score/Value	Rank	
2	**HUMAN CAPITAL & RESEARCH**	**26.0**	**79**	
2.1	**Education**	**48.4**	**[60]**	
2.1.1	Expenditure on education, % GDP	4.2	67	
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science ◷	502.0	16	◆
2.1.5	Pupil-teacher ratio, secondary	17.6	87	
2.2	**Tertiary education**	**22.7**	**87**	
2.2.1	Tertiary enrolment, % gross ◷	28.5	83	
2.2.2	Graduates in science & engineering, % ◷	22.7	53	
2.2.3	Tertiary inbound mobility, % ◷	0.2	104	○
2.3	**Research & development (R&D)**	**7.0**	**69**	
2.3.1	Researchers, FTE/mn pop. ◷	707.7	58	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.5	64	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	9.2	65	

		Score/Value	Rank	
3	**INFRASTRUCTURE**	**38.4**	**73**	◆
3.1	**Information & communication technologies (ICTs)**	**62.8**	**76**	◆
3.1.1	ICT access*	53.6	86	
3.1.2	ICT use*	55.0	65	◆
3.1.3	Government's online service*	73.6	58	
3.1.4	E-participation*	69.1	71	
3.2	**General infrastructure**	**29.3**	**55**	
3.2.1	Electricity output, kWh/mn pop.	2,079.3	76	◆
3.2.2	Logistics performance*	56.5	38	◆
3.2.3	Gross capital formation, % GDP	26.3	41	
3.3	**Ecological sustainability**	**23.0**	**86**	
3.3.1	GDP/unit of energy use	7.4	85	
3.3.2	Environmental performance*	33.4	110	○
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.0	43	◆

		Score/Value	Rank	
4	**MARKET SOPHISTICATION**	**53.0**	**34**	◆
4.1	**Credit**	**67.6**	**9**	● ◆
4.1.1	Ease of getting credit*	80.0	23	
4.1.2	Domestic credit to private sector, % GDP	133.3	15	● ◆
4.1.3	Microfinance gross loans, % GDP ◷	3.9	11	● ◆
4.2	**Investment**	**25.9**	**112**	○
4.2.1	Ease of protecting minority investors*	54.0	88	
4.2.2	Market capitalization, % GDP	48.6	32	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	63	
4.3	**Trade, competition, and market scale**	**65.5**	**49**	
4.3.1	Applied tariff rate, weighted avg., %	4.4	82	
4.3.2	Intensity of local competition†	63.2	91	
4.3.3	Domestic market scale, bn PPP$	770.2	32	

		Score/Value	Rank	
5	**BUSINESS SOPHISTICATION**	**34.5**	**39**	◆
5.1	**Knowledge workers**	**30.5**	**63**	
5.1.1	Knowledge-intensive employment, %	13.5	97	○
5.1.2	Firms offering formal training, % ◷	22.2	66	
5.1.3	GERD performed by business, % GDP ◷	0.4	42	◆
5.1.4	GERD financed by business, %	64.1	8	● ◆
5.1.5	Females employed w/advanced degrees, %	6.0	84	
5.2	**Innovation linkages**	**19.3**	**75**	
5.2.1	University/industry research collaboration†	42.0	65	
5.2.2	State of cluster development†	52.6	42	
5.2.3	GERD financed by abroad, % GDP	0.0	65	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	59	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	87	
5.3	**Knowledge absorption**	**53.6**	**10**	● ◆
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports, % total trade ◷	26.8	4	● ◆
5.3.3	ICT services imports, % total trade ◷	0.0	126	○ ◇
5.3.4	FDI net inflows, % GDP	6.3	19	● ◆
5.3.5	Research talent, % in business enterprise ◷	24.1	51	

		Score/Value	Rank	
6	**KNOWLEDGE & TECHNOLOGY OUTPUTS**	**31.7**	**37**	◆
6.1	**Knowledge creation**	**11.1**	**75**	
6.1.1	Patents by origin/bn PPP$ GDP	0.9	66	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	82	
6.1.3	Utility models by origin/bn PPP$ GDP	0.5	36	
6.1.4	Scientific & technical articles/bn PPP$ GDP	7.9	61	
6.1.5	Citable documents H-index	12.8	59	
6.2	**Knowledge impact**	**37.2**	**21**	◆
6.2.1	Growth rate of PPP$ GDP/worker, %	6.1	4	● ◆
6.2.2	New businesses/th pop. 15–64 ◷	1.1	81	
6.2.3	Computer software spending, % GDP	0.0	37	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	5.3	52	◆
6.2.5	High- and medium-high-tech manufacturing, %	40.0	23	◆
6.3	**Knowledge diffusion**	**46.7**	**14**	● ◆
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade ◷	33.2	2	● ◆
6.3.3	ICT services exports, % total trade ◷	0.1	126	○
6.3.4	FDI net outflows, % GDP	0.3	86	

		Score/Value	Rank	
7	**CREATIVE OUTPUTS**	**32.7**	**38**	◆
7.1	**Intangible assets**	**38.7**	**33**	◆
7.1.1	Trademarks by origin/bn PPP$ GDP	85.5	20	● ◆
7.1.2	Global brand value, top 5,000, % GDP	100.8	19	◆
7.1.3	Industrial designs by origin/bn PPP$ GDP	2.7	43	
7.1.4	ICTs & organizational model creation†	54.4	63	
7.2	**Creative goods and services**	**27.7**	**32**	◆
7.2.1	Cultural & creative services exports, % total trade	0.0	97	○
7.2.2	National feature films/mn pop. 15–69 ◷	1.2	83	
7.2.3	Entertainment & Media market/th pop. 15–69	2.3	52	○
7.2.4	Printing and other media, % manufacturing	0.9	66	
7.2.5	Creative goods exports, % total trade	5.6	11	● ◆
7.3	**Online creativity**	**25.7**	**42**	◆
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.4	72	◆
7.3.2	Country-code TLDs/th pop. 15–69	2.2	67	◆
7.3.3	Wikipedia edits/mn pop. 15–69	43.5	75	◆
7.3.4	Mobile app creation/bn PPP$ GDP	57.6	10	● ◆

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

YEMEN

GII 2020 rank

131

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
130	131	Low	NAWA	29.2	72.2	1,990.8	129

		Score/Value	Rank	
	INSTITUTIONS	**27.7**	**131**	○ ◇
1.1	**Political environment**	**0.0**	**131**	○ ◇
1.1.1	Political and operational stability*	0.0	131	○ ◇
1.1.2	Government effectiveness*	0.0	131	○ ◇
1.2	**Regulatory environment**	**31.1**	**126**	◇
1.2.1	Regulatory quality*	1.3	130	◇
1.2.2	Rule of law*	0.0	131	○ ◇
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	109	◇
1.3	**Business environment**	**51.9**	**124**	◇
1.3.1	Ease of starting a business*	76.8	115	
1.3.2	Ease of resolving insolvency*	26.9	125	◇

		Score/Value	Rank	
	HUMAN CAPITAL & RESEARCH	**10.4**	**[125]**	
2.1	**Education**	**20.5**	**[126]**	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Government funding/pupil, secondary, % GDP/cap ◷	11.8	88	
2.1.3	School life expectancy, years ◷	9.1	112	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ◷	26.8	111	
2.2	**Tertiary education**	**10.7**	**113**	
2.2.1	Tertiary enrolment, % gross ◷	10.2	109	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, % ◷	4.3	55	●
2.3	**Research & development (R&D)**	**0.0**	**[121]**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇

		Score/Value	Rank	
	INFRASTRUCTURE	**17.1**	**129**	◇
3.1	**Information & communication technologies (ICTs)**	**14.7**	**131**	○ ◇
3.1.1	ICT access*	25.5	127	
3.1.2	ICT use*	11.7	127	
3.1.3	Government's online service*	9.7	130	○ ◇
3.1.4	E-participation*	11.8	130	○ ◇
3.2	**General infrastructure**	**2.4**	**130**	◇
3.2.1	Electricity output, kWh/mn pop.	188.2	115	
3.2.2	Logistics performance*	9.2	120	
3.2.3	Gross capital formation, % GDP	7.9	125	○ ◇
3.3	**Ecological sustainability**	**34.1**	**51**	● ◆
3.3.1	GDP/unit of energy use	20.0	5	● ◆
3.3.2	Environmental performance*	n/a	n/a	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	121	

		Score/Value	Rank	
	MARKET SOPHISTICATION	**25.5**	**129**	◇
4.1	**Credit**	**0.2**	**131**	○ ◇
4.1.1	Ease of getting credit*	0.0	131	○ ◇
4.1.2	Domestic credit to private sector, % GDP ◷	5.6	128	○ ◇
4.1.3	Microfinance gross loans, % GDP	0.1	61	
4.2	**Investment**	**26.0**	**[110]**	
4.2.1	Ease of protecting minority investors*	26.0	125	◇
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**50.1**	**115**	
4.3.1	Applied tariff rate, weighted avg., % ◷	5.0	94	● ◆
4.3.2	Intensity of local competition†	50.4	126	◇
4.3.3	Domestic market scale, bn PPP$	72.2	93	●

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**18.7**	**[104]**	
5.1	**Knowledge workers**	**11.7**	**[122]**	
5.1.1	Knowledge-intensive employment, % ◷	12.4	101	
5.1.2	Firms offering formal training, % ◷	14.3	88	◇
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ◷	1.1	109	
5.2	**Innovation linkages**	**15.9**	**[105]**	
5.2.1	University/industry research collaboration†	17.7	126	○ ◇
5.2.2	State of cluster development†	30.8	120	◇
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV-strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**28.4**	**64**	●
5.3.1	Intellectual property payments, % total trade ◷	1.6	19	● ◆
5.3.2	High-tech imports, % total trade ◷	6.3	88	●
5.3.3	ICT services imports, % total trade ◷	0.4	109	
5.3.4	FDI net inflows, % GDP	-1.3	126	◇
5.3.5	Research talent, % in business enterprise	n/a	n/a	

		Score/Value	Rank	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**6.7**	**128**	◇
6.1	**Knowledge creation**	**3.8**	**116**	
6.1.1	Patents by origin/bn PPP$ GDP ◷	0.2	96	●
6.1.2	PCT patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP ◷	0.0	69	
6.1.4	Scientific & technical articles/bn PPP$ GDP	4.3	96	●
6.1.5	Citable documents H-index	3.3	121	
6.2	**Knowledge impact**	**0.8**	**131**	○ ◇
6.2.1	Growth rate of PPP$ GDP/worker, %	-4.2	119	○ ◇
6.2.2	New businesses/th pop. 15-64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	106	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.2	129	◇
6.2.5	High- and medium-high-tech manufacturing, % ◷	1.2	107	○ ◇
6.3	**Knowledge diffusion**	**15.5**	**91**	●
6.3.1	Intellectual property receipts, % total trade ◷	0.1	66	●
6.3.2	High-tech net exports, % total trade ◷	0.1	118	
6.3.3	ICT services exports, % total trade ◷	2.6	38	●
6.3.4	FDI net outflows, % GDP	-1.3	129	◇

		Score/Value	Rank	
	CREATIVE OUTPUTS	**7.8**	**124**	
7.1	**Intangible assets**	**13.6**	**117**	
7.1.1	Trademarks by origin/bn PPP$ GDP	58.2	35	● ◆
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP	0.2	97	
7.1.4	ICTs & organizational model creation†	21.7	125	○ ◇
7.2	**Creative goods and services**	**0.0**	**[131]**	
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15-69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15-69	0.0	63	○ ◇
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade ◷	0.0	130	○ ◇
7.3	**Online creativity**	**4.1**	**114**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15-69	0.4	114	
7.3.2	Country-code TLDs/th pop. 15-69	0.0	128	
7.3.3	Wikipedia edits/mn pop. 15-69	20.2	107	
7.3.4	Mobile app creation/bn PPP$ GDP	0.2	80	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ◷ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

ZAMBIA

GII 2020 rank

122

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
128	109	Lower middle	SSF	17.9	76.0	3,621.3	124

		Score/Value	Rank	
	INSTITUTIONS	**46.0**	**122**	
1.1	**Political environment**	**45.9**	**99**	
1.1.1	Political and operational stability*	62.5	92	
1.1.2	Government effectiveness*	37.6	101	
1.2	**Regulatory environment**	**24.8**	**128**	○ ◇
1.2.1	Regulatory quality*	30.1	102	
1.2.2	Rule of law*	37.7	83	●
1.2.3	Cost of redundancy dismissal, salary weeks	50.6	127	○ ◇
1.3	**Business environment**	**67.1**	**78**	●
1.3.1	Ease of starting a business*	84.9	90	
1.3.2	Ease of resolving insolvency*	49.3	71	●
	HUMAN CAPITAL & RESEARCH	**15.0**	**[111]**	
2.1	**Education**	**42.5**	**[75]**	
2.1.1	Expenditure on education, % GDP	4.7	56	●
2.1.2	Government funding/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary 🕐	21.1	101	
2.2	**Tertiary education**	**2.4**	**[126]**	
2.2.1	Tertiary enrolment, % gross 🕐	4.1	122	○ ◇
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	**Research & development (R&D)**	**0.0**	**[121]**	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**27.4**	**107**	
3.1	**Information & communication technologies (ICTs)**	**36.4**	**115**	
3.1.1	ICT access*	34.2	116	◇
3.1.2	ICT use*	23.8	110	◇
3.1.3	Government's online service*	47.9	108	
3.1.4	E-participation*	39.9	112	
3.2	**General infrastructure**	**30.2**	**51**	●
3.2.1	Electricity output, kWh/mn pop.	830.0	100	
3.2.2	Logistics performance*	21.4	105	
3.2.3	Gross capital formation, % GDP	41.1	9	● ◆
3.3	**Ecological sustainability**	**15.7**	**121**	◇
3.3.1	GDP/unit of energy use	5.1	110	◇
3.3.2	Environmental performance*	34.7	103	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	104	
	MARKET SOPHISTICATION	**43.9**	**85**	
4.1	**Credit**	**39.9**	**70**	●
4.1.1	Ease of getting credit*	95.0	4	● ◆
4.1.2	Domestic credit to private sector, % GDP	14.7	119	
4.1.3	Microfinance gross loans, % GDP	0.1	63	
4.2	**Investment**	**33.0**	**84**	
4.2.1	Ease of protecting minority investors*	60.0	71	●
4.2.2	Market capitalization, % GDP 🕐	13.6	63	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**58.9**	**80**	●
4.3.1	Applied tariff rate, weighted avg., %	3.4	68	●
4.3.2	Intensity of local competition†	66.4	75	●
4.3.3	Domestic market scale, bn PPP$	76.0	92	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**21.4**	**91**	
5.1	**Knowledge workers**	**27.2**	**[78]**	
5.1.1	Knowledge-intensive employment, %	19.1	79	
5.1.2	Firms offering formal training, % 🕐	28.2	53	●
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, %	6.2	82	
5.2	**Innovation linkages**	**17.1**	**95**	
5.2.1	University/industry research collaboration†	30.2	111	
5.2.2	State of cluster development†	41.7	90	
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	101	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**19.7**	**100**	
5.3.1	Intellectual property payments, % total trade	0.1	98	
5.3.2	High-tech imports, % total trade	6.3	89	
5.3.3	ICT services imports, % total trade	0.7	90	
5.3.4	FDI net inflows, % GDP	2.7	64	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**8.5**	**123**	◇
6.1	**Knowledge creation**	**4.0**	**115**	
6.1.1	Patents by origin/bn PPP$ GDP 🕐	0.2	106	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	100	○ ◇
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.6	108	
6.1.5	Citable documents H-index	6.8	92	
6.2	**Knowledge impact**	**10.0**	**117**	◇
6.2.1	Growth rate of PPP$ GDP/worker, %	-0.3	99	◇
6.2.2	New businesses/th pop. 15–64	1.1	82	
6.2.3	Computer software spending, % GDP	0.0	108	◇
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.5	120	◇
6.2.5	High- and medium-high-tech manufacturing, % 🕐	10.1	80	
6.3	**Knowledge diffusion**	**11.7**	**111**	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech net exports, % total trade	0.3	94	
6.3.3	ICT services exports, % total trade	0.4	105	
6.3.4	FDI net outflows, % GDP	0.1	108	
	CREATIVE OUTPUTS	**7.5**	**126**	○ ◇
7.1	**Intangible assets**	**12.7**	**123**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP 🕐	15.6	100	
7.1.2	Global brand value, top 5,000, % GDP	0.0	80	○ ◇
7.1.3	Industrial designs by origin/bn PPP$ GDP 🕐	0.4	85	
7.1.4	ICTs & organizational model creation†	37.3	119	○ ◇
7.2	**Creative goods and services**	**0.3**	**[130]**	
7.2.1	Cultural & creative services exports, % total trade 🕐	0.0	112	○
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.0	112	
7.3	**Online creativity**	**4.5**	**111**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.1	124	○ ◇
7.3.2	Country-code TLDs/th pop. 15–69	0.1	116	
7.3.3	Wikipedia edits/mn pop. 15–69	17.6	111	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. 🕐 indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

ZIMBABWE

GII 2020 rank

120

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$	GDP per capita, PPP$	GII 2019 rank
108	**123**	**Lower middle**	**SSF**	**14.6**	**40.3**	**2,358.9**	**122**

		Score/Value	Rank	
	INSTITUTIONS	**40.3**	**128**	○ ◇
1.1	**Political environment**	**32.2**	**130**	○ ◇
1.1.1	Political and operational stability*	50.0	126	◇
1.1.2	Government effectiveness*	23.4	130	○ ◇
1.2	**Regulatory environment**	**36.3**	**122**	
1.2.1	Regulatory quality*	0.0	131	○ ◇
1.2.2	Rule of law*	13.5	129	○ ◇
1.2.3	Cost of redundancy dismissal, salary weeks	25.3	104	
1.3	**Business environment**	**52.4**	**122**	
1.3.1	Ease of starting a business*	72.0	120	◇
1.3.2	Ease of resolving insolvency*	32.9	115	
	HUMAN CAPITAL & RESEARCH	**20.9**	**93**	
2.1	**Education**	**36.8**	**88**	
2.1.1	Expenditure on education, % GDP	4.6	59	
2.1.2	Government funding/pupil, secondary, % GDP/cap ⊕	22.2	35	●
2.1.3	School life expectancy, years ⊕	11.4	99	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⊕	22.5	103	
2.2	**Tertiary education**	**25.7**	**80**	
2.2.1	Tertiary enrolment, % gross ⊕	10.0	111	
2.2.2	Graduates in science & engineering, % ⊕	30.2	14	●
2.2.3	Tertiary inbound mobility, % ⊕	0.5	99	
2.3	**Research & development (R&D)**	**0.3**	**115**	
2.3.1	Researchers, FTE/mn pop. ⊕	99.5	88	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. exp. top 3, mn $US	0.0	42	○ ◇
2.3.4	QS university ranking, average score top 3*	0.0	77	○ ◇
	INFRASTRUCTURE	**16.4**	**131**	○ ◇
3.1	**Information & communication technologies (ICTs)**	**31.0**	**120**	◇
3.1.1	ICT access*	36.8	112	
3.1.2	ICT use*	27.0	107	
3.1.3	Government's online service*	32.6	117	◇
3.1.4	E-participation*	27.5	120	◇
3.2	**General infrastructure**	**2.0**	**131**	○ ◇
3.2.1	Electricity output, kWh/mn pop.	456.4	107	
3.2.2	Logistics performance*	2.4	123	○ ◇
3.2.3	Gross capital formation, % GDP	n/a	n/a	
3.3	**Ecological sustainability**	**16.2**	**120**	◇
3.3.1	GDP/unit of energy use	3.2	119	○ ◇
3.3.2	Environmental performance*	37.0	100	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.1	58	● ◆
	MARKET SOPHISTICATION	**44.1**	**84**	
4.1	**Credit**	**27.4**	**114**	
4.1.1	Ease of getting credit*	65.0	61	
4.1.2	Domestic credit to private sector, % GDP	13.1	121	◇
4.1.3	Microfinance gross loans, % GDP ⊕	0.0	71	
4.2	**Investment**	**54.0**	**[22]**	
4.2.1	Ease of protecting minority investors*	54.0	88	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	**Trade, competition, and market scale**	**50.9**	**111**	
4.3.1	Applied tariff rate, weighted avg., % ⊕	5.0	93	
4.3.2	Intensity of local competition†	58.4	111	◇
4.3.3	Domestic market scale, bn PPP$	40.3	111	

		Score/Value	Rank	
	BUSINESS SOPHISTICATION	**18.2**	**108**	
5.1	**Knowledge workers**	**13.6**	**[114]**	
5.1.1	Knowledge-intensive employment, % ⊕	6.1	112	◇
5.1.2	Firms offering formal training, % ⊕	26.4	58	
5.1.3	GERD performed by business, % GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % ⊕	0.9	111	
5.2	**Innovation linkages**	**21.3**	**63**	●
5.2.1	University/industry research collaboration†	29.0	114	
5.2.2	State of cluster development†	31.4	119	◇
5.2.3	GERD financed by abroad, % GDP	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	21	● ◆
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	○ ◇
5.3	**Knowledge absorption**	**19.7**	**101**	
5.3.1	Intellectual property payments, % total trade ⊕	0.2	87	
5.3.2	High-tech imports, % total trade	5.8	99	
5.3.3	ICT services imports, % total trade ⊕	0.9	82	
5.3.4	FDI net inflows, % GDP	1.7	89	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
	KNOWLEDGE & TECHNOLOGY OUTPUTS	**12.9**	**101**	
6.1	**Knowledge creation**	**8.0**	**82**	
6.1.1	Patents by origin/bn PPP$ GDP ⊕	0.2	100	
6.1.2	PCT patents by origin/bn PPP$ GDP	0.0	80	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	7.2	67	
6.1.5	Citable documents H-index	7.6	87	
6.2	**Knowledge impact**	**21.0**	**80**	
6.2.1	Growth rate of PPP$ GDP/worker, %	-1.4	111	◇
6.2.2	New businesses/th pop. 15–64	2.1	54	●
6.2.3	Computer software spending, % GDP	0.0	22	● ◆
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.0	73	
6.2.5	High- and medium-high-tech manufacturing, % ⊕	21.7	51	●
6.3	**Knowledge diffusion**	**9.7**	**123**	
6.3.1	Intellectual property receipts, % total trade ⊕	0.0	70	
6.3.2	High-tech net exports, % total trade	0.1	103	
6.3.3	ICT services exports, % total trade ⊕	0.2	114	
6.3.4	FDI net outflows, % GDP	1.9	37	● ◆
	CREATIVE OUTPUTS	**11.0**	**112**	
7.1	**Intangible assets**	**11.6**	**126**	◇
7.1.1	Trademarks by origin/bn PPP$ GDP ⊕	4.1	123	○
7.1.2	Global brand value, top 5,000, % GDP	12.2	56	●
7.1.3	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.4	ICTs & organizational model creation†	29.7	123	○ ◇
7.2	**Creative goods and services**	**15.2**	**[63]**	
7.2.1	Cultural & creative services exports, % total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Entertainment & Media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing and other media, % manufacturing	n/a	n/a	
7.2.5	Creative goods exports, % total trade	1.2	40	●
7.3	**Online creativity**	**5.6**	**107**	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.5	111	
7.3.2	Country-code TLDs/th pop. 15–69	0.9	89	
7.3.3	Wikipedia edits/mn pop. 15–69	19.7	108	
7.3.4	Mobile app creation/bn PPP$ GDP	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⊕ indicates that the economy's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org. Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level.

APPENDIX III

SOURCES AND DEFINITIONS

This appendix complements the country/economy profiles and the online data tables by providing, for each of the 80 indicators included in the Global Innovation Index (GII) this year, its title, description, definition, and source.

For all 131 economies in the GII in 2020, the most recent values, within the period 2010 to 2019, were used for each indicator with a few noted exceptions (Appendix IV). The year provided next to the indicator description corresponds to the year when data were most frequently available for economies. When more than one year is considered, the period is indicated at the end of the indicator's source in parentheses.

Of the 80 indicators, 58 variables are hard data, 18 are composite indicators from third-party data providers, marked with (*), and 4 are survey questions from the World Economic Forum's Executive Opinion Survey (EOS), marked with (†). In some cases, additional markings are provided at the end of the indictor description. Instances marked with superscript "a" signal indicators that were assigned half weights and those marked with superscript "b" are indicators where higher scores indicate poorer outcomes, commonly known as "bads". Details on the computation can be found in Appendix IV.

Some indicators received special treatment by way of scaling during computation to be comparable across economies. Scaling of indicators by other comparable indicators or through division by gross domestic product (GDP) in current U.S. dollars, purchasing power parity GDP in international dollars (PPP$ GDP), population, total exports, total trade, and so on. Details are provided in this appendix. In all cases, the scaling factor used was the value that corresponded to the same year of the indicator.

1. Institutions

1.1. Political Environment

1.1.1. Political and operational stability

Political, legal, operational or security risk index*[ab] | 2019

Index that measures the likelihood and severity of political, legal, operational or security risks impacting business operations. Scores are annualized and standardized.

Source: IHS Markit, *Country Risk Scores*, aggregated for end Q1, Q2, Q3, and Q4 2019. (https://ihsmarkit.com/industry/economics-country-risk.html).

1.1.2. Government effectiveness

Government effectiveness index* | 2018

Index that reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Scores are standardized.

Source: World Bank, *Worldwide Governance Indicators*, 2019 update. (http://info.worldbank.org/governance/wgi/#home).

1.2. Regulatory environment

1.2.1. Regulatory quality

Regulatory quality index*[a] | 2018

Index that reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private-sector development. Scores are standardized.

Source: World Bank, *Worldwide Governance Indicators*, 2019 update. (http://info.worldbank.org/governance/wgi/#home).

1.2.2. Rule of law
Rule of law index*[a] | 2018

Index that reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Scores are standardized.

Source: World Bank, *Worldwide Governance Indicators*, 2019 update. (http://info.worldbank.org/governance/wgi/#home).

1.2.3. Cost of redundancy dismissal
Sum of notice period and severance pay for redundancy dismissal (salary in weeks, averages for workers with 1, 5, and 10 years of tenure, with a minimum threshold of 8 weeks)[b] | 2019

Redundancy costs measure the cost of advance notice requirements and severance payments due when terminating a redundant worker, expressed in weeks of salary. The average value of notice requirements and severance payments applicable to a worker with 1 year of tenure, a worker with 5 years, and a worker with 10 years is also considered. One month is recorded as 4 and 1/3 weeks. If the redundancy cost adds up to 8 or fewer weeks of salary, a value of 8 is assigned but the actual number of weeks is published. If the cost adds up to more than 8 weeks of salary, the score is the number of weeks.

Source: World Bank, *Doing Business 2020, Comparing Business Regulation in 190 Economies, 2020* (https://www.doingbusiness.org/en/reports/global-reports/doing-business-2020)

1.3. Business environment

1.3.1. Ease of starting a business
Ease of starting a business (score)* | 2019

The ranking of economies on the ease of starting a business is determined by sorting their scores. These scores are the simple average of the scores for each of the component indicators. The World Banks Doing Business records all procedures officially required, or commonly done in practice, for an entrepreneur to start up and formally operate an industrial or commercial business, as well as the time and cost to complete these procedures and the paid-in minimum capital requirement. These procedures include obtaining all necessary licenses and permits and completing any required notifications, verifications, or inscriptions for the company and employees with relevant authorities. Data are collected from limited liability companies based in the largest business cities. For 11 economies, namely Bangladesh, Brazil, China, India, Indonesia, Japan, Mexico, Nigeria, Pakistan, the Russian Federation, and the United States, the data are also collected for the second-largest business city.

Source: World Bank, *Doing Business 2020, Comparing Business Regulation in 190 Economies*, 2020 (https://www.doingbusiness.org/en/reports/global-reports/doing-business-2020).

1.3.2. Ease of resolving insolvency
Ease of resolving insolvency (score)* | 2019

The ranking of economies on the ease of resolving insolvency is determined by sorting their scores. These scores are the simple average of the scores for the recovery rate and the strength of insolvency framework index. The recovery rate is recorded as cents on the dollar recovered by secured creditors through reorganization, liquidation, or debt enforcement (foreclosure or receivership) proceedings. The calculation takes into account the outcome: whether the business emerges from the proceedings as a going concern or the assets are sold piecemeal. Then the costs of the proceedings are deducted (1 cent for each percentage point of the value of the debtor's estate). Finally, the value lost as a result of the time that the money remains tied up in insolvency proceedings is taken into account, including the loss of value due to depreciation of a hotel's furniture. The strength of the insolvency framework index is based on four other indices: commencement of proceedings index, management of debtor's assets index, reorganization proceedings index, and creditor participation index.

Source: World Bank, *Doing Business 2020, Comparing Business Regulation in 190 Economies, 2020* (https://www.doingbusiness.org/en/reports/global-reports/doing-business-2020).

2. Human capital and research

2.1. Education

2.1.1. Expenditure on education
Government expenditure on education (% of GDP) | 2018

Total general (local, regional and central) government expenditure on education (current, capital, and transfers), expressed as a percentage of GDP. It includes expenditure funded by transfers from international sources to government. Botswana, Morocco, and the Philippines use data for 2009.

Data for France sourced from Eurostat and UIS. Data for Greece sourced from Eurostat. Eurostat data sourced from table gov_10_exp General government expenditure by function (COFOG), General government sector, Education, Total general government expenditure (Extracted on 05/05/2020).

Source: UNESCO Institute for Statistics, *UIS online database; and Eurostat* (2009–18). (http://data.uis.unesco.org/; https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=gov_10a_exp&lang=en).

2.1.2. Government funding per secondary student
Government funding per secondary student (% of GDP per capita) | 2016

Total general (local, regional and central, current and capital) initial government funding of education per student, which includes transfers paid (such as scholarships to students), but excludes transfers received, in this case international transfers to government for education (when foreign donors provide education sector budget support or other support integrated in the government budget). This is then expressed as a share of GDP per capita, in US$. Botswana and Qatar use data for 2009.

Source: UNESCO Institute for Statistics, *UIS online database* (2009-18). (http://data.uis.unesco.org/).

2.1.3. School life expectancy
School life expectancy, primary to tertiary education, both sexes (years) | 2017

Total number of years of schooling that a child of a certain age can expect to receive in the future, assuming that the probability of his or her being enrolled in school at any particular age is equal to the current enrolment ratio for that age. For a child of a certain age, the school life expectancy is calculated as the sum of the age-specific enrolment rates for primary to tertiary levels of education. The part of the enrollment that is not distributed by age is divided by the school-age population for the primary to tertiary level of education in which they are enrolled, and multiplied by the duration of that level of education. The result is then added to the sum of the age-specific enrolment rates. A relatively high value indicates a greater probability that children will spend more years in education and a higher overall retention within the education system. It must be noted that the expected number of years spent in school does not necessarily coincide with the expected number of grades of education completed, because of grade repetition. Kenya uses data for 2009.

Source: UNESCO Institute for Statistics, *UIS online database* (2009–19). (http://data.uis.unesco.org).

2.1.4. Assessment in reading, mathematics, and science
PISA average scales in reading, mathematics, and science[a] | 2018

PISA is the OECD's (Organisation for Economic Co-operation and Development) Programme for International Student Assessment. PISA measures 15-year-olds' ability to use their reading, mathematics and science knowledge and skills. Results from PISA indicate the quality and equity of learning outcomes attained around the world. The 2018 PISA survey is the seventh round of the triennial assessment.

The indicator is built using the average of the reading, mathematics and science scores for each country. PISA scores are set in relation to the variation in results observed across all test participants in a country. There is theoretically no minimum or maximum score in PISA; rather, the results are scaled to fit approximately normal distributions, with means around 500 score points and standard deviations around 100 score points.

The 2018 scores for China correspond to the provinces/municipalities of Beijing, Shanghai, Jiangsu and Zhejiang only. The 2018 scores for Azerbaijan correspond only to the capital Baku. The 2018 average scores for Spain are based only on the scores for mathematics and science, given that the reading scores were not published by the OECD due to implausible response behavior amongst students. PISA 2018 results for Malaysia fully met the technical standards. However, Malaysia's PISA 2015 results cannot be compared to results from previous years or to those from 2018 due to the potential of bias introduced by low response rates in the original PISA sample. PISA 2015 results for Argentina cannot be compared to results from previous years or to results from 2018 due to the use of an incomplete sampling frame.

Source: OECD Programme for International Student Assessment (PISA) (2015–18). (www.pisa.oecd.org/).

2.1.5. Pupil-teacher ratio, secondary
Pupil-teacher ratio, secondary[ab] | 2018

The number of pupils enrolled in secondary school divided by the number of secondary school teachers (regardless of their teaching assignment). Where the data are missing for some countries, the ratios for upper-secondary are reported; if these are also missing, the ratios for lower-secondary are reported instead. A high pupil-teacher ratio suggests that each teacher has to be responsible for a large number of pupils. In other words, the higher the pupil/teacher ratio, the lower the relative access of pupils to teachers. Israel, Kenya, and Trinidad and Tobago use data for 2009.

Source: UNESCO Institute for Statistics, *UIS online database* (2009–19). (http://data.uis.unesco.org).

2.2. Tertiary education

2.2.1. Tertiary enrolment

School enrolment, tertiary (% gross) | 2017

The ratio of total tertiary enrolment, regardless of age, to the population of the age group that officially corresponds to the tertiary level of education. Tertiary education, whether or not at an advanced research qualification, normally requires, as a minimum condition of admission, the successful completion of education at the secondary level. The school enrolment ratio can exceed 100% as a result of grade repetition and the inclusion of over-aged and under-aged students because of early or late entrants.

Source: UNESCO Institute for Statistics, *UIS online database* (2010–19). (http://data.uis.unesco.org).

2.2.2. Graduates in science and engineering

Tertiary graduates in science, technology, engineering, and mathematics (% of total tertiary graduates) | 2017

The share of all tertiary-level graduates in natural sciences, mathematics, statistics, information and technology, manufacturing, engineering, and construction as a percentage of all tertiary-level graduates.

Source: UNESCO Institute for Statistics, *UIS online database* (2010–19). (http://data.uis.unesco.org).

2.2.3. Tertiary inbound mobility

Tertiary inbound mobility rate (%)[a] | 2017

The number of students from abroad studying in a given country as a percentage of the total tertiary-level enrolment in that country. Bangladesh uses data from 2009.

Source: UNESCO Institute for Statistics, *UIS online database* (2009–19). (http://data.uis.unesco.org).

2.3. Research and development (R&D)

2.3.1. Researchers FTE

Researchers, full-time equivalent (FTE) (per million population) | 2018

Researchers per million population, FTE. Researchers in R&D are professionals engaged in the conception or creation of new knowledge, products, processes, methods, or systems and in the management of the projects concerned. Postgraduate PhD students (ISCED97 level 6) engaged in R&D are included. Data collected from UNESCO Institute for Statistics, Eurostat, and OECD Main Science and Technology Indicators.

Source: UNESCO Institute for Statistics, *UIS online database*; Eurostat, Eurostat data base, 2020; OECD, *Main Science and Technology Indicators MSTI database, 2020* (2010–18). (http://data.uis.unesco.org; https://ec.europa.eu/eurostat/data/database; https://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB).

2.3.2. Gross expenditure on R&D (GERD)

Gross expenditure on R&D (% of GDP) | 2018

Total domestic intramural expenditure on R&D during a given period as a percentage of GDP. "Intramural R&D expenditure" is all expenditure for R&D performed within a statistical unit or sector of the economy during a specific period, whatever the source of funds. Data collected from UNESCO Institute for Statistics, Eurostat, and OECD Main Science and Technology Indicators. Plurinational State of Bolivia uses data for 2009.

Source: UNESCO Institute for Statistics, *UIS online database*; Eurostat, Eurostat data base, 2020; OECD, *Main Science and Technology Indicators MSTI database, 2020* (2009–19). (http://data.uis.unesco.org; https://ec.europa.eu/eurostat/data/database; https://stats.oecd.org/Index.aspx?DataSet-Code=MSTI_PUB).

2.3.3. Global R&D companies, average expenditure, top 3

Average expenditure of the top 3 global companies by R&D, mn US$* | 2019

Average expenditure on R&D of the top three global companies. If a country has fewer than three global companies listed, the figure is either the average of the sum of the two companies listed or the total for a single listed company. A score of 0 is given to countries with no listed companies.

Source: European Commission, *The 2019 EU Industrial R&D Investment Scoreboard*. (https://iri.jrc.ec.europa.eu/scoreboard/2019-eu-industrial-rd-investment-scoreboard).

2.3.4. QS university ranking score of top 3 universities

Average score of the top 3 universities at the QS world university ranking* | 2019

Average score of the top three universities per country. If fewer than three universities are listed in the QS ranking of the global top 1000 universities, the sum of the scores of the listed universities is divided by three, thus implying a score of zero for the non-listed universities.

Source: QS Quacquarelli Symonds Ltd, *QS World University Ranking 2019/2020, Top Universities*. (https://www.topuniversities.com/qs-world-university-rankings).

3. Infrastructure

3.1. Information and communication technologies (ICTs)

3.1.1. ICT access

ICT access index*[a] | 2018

The ICT access index, previously part of the ITU ICT Development Index, is a composite index that weights five ICT indicators (20% each): (1) Fixed telephone subscriptions per 100 inhabitants; (2) Mobile cellular telephone subscriptions per 100 inhabitants; (3) International Internet bandwidth (bit/s) per Internet user; (4) Percentage of households with a computer; and (5) Percentage of households with Internet access.

Source: GII calculations based on the *World Telecommunication/ICT Indicators Database* (Released January 18, 2019) following the methodology of the International Telecommunication Union, *ICT Development Index 2017* (http://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2017.aspx).

3.1.2. ICT use

ICT use index*[a] | 2018

The ICT use index, previously part of the ITU ICT Development Index, is a composite index that weights three ICT indicators (33% each): (1) Percentage of individuals using the Internet; (2) Fixed (wired)-broadband Internet subscriptions per 100 inhabitants; (3) Active mobile-broadband subscriptions per 100 inhabitants.

Source: GII calculations based on the *World Telecommunication/ICT Indicators Database* (Released January 18, 2019) following the methodology of the International Telecommunication Union, *ICT Development Index 2017* (http://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2017.aspx).

3.1.3. Government online service

Government's online service index*[a] | 2018

The Online Services Index component of the E-Government Development Index is a composite indicator measuring the use of ICTs by governments in delivering public services at the national level. The 2018 Online Service Questionnaire (OSQ) consists of a list of 140 questions. To arrive at a set of Online Service Index values for 2018, a total of 206 online United Nations Volunteer (UNV) researchers from 89 countries covering 66 languages, assessed each country's national website in the native language, including the national portal, e-services portal and e-participation portal, as well as the websites of the related ministries of education, labor, social services, health, finance, and environment, as applicable. The total number of points scored by each country is normalized to a range of 0 to 1. The online index value for a given country is equal to the actual total score less the lowest total score divided by the range of total score values for all countries.

Note: The precise meaning of these values varies from one edition of the Survey to the next as understanding of the potential of e-government changes and the underlying technology evolves. See link below for more details.

Source: United Nations Public Administration Network, *e-Government Survey 2018*. (https://publicadministration.un.org/en/research/un-e-government-surveys).

3.1.4. Online e-participation

E-Participation Index*[a] | 2018

The E-Participation Index (EPI) is derived as a supplementary index to the United Nations E-Government Survey. It extends the dimension of the Survey by focusing on the government use of online services in providing information to its citizens or "e-information sharing", interacting with stakeholders or "e-consultation" and engaging in decision-making processes or "e-decision-making." A country's EPI reflects the e-participation mechanisms that are deployed by the government as compared to all other countries. The purpose of this measure is not to prescribe any specific practice, but rather to offer insight into how different countries are using online tools in promoting interaction between the government and its citizens, as well as among the citizens, for the benefit of all. As the EPI is a qualitative assessment based on the availability and relevance of participatory services available on government websites, the comparative ranking of countries is for illustrative purposes and only serves as an indicator of the broad trends in promoting citizen engagement. As with the EGDI, the EPI is not intended as an absolute measurement of e-participation, but rather, as an attempt to capture the e-participation performance of counties relative to one another at a point in time. The index ranges from 0 to 1, with 1 showing greater e-participation. Mathematically, the EPI is normalized by taking the total score value for a given country, subtracting the lowest total score for any country in the Survey and dividing by the range of total score values for all countries.

Note: The precise meaning of these values varies from one edition of the Survey to the next as understanding of the potential of e-government changes and the underlying technology evolves. See link in source for more details.

Source: United Nations Public Administration Network, *e-Government Survey 2018*. (https://publicadministration.un.org/en/research/un-e-government-surveys).

3.2. General infrastructure

3.2.1. Electricity output

Electricity output (GWh per mn population)[a] 2017

Electricity production, measured at the terminals of all alternator sets in a station. In addition to hydropower, coal, oil, gas, and nuclear power generation, this indicator covers generation by geothermal, solar, wind, and tide and wave energy, as well as that from combustible renewables and waste. Production includes the output of electric plants that are designed to produce electricity only as well as that of combined heat and power plants. Electricity output in GWh is scaled by population.

Source: International Energy Agency (IEA) *World Energy Balances on-line data service, 2019 edition* (2017–18). (https://www.iea.org/reports/world-energy-balances-2019).

3.2.2. Logistics performance

Logistics Performance Index*[a] | 2018

A multidimensional assessment of logistics performance, the Logistics Performance Index (LPI) ranks 160 countries combining data on six core performance components into a single aggregate measure—including customs performance, infrastructure quality, and timeliness of shipments. The data used in the ranking comes from a survey of logistics professionals who are asked questions about the foreign countries in which they operate. The LPI's six components are: (1) the efficiency of customs and border management clearance ("Customs"); (2) the quality of trade and transport infrastructure ("Infrastructure"); (3) the ease of arranging competitively priced shipments ("International shipments"); (4) the competence and quality of logistics services ("Services Quality"); (5) the ability to track and trace consignments ("Tracking and tracing"); and (6) the frequency with which shipments reach consignees within scheduled or expected delivery times ("Timeliness"). The LPI consists therefore of both qualitative and quantitative measures and helps build profiles of logistics friendliness for these countries.

Source: World Bank and Turku School of Economics, *Logistics Performance Index 2018*; Arvis et al., 2018, *Connecting to Compete 2018: Trade Logistics in the Global Economy–The Logistics Performance Index and its Indicators*. (https://openknowledge.worldbank.org/bitstream/handle/10986/29971/LPI2018.pdf).

3.2.3. Gross capital formation

Gross capital formation (% of GDP) | 2019

Gross capital formation is expressed as a ratio of total investment in current local currency to GDP in current local currency. Investment or gross capital formation is measured by the total value of the gross fixed capital formation and changes in inventories and acquisitions less disposals of valuables for a unit or sector, on the basis of the System of National Accounts (SNA) of 1993.

Source: International Monetary Fund, W*orld Economic Outlook Database, October 2019* (PPP$ GDP). (https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

3.3. Ecological sustainability

3.3.1. GDP per unit of energy use

GDP per unit of energy use (2010 PPP$ per kg of oil equivalent) | 2017

Purchasing power parity gross domestic product (PPP$ GDP) per kilogram of oil equivalent of energy use. Total primary energy supply (TPES) is made up of production + imports − exports − international marine bunkers − international aviation bunkers +/– stock changes.

Source: International Energy Agency (IEA) *World Energy Balances on-line data service, 2019 edition* (2017–18). (https://www.iea.org/reports/world-energy-balances-2019).

3.3.2. Environmental performance

Environmental Performance Index* | 2019

The 2020 Environmental Performance Index (EPI) ranks 180 countries on 32 performance indicators across 11 issue categories covering environmental health and ecosystem vitality. These indicators provide a gauge at a national scale of how close countries are to established environmental policy targets. The EPI offers a scorecard that highlights leaders and laggards in environmental performance and provides practical guidance for countries that aspire to move toward a sustainable future. The index ranges from 0 to 100, with 100 indicating best performance.

Source: Yale University and Columbia University *2020 Environmental Performance Index*. (http://epi.yale.edu/).

3.3.3. ISO 14001 environment certificates

ISO 14001 Environmental management systems—Requirements with guidance for use: Number of certificates issued (per billion PPP$ GDP) | 2018

ISO 14001:2015 specifies the requirements for an environmental management system that an organization can use to enhance its environmental performance. ISO 14001 is intended for use by an organization seeking to manage its environmental responsibilities in a systematic manner that contributes to the environmental pillar of sustainability. ISO 14001 helps an organization achieve the intended outcomes of its environmental management system, which provide value for the environment, the organization itself, and interested parties. Consistent with the organization's environmental policy, the intended outcomes of an environmental management system include enhancement of environmental performance, fulfillment of compliance obligations, and achievement of environmental objectives. ISO 14001 is applicable to any organization, regardless of size, type, or nature, and applies to the environmental aspects of its activities, products, and services that the organization determines it can either control or influence from a life cycle perspective. ISO 14001 does not state specific environmental performance criteria. ISO 14001 can be used in whole or in part to systematically improve environmental management. Claims of conformity to ISO 14001, however, are not acceptable unless all its requirements are incorporated into an organization's environmental management system and fulfilled without exclusion. The data are reported per billion PPP$ GDP.

Source: International Organization for Standardization, *The ISO Survey of certifications to management system standards, 2018*; International Monetary Fund, *World Economic Outlook Database, October 2019* (PPP$ GDP). (https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

4. Market Sophistication

4.1. Credit

4.1.1. Ease of getting credit

Ease of getting credit* | 2019

The ranking of economies on the ease of getting credit is determined by sorting their scores for getting credit.

These scores are the score for the sum of the strength of the legal rights index (range 0–12) and the depth of credit information index (range 0–8). Doing Business measures the legal rights of borrowers and lenders with respect to secured transactions through one set of indicators and the reporting of credit information through another. The first set of indicators measures whether certain features that facilitate lending exist within the applicable collateral and bankruptcy laws. The second set measures the coverage, scope, and accessibility of credit information available through credit reporting service providers such as credit bureaus or credit registries. Although Doing Business compiles data on getting credit for public registry coverage (% of adults) and for private bureau coverage (% of adults), these indicators are not included in the ranking.

Source: World Bank, *Doing Business 2020, Comparing Business Regulation in 190 Economies, 2020* (https://www.doingbusiness.org/en/reports/global-reports/doing-business-2020)

4.1.2. Domestic credit to private sector

Domestic credit to private sector (% of GDP) | 2018

"Domestic credit to private sector" refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable that establish a claim for repayment. For some countries, these claims include credit to public enterprises. The financial corporations include monetary authorities and deposit money banks, as well as other financial corporations where data are available (including corporations that do not accept transferable deposits but do incur such liabilities as time and savings deposits). Examples of other financial corporations are finance and leasing companies, money lenders, insurance corporations, pension funds, and foreign exchange companies.

Source: International Monetary Fund, International Financial Statistics and data files; and World Bank and OECD GDP estimates; extracted from the World Bank's *World Development Indicators* database (2010-2018). (http://data.worldbank.org/).

4.1.3. Microfinance institutions gross loan portfolio

Microfinance institutions: Gross loan portfolio (% of GDP)[a] | 2018

Combined gross loan balances of microfinance institutions (current US$) in a country as a percentage of its GDP (current US$).

Source: Microfinance Information Exchange, *Mix Market database*; International Monetary Fund, *World Economic Outlook Database, October 2019* (current US$ GDP) (2011-2019). (https://datacatalog.worldbank.org/dataset/mix-market; https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

4.2. Investment

4.2.1. Ease of protecting minority investors

Ease of protecting minority investors* | 2019

This ranking is the sum of the scores for the extent of conflict of interest regulation index and the extent of shareholder governance index. The extent of conflict of interest regulation index measures the protection of shareholders against directors' misuse of corporate assets for personal gain by distinguishing three dimensions of regulation that address conflicts of interest: transparency of related-party transactions (extent of disclosure index), shareholders' ability to sue and hold directors liable for self-dealing (extent of director liability index), and access to evidence and allocation of legal expenses in shareholder litigation (ease of shareholder suits index). The extent of shareholder governance index measures shareholders' rights in corporate governance by distinguishing three dimensions of good governance: shareholders' rights and role in major corporate decisions (extent of shareholder rights index); governance safeguards protecting shareholders from undue board control and entrenchment (extent of ownership and control index); and corporate transparency on ownership stakes, compensation, audits, and financial prospects (extent of corporate transparency index). The index also measures whether a subset of relevant rights and safeguards are available in limited companies. The data come from a questionnaire administered to corporate and securities lawyers and are based on securities regulations, company laws, civil procedure codes, and court rules of evidence.

Source: World Bank, *Doing Business 2020, Comparing Business Regulation in 190 Economies, 2020* (https://www.doingbusiness.org/en/reports/global-reports/doing-business-2020).

4.2.2. Market capitalization

Market capitalization of listed domestic companies (% of GDP, three-year average) | 2018

Market capitalization (also known as "market value") is the share price times the number of shares outstanding (including their several classes) for listed domestic companies. Investment funds, unit trusts, and companies whose only business goal is to hold shares of other listed companies are excluded. Data are the average of the end-of-year values for the last three years with the exception of Bulgaria, Ghana, Jamaica, Kenya, Romania, and Serbia (averages for two years: 2010 and 2011); and Zambia (2011).

Source: World Federation of Exchanges database; extracted from the World Bank's *World Development Indicators* database (2011–18). (http://data.worldbank.org/).

4.2.3. Venture capital deals

Venture capital per investment location: Number of deals (per billion PPP$ GDP) | 2019

Thomson Reuters Eikon data on private equity deals, per deal, with information on the location of investment, investment company, investor firms, funds, and crowdfunding, among other details. The series corresponds to a query on venture capital deals from January 1, 2019 to December 31, 2019, with the data collected by investment location, for a total of 17,960 deals in 81 countries in 2019. The data are reported per billion PPP$ GDP.

Source: Thomson Reuters Eikon, *Private Equity* screener; International Monetary Fund, *World Economic Outlook Database October 2019* (PPP$ GDP). (https://eikon.thomsonreuters.com/index.html); https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

4.3. Trade, competition, and market scale

4.3.1. Applied tariff rate, weighted average

Tariff rate, applied, weighted average, all products (%)[a,b] | 2018

"Weighted mean applied tariff" is the average of effectively applied rates weighted by the product import shares corresponding to each partner country. Data are classified using the Harmonized System of trade at the six- or eight-digit level. Tariff line data were matched to Standard International Trade Classification (SITC) revision 3 codes to define commodity groups and import weights. To the extent possible, specific rates have been converted to their ad valorem equivalent rates and have been included in the calculation of weighted mean tariffs. Effectively applied tariff rates at the six- and eight-digit product level are averaged for products in each commodity group. When the effectively applied rate is unavailable, the most favored nation rate is used instead.

Source: World Bank, based on data from United Nations Conference on Trade and Development's Trade Analysis and Information System (TRAINS) database and the World Trade Organization's (WTO) Integrated Data Base (IDB) and Consolidated Tariff Schedules (CTS) database; extracted from World Bank's *World Development Indicators* database (2015–18). (http://data.worldbank.org/).

4.3.2. Intensity of local competition

Average answer to the survey question: In your country, how intense is competition in the local markets? [1 = not intense at all; 7 = extremely intense][†] | 2019

Source: World Economic Forum, *Executive Opinion Survey 2019*. (http://www3.weforum.org/docs/WEF_GCR_2019_Appendix_B.pdf).

4.3.3. Domestic market scale

Domestic market scale as measured by GDP, bn PPP$ | 2019

The domestic market size is measured by gross domestic product (GDP) based on the purchasing-power-parity (PPP) valuation of country GDP, in current international dollars (billions).

Source: International Monetary Fund, *World Economic Outlook Database, October 2019* (PPP$ GDP). (https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

5. Business sophistication

5.1. Knowledge workers

5.1.1. Knowledge-intensive employment

Employment in knowledge-intensive occupations (% of workforce) | 2018

Sum of people in categories 1 to 3 as a percentage of total people employed, according to the International Standard Classification of Occupations (ISCO). Categories included in ISCO-08 are: 1 Managers, 2 Professionals, and 3 Technicians and associate professionals (years 2009–18). Where ISCO-08 data were not available, ISCO-88 data were used. Categories included in ISCO-88 are: 1 Legislators, senior officials and managers; 2 Professionals; 3 Technicians and associate professionals (2010–19).

Source: International Labour Organization *ILOSTAT Database of Labour Statistics* (2010–19). (http://www.ilo.org/ilostat/).

5.1.2. Firms offering formal training

Firms offering formal training (% of firms) | 2018

The percentage of firms offering formal training programs for their permanent, full-time employees in the sample of firms in the World Bank's Enterprise Survey in each country. Botswana, Chile, Costa Rica, Jamaica, Mexico, Paraguay, and Trinidad and Tobago use data for 2009.

Source: World Bank, *Enterprise Surveys* (2009–19). (http://www.enterprisesurveys.org/).

5.1.3. GERD performed by business enterprise

GERD performed by business enterprise (% of GDP) | 2018

Gross expenditure on R&D performed by business enterprise as a percentage of GDP. For the definition of GERD see indicator 2.3.2.

Source: UNESCO Institute for Statistics, *UIS online database*; Eurostat, Eurostat database, 2019; OECD, *Main Science and Technology Indicators MSTI database, 2019* (2010–19). (http://data.uis.unesco.org; https://ec.europa.eu/eurostat/data/database; https://stats.oecd.org/Index.aspx?DataSet-Code=MSTI_PUB).

5.1.4. GERD financed by business enterprise

GERD: Financed by business enterprise (% of total GERD) | 2017

Gross expenditure on R&D financed by business enterprise as a percentage of total gross expenditure on R&D. For the definition of GERD see indicator 2.3.2. The Plurinational State of Bolivia and Burkina Faso use data for 2009.

Source: UNESCO Institute for Statistics, *UIS online database*; Eurostat, *Eurostat database, 2019*; OECD, *Main Science and Technology Indicators MSTI database, 2019* (2009-18). (http://data.uis.unesco.org; https://ec.europa.eu/eurostat/data/database; https://stats.oecd.org/Index.aspx?DataSet-Code=MSTI_PUB).

5.1.5. Females employed with advanced degrees

Females employed with advanced degrees, % total employed (25+ years old)[a] | 2018

The percentage of females employed with advanced degrees out of total employed. The employed comprise all persons of working age who, during a specified brief period, were in one of the following categories: (1) paid employment (whether at work or with a job but not at work); or (2) self-employment (whether at work or with an enterprise but not at work). Data are disaggregated by level of education, which refers to the highest level of education completed, classified according to the International Standard Classification of Education (ISCE). Data for Canada are based on Table 14-10-0020-01 of the country's Labour Force Survey estimates. Tajikistan uses data for 2009.

Source: International Labour Organization, *ILOSTAT Annual Indicators*; Statistics Canada, *Table 14-10-0020-01 Unemployment rate, participation rate and employment rate by educational attainment, annual* (x 1,000), accessed February 10, 2020 (2009-19).

5.2. Innovation linkages

5.2.1. University/industry research collaboration

Average answer to the survey question: In your country, to what extent do businesses and universities collaborate on research and development (R&D)? [1 = do not collaborate at all; 7 = collaborate extensively][†a] | 2019

Source: World Economic Forum, *Executive Opinion Survey 2019*. (http://www3.weforum.org/docs/WEF_GCR_2019_Appendix_B.pdf).

5.2.2. State of cluster development

Average answer to the survey question on the role of clusters in the economy: In your country, how widespread are well-developed and deep clusters (geographic concentrations of firms, suppliers, producers of related products and services, and specialized institutions in a particular field)? [1 = non-existent; 7 = widespread in many fields][†] | 2019

Source: World Economic Forum, *Executive Opinion Survey 2019*. (http://www3.weforum.org/docs/WEF_GCR_2019_Appendix_B.pdf).

5.2.3. GERD financed by abroad

GERD: Financed by abroad (% of GDP) | 2017

Percentage of gross expenditure on R&D financed by abroad (billions, national currency)—that is, with foreign financing as a percentage of GDP (billions, national currency). For the definition of GERD see indicator 2.3.2.

Source: UNESCO Institute for Statistics, *UIS online database*; Eurostat, *Eurostat database, 2019*; OECD, *Main Science and Technology Indicators MSTI database, 2019* (2010-18). (http://data.uis.unesco.org; https://ec.europa.eu/eurostat/data/database; https://stats.oecd.org/Index.aspx?DataSet-Code=MSTI_PUB).

5.2.4. Joint venture/strategic alliance deals

Joint ventures/strategic alliances: Number of deals, fractional counting (per billion PPP$ GDP) | 2019

Thomson Reuters data on joint ventures/strategic alliances deals, per deal, with details on the country of origin of partner firms, among others. The series corresponds to a query on joint venture/strategic alliance deals from January 1, 2019 to December 31, 2019, for a total of 10,535 deals announced in 2019, with firms headquartered in 122 GII participating economies. Each participating nation of each company in a deal (n countries per deal) gets, per deal, a score equivalent to 1/n (with the effect that all country scores add up to 10,535). The data are reported per billion PPP$ GDP.

Source: Thomson Reuters, *Thomson One Banker Private Equity, SDC Platinum* database; International Monetary Fund *World Economic Outlook Database*, October 2019 (PPP$ GDP). (http://banker.thomsonib.com; https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).).

5.2.5. Patent families filed in two offices

Number of patent families in at least two offices (per billion PPP$ GDP) | 2016

A "patent family" is a set of interrelated patent applications filed in one or more countries or jurisdictions to protect the same invention. Patent families containing applications filed in at least two different offices is a subset of patent families where protection of the same invention is sought in at least two different countries. In this report, "patent families data" refers to patent families containing applications filed in at least two IP offices; the data are scaled by PPP$ GDP (billions). A "patent" is a set of exclusive rights granted by law to applicants for inventions that are new, non-obvious, and industrially applicable. A patent is valid for a limited period of time (generally 20 years) and within a limited territory. The patent system is designed to encourage innovation by providing innovators with time-limited exclusive legal rights, thus enabling them to appropriate the returns from their innovative activity.

Source: World Intellectual Property Organization, *Intellectual Property Statistics*; International Monetary Fund, *World Economic Outlook Database*, October 2019 (PPP$ GDP). (http://www.wipo.int//ipstats/; https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

5.3. Knowledge absorption

5.3.1. Intellectual property payments

Charges for use of intellectual property, i.e., payments (%, total trade, three-year average) | 2018

Charges for the use of intellectual property not included elsewhere payments (% of total trade), average of three most recent years or available data. Value according to the Extended Balance of Payments Services Classification EBOPS 2010—that is, code SH charges for the use of intellectual property not included elsewhere as a percentage of total trade. "Total trade" is defined as the sum of total imports code G goods and code SOX commercial services (excluding government goods and services not included elsewhere) plus total exports of code G goods and code SOX commercial services (excluding government goods and services not included elsewhere), divided by 2. According to the sixth edition of the International Monetary Fund's Balance of Payments Manual, the item "Goods" covers general merchandise, net exports of goods under merchanting, and non-monetary gold. The "commercial services" category is defined as being equal to "services" minus "government goods and services not included elsewhere". Receipts are between residents and non-residents for the use of proprietary rights (such as patents, trademarks, copyrights, industrial processes and designs including trade secrets, franchises), and for licenses to reproduce or distribute (or both) intellectual property embodied in produced originals or prototypes (such as copyrights on books and manuscripts, computer software, cinematographic works, and sound recordings) and related rights (such as for live performances and television, cable, or satellite broadcast). Data for Azerbaijan is for (2010-12), Guinea (2010-12), Islamic Republic of Iran (2014-16), Mali (2009, 2019), Niger (2009), Rwanda (2009), Tajikistan (2009, 2017, 2018), and Yemen (2014-16).

Source: World Trade Organization, *Trade in Commercial Services* database, based on the sixth (2009) edition of the International Monetary Fund's *Balance of Payments and International Investment Position Manual* and *Balance of Payments* database (https://data.wto.org/ ; http://www.oecd.org/std/its/EBOPS-2010.pdf).

5.3.2. High-tech imports

High-tech imports (% of total trade) | 2018

High-technology imports as a percentage of total trade. High-technology exports and imports contain technical products with a high intensity of R&D, defined by the Eurostat classification, which is based on Standard International Trade Classification (SITC) Revision 4 and the Organisation for Economic Co-operation and Development (OECD) definition. Commodities belong to the following sectors: aerospace; computers & office machines; electronics; telecommunications; pharmacy; scientific instruments; electrical machinery; chemistry; non-electrical machinery; and armament.

Source: World Trade Organization, United Nations, *Comtrade* database; Eurostat, *Annex 5: High-tech aggregation by SITC Rev. 4*, April 2009 (2015-2018). (http://comtrade.un.org/; http://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an5.pdf).

5.3.3. ICT services imports

Telecommunications, computers, and information services imports (% of total trade)[a] | 2018

Telecommunications, computer and information services as a percentage of total trade according to the Organisation for Economic Co-operation and Development (OECD)'s Extended Balance of Payments Services Classification EBOPS 2010, coded SI: Telecommunications, computer and information services. For the definition of total trade see indicator 5.3.1.

Source: World Trade Organization, T*rade in Commercial Services* database, based on the sixth (2009) edition of the International Monetary Fund's *Balance of Payments and International Investment Position Manual* and B*alance of Payments* database (2015-18) (https://data.wto.org/; http://www.oecd.org/std/its/EBOPS-2010.pdf).

5.3.4. Foreign direct investment net inflows

Foreign direct investment (FDI), net inflows (% of GDP, three-year average)[a] | 2018

Foreign direct investment is the average of the most recent three years of net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP.

Source: International Monetary Fund, *International Financial Statistics* and *Balance of Payments* databases, World Bank, *International Debt Statistics*, and World Bank and OECD GDP estimates; extracted from the World Bank's *World Development Indicators* database, 2019. (http://data.worldbank.org/).

5.3.5. Research talent in business enterprise

Researchers in business enterprise per thousand population (%) | 2018

"Full-time equivalent (FTE) researchers in the business enterprise sector" refers to researchers as professionals engaged in the conception or creation of new knowledge, products, processes, methods, and systems, as well as in the management of these projects, broken down by the sectors in which they are employed (business enterprise, government, higher education, and private non-profit organizations). In the context of R&D statistics, the business enterprise sector includes all firms, organizations, and institutions whose primary activity is the market production of goods or services (other than higher education) for sale to the general public at an economically significant price, and the private non-profit institutions mainly serving them; the core of this sector is made up of private enterprises. This also includes public enterprises.

Source: UNESCO Institute for Statistics, *UIS online database*; Eurostat, *Eurostat database, 2019*; OECD, *Main Science and Technology Indicators MSTI database, 2019* (2010–18). (http://data.uis.unesco.org; https://ec.europa.eu/eurostat/data/database; https://stats.oecd.org/Index.aspx?DataSet-Code=MSTI_PUB).

6. Knowledge and technology outputs

6.1. Knowledge creation

6.1.1. Patent applications by origin

Number of resident patent applications filed at a given national or regional patent office (per billion PPP$ GDP) | 2018

A "patent" is defined in the description of indicator 5.2.5. A resident patent application refers to an application filed with an IP office for or on behalf of the first-named applicant's country of residence. For example, an application filed with the Japan Patent Office (JPO) by a resident of Japan is considered a resident application for Japan. Similarly, an application filed with the European Patent Office (EPO) by an applicant who resides in any of the EPO member states, for example Germany, is considered a resident application for that member state (Germany). Data are scaled by PPP$ GDP (billions).

Source: World Intellectual Property Organization, *Intellectual Property Statistics*; International Monetary Fund, *World Economic Outlook Database*, October 2019 (PPP$ GDP) (2010–18). (http://www.wipo.int/ipstats/; https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

6.1.2. PCT applications by origin

Number of Patent Cooperation Treaty applications (per billion PPP$ GDP)[a] | 2019

A PCT application refers to an international patent applications filed through the WIPO-administered Patent Cooperation Treaty (PCT). The PCT system makes it possible to seek patent protection for an invention simultaneously in a number of countries by filing a single international patent application. The origin of PCT applications is defined by the residence of the first-named applicant. Data is available only for those economies which are PCT Contracting States. Data are scaled by PPP$ GDP (billions).

Source: World Intellectual Property Organization, *Intellectual Property Statistics*; International Monetary Fund, *World Economic Outlook Database*, October 2019 (PPP$ GDP). (http://www.wipo.int/ipstats/; https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

6.1.3. Utility models by origin

Number of resident utility model applications filed at the national patent office (per billion PPP$ GDP) | 2018

A "utility model" (UM) is a special form of patent right. The terms and conditions for granting a utility model are slightly different from those for normal patents and include a shorter term of protection and less stringent patentability requirements. A utility model is sometimes referred to in certain countries as "petty patents", "short-term patents", or "innovation patents". A resident UM application refers to an application filed with an IP office for or on behalf of the first-named applicant's country of residence. For example, an application filed with the IP office of Germany by a resident of Germany is considered a resident application for Germany. Data are scaled by PPP$ GDP (billions).

Source: World Intellectual Property Organization, *Intellectual Property Statistics*; International Monetary Fund, *World Economic Outlook Database*, October 2019 (PPP$ GDP) (2010–18). (http://www.wipo.int/ipstats/; https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

6.1.4. Scientific and technical publications

Number of scientific and technical journal articles (per billion PPP$ GDP) | 2019

The number of scientific and engineering articles published in those fields, including: agriculture, astronomy, astrophysics, automation control systems, biochemistry molecular biology, biodiversity conservation, biotechnology applied microbiology, cell biology, chemistry, computer science, construction building technology, dentistry oral surgery medicine, engineering, environmental sciences, ecology, evolutionary biology, food science technology, general internal medicine, life sciences biomedicine and other topics, marine freshwater biology, materials science, mathematical computational biology, mathematics, metallurgy and metallurgical engineering, meteorology atmospheric science, microbiology, nuclear science and technology, physics, plant sciences, radiology nuclear medicine medical imaging, reproductive biology, research experimental medicine, science technology and other topics, telecommunications, transportation, and veterinary sciences. Article counts are from a set of journals covered by the Science Citation Index (SCI) and the Social Sciences Citation Index (SSCI). Articles are classified by year of publication and assigned to each country/economy on the basis of the institutional address(es) listed in the article.

Articles are counted on a count basis (rather than a fractional basis)—that is, for articles with collaborating institutions from multiple countries/economies, each country/economy receives credit on the basis of its participating institutions. The data are reported per billion PPP$ GDP.

Source: Clarivate Analytics, special tabulations from Clarivate Analytics, Web of Science, Science Citation Index (SCI), and Social Sciences Citation Index (SSCI); International Monetary Fund, *World Economic Outlook Database*, October 2019 (PPP$ GDP). (https://www.webofknowledge.com; https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

6.1.5. Citable documents H-index

The H-index is the economy's number of published articles (H) that have received at least H citations | 2019

The H-index expresses the journal's number of articles (H) that have received at least H citations. It quantifies both journal scientific productivity and scientific impact. The H-index is tabulated from the number of citations received in subsequent years by articles published in a given year, divided by the number of articles published that year.

Source: SCImago (2020) *SJR—SCImago Journal & Country Rank*. Retrieved March 2020. (http://www.scimagojr.com).

6.2. Knowledge impact

6.2.1. Growth rate of GDP per person engaged

Growth rate of GDP per person engaged (%, three-year average) | 2019

Growth rate of real GDP per person employed (constant 1990 PPP$), average of three last available years. Growth of gross domestic product (GDP) per person engaged provides a measure of labor productivity (defined as output per unit of labor input). GDP per person employed is GDP divided by total employment in the economy. PPP$ GDP is Constant 1990 in U.S. dollars, expressed in 1990 GK PPP, Millions. While this is a relatively robust measure, it does not correct for part-time jobs as it merely counts people who are employed. Hence, GDP per person employed is somewhat underestimated in countries with a higher share of part-time workers, which are mostly OECD countries.

Source: The Conference Board Total Economy Database™ Output, Labor and Labor Productivity, 1950–2019, April 2020 preliminary release. (https://www.conference-board.org/data/economydatabase/).

6.2.2. New business density

New business density (new registrations per thousand population 15–64 years old)[a] | 2018

Number of newly registered corporations per 1,000 working-age (15–64 years old). The units of measurement are private, formal sector companies with limited liability. The scope of data was expanded in 2018 for Brazil. Data corrections relative to the 2016 survey were implemented for Panama. Malawi uses data for 2009.

Source: *World Bank, Doing Business 2020, Entrepreneurship Project* (2009–2018). (https://www.doingbusiness.org/en/data/exploretopics/entrepreneurship).

6.2.3. Total computer software spending

Total computer software spending (% of GDP) | 2019

Computer software spending includes the total value of purchased or leased packaged software such as operating systems, database systems, programming tools, utilities, and applications. It excludes expenditures for internal software development and outsourced custom software development. The data are a combination of actual figures and estimates. Data are reported as a percentage of GDP.

Source: IHS Markit, *Information and Communication Technology Database*. (https://www.ihs.com/index.html).

6.2.4. ISO 9001 quality certificates

ISO 9001 Quality management systems—Requirements: Number of certificates issued (per billion PPP$ GDP) | 2018

ISO 9001:2015 specifies requirements for a quality management system when an organization needs to demonstrate its ability to consistently provide products and services that meet customer and applicable statutory and regulatory requirements, and aims to enhance customer satisfaction through the effective application of the system, including processes for improving the system and assuring conformity to customer and applicable statutory and regulatory requirements. All the requirements of ISO 9001:2015 are generic and are intended to be applicable to any organization, regardless of its type or size, or the products and services it provides. The data are reported per billion PPP$ GDP. Refer to indicator 3.3.3 for more details.

Source: International Organization for Standardization (ISO), *The ISO Survey of certifications to management system standards, 2018*; International Monetary Fund, *World Economic Outlook database, October 2019* (PPP$ GDP). (http://www.iso.org; https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

6.2.5. High-tech and medium-high-tech manufacturing

High-tech and medium-high-tech manufacturing (% of total manufacturing output) | 2017

High-tech and medium-high-tech output as a percentage of total manufactures output, on the basis of the Organisation for Economic Co-operation and Development (OECD) classification of Technology Intensity Definition, itself based on International Standard Industrial Classification ISIC Revision 4 and ISIC Revision 3. ISIC Revision 4 data were preferred; when not available or not reported for a given country, ISIC Revision 3 data were used. For all ISIC three-digit classification codes included in the definition of high-tech and medium-high-tech output reported as missing for a given country, but for which four-digit level data were available, the three-digit values were calculated as the sum of all four-digit codes that were available.

Source: United Nations Industrial Development Organization (UNIDO), *Industrial Statistics Database*, 3- and 4-digit level of International Standard Industrial Classification ISIC Revision 4 and Revision 3 (INDSTAT4 2020); OECD, Directorate for Science, Technology and Industry, Economic Analysis and Statistics Division, *ISIC Rev. 3 and Rev. 4 Technology Intensity Definition: Classification of Manufacturing Industries into Categories Based on R&D Intensities* (2010-17) (http://www.unido.org/statistics.html; https://stat.unido.org/content/focus/classification-of-manufacturing-sectors-by-technological-intensity-%2528isic-revision-4%2529;jsessionid=4DB1A3A5812144CACC956F4B8137C1CF; http://www.oecd.org/sti/ind/48350231.pdf).

6.3. Knowledge diffusion

6.3.1. Intellectual property receipts

Charges for use of intellectual property, i.e., receipts (% total trade, three-year average)[a] | 2018

Charges for the use of intellectual property not included elsewhere receipts (% of total trade), average of three most recent years or available data. Value according to the Extended Balance of Payments Services Classification EBOPS 2010—that is, code SH charges for the use of intellectual property not included elsewhere as a percentage of total trade. Receipts are between residents and non-residents for the use of proprietary rights (such as patents, trademarks, copyrights, industrial processes, and designs including trade secrets, franchises), and for licenses to reproduce or distribute (or both) intellectual property embodied in produced originals or prototypes (such as copyrights on books and manuscripts, computer software, cinematographic works, and sound recordings) and related rights (such as for live performances and television, cable, or satellite broadcast). For definition of total trade see indicator 5.3.1. Data for Azerbaijan (2010-12), Benin (2014-16), Côte d'Ivoire (2014-16), Islamic Republic of Iran (2013-15), Mali (2011-12, 2017), Mozambique (2009, 2011 -12), Niger (2015-16), Rwanda (2009), Tajikistan (2009), Yemen (2009, 2016), and Zimbabwe (2014-16).

Source: World Trade Organization, *Trade in Commercial Services* database, based on the sixth (2009) edition of the International Monetary Fund's *Balance of Payments and International Investment Position Manual* and *Balance of Payments* database (2010-2018) (https://data.wto.org/; http://www.oecd.org/std/its/EBOPS-2010.pdf).

6.3.2. High-tech exports

High-tech net exports (% of total trade) | 2018

High-technology exports minus re-exports (% of total trade). See indicator 5.3.2 for details.

Source: World Trade Organization, United Nations, *Comtrade* database; Eurostat, *Annex 5: High-tech aggregation by SITC Rev. 4*, April 2009 (2012-2018). (http://comtrade.un.org/; https://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an5.pdf).

6.3.3. ICT services exports

Telecommunications, computers, and information services exports (% of total trade) | 2018

Telecommunications, computer and information services (% of total trade) according to the Extended Balance of Payments Services Classification EBOPS 2010, coded SI: Telecommunications, computer and information services.

Source: World Trade Organization, *Trade in Commercial Services* database, based on the sixth (2009) edition of the International Monetary Fund's *Balance of Payments and International Investment Position Manual* and *Balance of Payments* database (2015-18) (https://data.wto.org/ ; http://www.oecd.org/std/its/EBOPS-2010.pdf).

6.3.4. Foreign direct investments net outflows

Foreign direct investment (FDI), net outflows (% of GDP, three-year average)[a] | 2018

"Foreign direct investment" refers to the average of the most recent three years of direct investment equity flows in an economy. It is the sum of equity capital, reinvestment of earnings, and other capital. Direct investment is a category of cross-border investment associated with a resident in one economy having control or a significant degree of influence on the management of an enterprise that is resident in another economy.

Ownership of 10 percent or more of the ordinary shares of voting stock is the criterion for determining the existence of a direct investment relationship. This series shows net outflows of investment from the reporting economy to the rest of the world, and is divided by GDP.

Source: International Monetary Fund, *International Financial Statistics* and *Balance of Payments* databases, World Bank, *International Debt Statistics*, and World Bank and OECD GDP estimates; extracted from the World Bank's World Development *Indicators* database (2015–18). (http://data.worldbank.org/).

7. Creative outputs

7.1. Intangible assets

7.1.1. Trademark application class count by origin

Number of classes in resident trademark applications issued at a given national or regional office (per billion PPP$ GDP) | 2018

A "trademark" is a sign used by the owner of certain products or provider of certain services to distinguish them from the products or services of other companies. A trademark can consist of words and/or combinations of words, such as slogans, names, logos, figures and images, letters, numbers, sounds, and moving images, or a combination thereof. The procedures for registering trademarks are governed by the legislation and procedures of national and regional IP offices. Trademark rights are limited to the jurisdiction of the IP office that registers the trademark. Trademarks can be registered by filing an application at the relevant national or regional office(s) or by filing an international application through the Madrid System. A resident trademark application refers to an application filed with an IP office for or on behalf of the first-named applicant's country of residence. For example, an application filed with the Japan Patent Office (JPO) by a resident of Japan is considered a resident application for Japan. Similarly, an application filed with the Office for Harmonization in the Internal Market (OHIM) by an applicant who resides in any of the EU member states, such as France, is considered a resident application for that member state (France). This indicator is based on class count—the total number of goods and services classes specified in resident trademark applications. Data are scaled by PPP$ GDP (billions).

Source: World Intellectual Property Organization, *Intellectual Property Statistics*; International Monetary Fund, *World Economic Outlook Database, October 2019* (PPP$ GDP) (2012–18). (http://www.wipo.int//ipstats/; https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

7.1.2. Global brand value

Global brand value of the top 5,000 brands (% of GDP) | 2019

Sum of Global Brand Values, top 5,000 as a percentage of GDP. 2020 rankings based on 2019 data. Brand Finance calculates brand value using the Royalty Relief methodology, which determines the value a company would be willing to pay to license its brand as if it did not own it. The methodology is compliant with industry standards set in ISO 10668. ISO This approach involves estimating the future revenue attributable to a brand and calculating a royalty rate that would be charged for the use of the brand. Brand Finance's study is based on publicly available information on the largest brands in the world. This indicator assess the economy's brands in the top 5,000 global brand database and produces the sum of the brand values corresponding to that economy. This sum is then scaled by GDP. A score of 0 is assigned where there are no brands in the country that make the Top 5000 ranking. A score of n/a is assigned where Brand Finance has been unable to determine if there are brands from the country that would rank within the Top 5000 due to data availability limitations.

Source: Brand Finance database; International Monetary Fund, *World Economic Outlook Database, October 2019* (2019). (https://brandirectory.com/; https://brandfinance.com/knowledge-centre/; https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

7.1.3. Industrial designs by origin

Number of designs contained in resident industrial design applications filed at a given national or regional office (per billion PPP$ GDP)[a] | 2018

An "industrial design" is a set of exclusive rights granted by law to applicants for protecting the ornamental or aesthetic aspect of their products. An industrial design is valid for a limited period of time and within a limited territory. A resident industrial design application refers to an application filed with the IP office for or on behalf of the applicant's country of residence. For example, an application filed with the Japan Patent Office (JPO) by a resident of Japan is considered a resident application for Japan. Similarly, an application filed with the Office for Harmonization in the Internal Market (OHIM) by an applicant who resides in any of the OHIM member states, such as Italy, is considered as a resident application for that member state (Italy). This indicator is based on design count – the total number of designs contained in the resident industrial design applications. Data are scaled by PPP$ GDP (billions).

Source: World Intellectual Property Organization, *Intellectual Property Statistics*; International Monetary Fund, *World Economic Outlook Database, October 2019* (PPP$ GDP) (2014–18). (http://www.wipo.int//ipstats/; https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

7.1.4. ICTs and organizational model creation

Average answer to the question: In your country, to what extent do ICTs enable new organizational models (e.g., virtual teams, remote working, telecommuting) within companies? [1 = not at all; 7 = to a great extent][†] | 2018

Source: World Economic Forum, *Executive Opinion Survey 2019*. (http://www3.weforum.org/docs/WEF_GCR_2019_Appendix_B.pdf).

7.2. Creative goods and services

7.2.1. Cultural and creative services exports

Cultural and creative services exports (% of total trade)[a] | 2018

Creative services exports (% of total exports) according to the Extended Balance of Payments Services Classification EBOPS 2010—that is, EBOPS code SI3 Information services; code SJ22 Advertising, market research, and public opinion polling services; code SK1 Audiovisual and related services; and code SK23 Heritage and recreational services as a percentage of total trade. See 5.3.1 for a full definition of total trade.

Data for the United States of America (U.S.) was obtained from the Bureau of Economic Analysis (BEA), *Table 2.1 U.S. Trade in Services, by Type of Service*. The following BEA categories are used: Audio-visual and related products (including Movies and television programming, Books and sound recordings, and Broadcasting and recording of live events); Information Services; Advertising; and Sports and performing arts.

Source: World Trade Organization, *Trade in Commercial Services* database, based on the sixth (2009) edition of the International Monetary Fund's *Balance of Payments* and *International Investment Position Manual* and *Balance of Payments* database; Bureau of Economic Analysis (BEA) released October 2019. (2011-18). (https://timeseries.wto.org/; http://www.oecd.org/std/its/EBOPS-2010.pdf; https://apps.bea.gov/itable/index.cfm).

7.2.2. National feature films produced

Number of national feature films produced (per million population 15–69 years old)[a] | 2017

A film with a running time of 60 minutes or longer. It includes works of fiction, animation, and documentaries. It is intended for commercial exhibition in cinemas. Feature films produced exclusively for television broadcasting, as well as newsreels and advertising films, are excluded. Data are reported per million population 15–69 years old. Paraguay and Cameroon use data for 2009.

Source: UNESCO Institute for Statistics, *UIS online database*; United Nations, Department of Economic and Social Affairs, Population Division, W*orld Population Prospects: The 2019 Revision* (population) (2009-2017). (http://data.uis.unesco.org; https://population.un.org/wpp/).

7.2.3. Entertainment and media market

Global entertainment and media market (per thousand population 15–69 years old)[*a] | 2018

The Global Entertainment & Media Outlook (the Outlook) is a comprehensive source of global analyses and five-year forecasts of consumer and advertising spending across 53 territories for 14 entertainment and media segments.

A total of 53 territories are represented within the Outlook spread across North America, Western Europe, Central Europe, the Middle East and North Africa, Latin America, and Asia Pacific. The score and rankings for the Global Media Expenditures for the 53 territories considered in the Outlook report are based on advertising and consumer digital and non-digital data in US$ millions at average 2019 exchange rates for the year 2019. These results are reported normalized per thousand population, 15–69 years old. The figures for Algeria, Bahrain, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, the Islamic Republic of Iran, Malta, Tunisia, and Yemen were estimated from a total corresponding to Middle East and North Africa (MENA) countries using a breakdown of total GDP (current US$) for the above-mentioned countries to define referential percentages.

Source: Calculations were derived from PwC's *Global Entertainment and Media Outlook, 2019–2023*; United Nations, Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2019 Revision* (population); *World Economic Outlook Database*, October 2019 (current US$ GDP); Middle East & North Africa in the World Bank's *DataBank*. (http://www.pwc.com/outlook ; https://population.un.org/wpp/; https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx; http://data.worldbank.org/region/middle-east-and-north-africa).

7.2.4. Printing publications and other media output

Printing publications and other media (% of manufactures total output)[a] | 2017

Printing, and reproduction of recorded media output (ISIC Revision 4 Division 18, group 181 with class 1811 and 1812 and group 182 with class 1820) as a percentage of total manufacturing output (ISIC Revision 4, section C). Where data for ISIC Revision 4 were not available, data from ISIC Revision 3 were used (ISIC Revision 3 group 222, classes 2221, 2222, and 2230).

Source: United Nations Industrial Development Organization, I*ndustrial Statistics Database*; 4-digit level of International Standard Industrial Classification ISIC Revision 4 (INDSTAT4 2020) and ISIC Revision 3 (INDSTAT2 2020). (2010-17). (http://www.unido.org/statistics.html; http://data.un.org/).

7.2.5. Creative goods exports

Creative goods exports (% of total trade) | 2018

Total value of creative goods exports (current US$) over total trade. Creative goods as defined in 2009 UNESCO Framework for Cultural Statistics, *Table 3, International trade of cultural goods and services based on the 2007 Harmonised System (HS 2007*). For the definition of total trade, see indicator 5.3.1.

Source: United Nations, *Comtrade* database; 2009 UNESCO Framework for Cultural Statistics, Table 3, *International trade of cultural goods and services based on the 2007 Harmonised System (HS 2007)*; World Trade Organization, Trade in Commercial Services database, itself based on the sixth (2009) edition of the International Monetary Fund's Balance of Payments and International Investment Position Manual and Balance of Payments database (2012-18). (http://comtrade.un.org/; http://uis.unesco.org/sites/default/files/documents/measuring-cultural-participation-2009-unesco-framework-for-cultural-statistics-handbook-2-2012-en.pdf; https://www.wto.org/english/res_e/statis_e/tradeserv_stat_e.htm; https://www.oecd.org/sdd/its/EBOPS-2010.pdf).

7.3. Online creativity

7.3.1. Generic top-level domains (gTLDs)

Generic top-level domains (gTLDs) (per thousand population 15–69 years old) | 2019

A generic top-level domain (gTLD) is one of the categories of top-level domains (TLDs) maintained by the Internet Assigned Numbers Authority (IANA) for use on the Internet. Generic TLDs can be unrestricted (.com, .info, .net, and .org) or restricted—that is, used on the basis of fulfilling eligibility criteria (.biz, .name, and .pro). Of these, the statistic covers the five generic domains .biz, .info, .org, .net, and .com. Generic domains .name and .pro, and sponsored domains (.arpa, .aero, .asia, .cat, .coop, .edu, .gov, .int, .jobs, .mil, .museum, .tel, .travel, and .xxx) are not included. Neither are country-code top-level domains (refer to indicator 7.3.2). The statistic represents the total number of registered domains (i.e., net totals by December 2019, existing domains + new registrations – expired domains). Data are collected on the basis of a 4% random sample of the total population of domains drawn from the root zone files (a complete listing of active domains) for each TLD. The geographic location of a domain is determined by the registration address for the domain name registrant that is returned from a *whois* query. These registration data are parsed by country and postal code and then aggregated to any number of geographic levels such as county, city, or country/economy. The original hard data were scaled by thousand population 15–69 years old. For confidentiality reasons, only normalized values are reported; while relative positions are preserved, magnitudes are not.

Source: ZookNIC Inc; United Nations, Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2019 Revision* (population). (http://www.zooknic.com; https://population.un.org/wpp/).

7.3.2. Country-code top-level domains (ccTLDs)

Country-code top-level domains (ccTLDs) (per thousand population 15–69 years old) | 2019

A country-code top-level domain (ccTLD) is one of the categories of top-level domains (TLDs) maintained by the Internet Assigned Numbers Authority (IANA) for use on the Internet. Country-code TLDs are two-letter domains especially designated for a particular economy, country, or autonomous territory (there are 3916 ccTLDs, in various alphabets/characters as of June 2020). The statistic represents the total number of registered domains (i.e., net totals by December 2019, existing domains + new registrations – expired domains). Data are collected from the registry responsible for each ccTLD and represent the total number of domain registrations in the ccTLD. Each ccTLD is assigned to the country with which it is associated rather than based on the registration address of the registrant. ZookNIC reports that, for the ccTLDs it covers, 85–100% of domains that are registered in the same country; the only exceptions are the ccTLDs that have been licensed for worldwide commercial use. Data are reported per thousand population 15–69 years old. For confidentiality reasons, only normalized values are reported; while relative positions are preserved, magnitudes are not.

Source: ZookNIC Inc; United Nations, Department of Economic and Social Affairs, Population Division, W*orld Population Prospects: The 2019 Revision* (population). (http://www.zooknic.com; https://population.un.org/wpp/).

7.3.3. Wikipedia yearly edits

Wikipedia yearly edits by country (per million population 15–69 years old) | 2019

Data extracted from Wikimedia Foundation's internal data sources. Data reflects economies with more than 100,000 edit counts in 2019; The data exclude both contributions to the extent that is identifiable in the data sources. Data are reported per million population 15–69 years old. Data from China are treated as missing and considered “n/a”.

Source: Wikimedia Foundation; United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Prospects: The 2019 Revision (population). (https://wikimediafoundation.org; https://esa.un.org/unpd/wpp/).

7.3.4. Mobile app creation

Global downloads of mobile apps (scaled by per billion PPP $ GDP) | 2019

Global downloads of mobile apps, by origin of the headquarters of the developer/firm, scaled by PPP$ GDP (billions). Global downloads are compiled by App Annie Intelligence, public data sources, and the company's proprietary forecast model based on data from Google play store and iOS App store in each country between January 1, 2019 and December 31, 2019. Since data for China are not available for Google play store and only for iOS App store, data from China are treated as missing and considered “n/a”.

Source: App Annie Intelligence; International Monetary Fund, *World Economic Outlook Database, October 2019* (PPP$ GDP) (2016-19). (https://www.appannie.com/en/; https://www.imf.org/external/pubs/ft/weo/2019/02/weodata/index.aspx).

ADJUSTMENTS TO THE GLOBAL INNOVATION INDEX FRAMEWORK, YEAR-ON-YEAR COMPARABILITY OF RESULTS, AND TECHNICAL NOTES

Adjustments to the Global Innovation Index framework

The Global Innovation Index (GII) is a cross-economy performance assessment, compiled on an annual basis, which continuously seeks to update and improve the way innovation is measured. The GII report pays special attention to making the statistics used in the Economy Profiles and Data Tables accessible by providing data sources and definitions, and detailing the computation methodology (Appendix II, III, and IV). This Appendix summarizes the changes made this year and provides an assessment of the impact these changes have on the comparability of rankings.

Beyond the use of the World Intellectual Property Organization (WIPO) data, we collaborate with public international bodies, such as the International Energy Agency, the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Industrial Development Organization (UNIDO), the World Trade Organization (WTO), and the Joint Research Centre of the European Commission (JRC). We also collaborate with private organizations, such as Brand Finance, IHS Markit, ZookNIC Inc, Thomson Reuters, Wikimedia Foundation, and AppAnnie to obtain the best globally available data on innovation.

Table A-IV.1 provides a summary of adjustments to the GII 2020 framework. A total of 10 indicators were modified this year. Six indicators had a methodology change at source, two underwent methodological changes, one new indicator was replaced, and one changed in code only.

Methodology and data

The methodologies for computing indicators 3.3.2, 3.3.3, 4.2.1, 4.2.3, 6.2.4, and 7.2.3 were all changed by the corresponding data source institutions; therefore, the scores calculated under the old methodology are not comparable to the new scores. The methodology underpinning indicator 5.2.3 GERD financed by abroad was updated. This year, the indicator is scaled by current GDP rather than as a percentage of total gross

TABLE A-IV.1

Changes to the GII 2020 framework

GII 2019		Adjustment	GII 2020	
3.3.2	Environmental performance	Indicator changed at source	3.3.2	Environmental performance
3.3.3	ISO 140001 environxment certificates/bn PPP$ GDP	Indicator changed at source	3.3.3	ISO 140001 environment certificates/bn PPP$ GDP
4.2.1	Ease of protecting minority investors	Indicator changed at source	4.2.1	Ease of protecting minority investors
4.2.3	Venture capital deals/bn PPP$ GDP	Indicator changed at source	4.2.3	Venture capital deals/bn PPP$ GDP
5.2.3	GERD financed by abroad, %	Methodology changed	5.2.3	GERD financed by abroad, % GDP
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	Indicator changed at source	6.2.4	ISO 9001 quality certificates/bn PPP$ GDP
7.1.2	Industrial designs by origin/bn PPP$ GDP	Code changed	7.1.3	Industrial designs by origin/bn PPP$ GDP
7.1.3	ICTs & business model creation	Replaced	7.1.2	Global brand value / bn PPP$ GDP
7.2.1	Cultural & creative services exports, % total trade	Methodology changed	7.2.1	Cultural & creative services exports, % total trade
7.2.3	Entertainment & Media market/th pop. 15-69	Indicator changed at source	7.2.3	Entertainment & Media market/th pop. 15-69

Source: Global Innovation Database, Cornell, INSEAD, and WIPO.
Notes: Refer to Appendix I and III for a detailed explanation of terminology and acronyms. Refer to Appendix III for a detailed explanation of methodological changes at source.

expenditure on R&D in a country. Indicator 7.2.1 Cultural & creative services exports is based on a revised list of cultural and creative services, to align closer to the 2009 UNESCO Framework on Cultural Statistics.[1] The services included are: information services (EBOPS 2010 code SI3); Advertising, market research, and public opinion polling services (SJ22); Audio-visual and related services (SK1); and Heritage and recreational services (SK23) (Appendix III). One new indicator 7.1.2 Global brand value, top 5,000 was added to the model replacing indicator 7.1.3 on ICT and business model creation. This also resulted in a change in the numbering of one 2019 indicator 7.1.2, that is now labeled 7.1.3.

Missing values

Since its inception, one of the core missions of the GII is to increase awareness of the importance of collecting data. The GII has helped to improve the number of data points submitted to international data agencies. In the GII 2020, with the inclusion of four economies in the GII sample, coverage remains relatively close to the level seen last year, with 10% of data points missing.

When it comes to economy coverage, the objective is to include as many as possible. However, it is also important to maintain a good level of data coverage within each of these economies. Because the GII results depend on data availability (Appendix V), which in turn affects the overall GII rankings, the threshold rule for economies with missing data and the minimum coverage necessary per sub-pillar were progressively tightened in 2016 and 2017 (Appendix IV: Technical Notes).

The motivation behind the introduction of these adjustments is because of data availability, which, historically, was less satisfactory when considering innovation outputs in the GII. For instance, this year, 18.8% of all economies show data coverage of less than 75% but exhibit over 66% coverage in the Output Sub-Index, while only 1.3% of these economies have this coverage range in the Input Sub-Index. This year, four new economies, Cabo Verde, the Lao People's Democratic Republic, Myanmar, and Uzbekistan are included in the GII 2020 due to data coverage improving to above the 66% threshold in the Output Sub-Index. Conversely, Burundi and Nicaragua drop from the GII economy sample due to data coverage being below the 66% threshold in the Output Sub-Index.

Despite the requirement for a minimum level of coverage, for several economies the number of missing data points remains high. Table A-IV.2 lists the economies with the highest number of missing data points (20 or more).

Conversely, Table A-IV.3 lists economies with the best data coverage. These economies are missing five data points at the most, while others are missing none.

For the last three years, more stringent rules were introduced, resulting in significant data coverage improvements for various economies. Table A-IV.4 shows economies with improved data coverage from 2016 to 2020. The list compiles those economies that have consistently improved the number of indicators with data available from year to year during that time period. At the same time, fewer economies had a decline in data coverage, as shown in Table A-IV.5. In particular, Uzbekistan, which is a new addition to the GII sample, displayed a noteworthy improvement in the coverage of its Output Sub-Index variables showing this year's data for 8 additional indicators, when compared to the data collected in 2019.

Year-on-year comparability of results—sources of change in the rankings

The GII compares the performance of national innovation systems across economies and presents the changes in economy rankings over time.

Importantly, scores and rankings from one year to the next are not directly comparable (see GII 2013, Annex 2, for a full explanation). Making inferences about absolute or relative performance based on year-on-year differences in rankings can be misleading. Each ranking reflects the relative positioning of a particular economy based on the conceptual framework, data coverage, and the sample of economies in a given year, also reflecting changes in the underlying indicators at source and in data availability.

A few factors influence year-on-year rankings of an economy:

- the actual performance of the economy in question;
- adjustments made to the GII framework;
- data updates, the treatment of outliers, and missing values; and
- the inclusion or exclusion of economies in the sample.

Additionally, the following characteristics complicate the time-series analysis based on simple GII scores or rankings:

- **Missing values.** The GII produces relative index scores, which means that a missing value for one economy affects the index score of other economies. Because the number of missing values decreases every year, this problem reduces over time.
- **Reference year.** The data underlying the GII do not refer to a single year but to several years, depending on the latest available year for any given variable. In addition, the reference years for different variables are not the same for each economy. The motivation for this approach is that it widens the set of data points for cross-economy comparability.
- **Normalization factor.** Most GII variables are normalized using either GDP or population, with the intention to enable cross-economy comparability. Yet, this implies that year-on-year changes in individual variables may be driven either by the variable's numerator or by its denominator.
- **Consistent data collection.** Measuring the change of year-on-year performance relies on the consistent collection of data over time. Changes in the definition of variables or in the data collection process could create movements in the rankings that are unrelated to performance.

TABLE A-IV.2

GII economies with the most missing values

Economy	Number of missing values
Guinea	23
Cabo Verde	22
Lao People's Democratic Republic	21
Niger	20

Source: Global Innovation Database, Cornell, INSEAD, and WIPO.

TABLE A-IV.3

GII economies with the fewest missing values

Economy	Number of missing values	Economy	Number of missing values	Economy	Number of missing values
Chile	0	Russian Federation	2	Argentina	4
Indonesia	0	Slovakia	2	Belgium	4
Malaysia	0	Spain	2	Canada	4
Mexico	0	Brazil	3	Ireland	4
Thailand	0	Costa Rica	3	Kenya	4
Colombia	1	Cyprus	3	Latvia	4
Hungary	1	Denmark	3	Lithuania	4
Poland	1	Estonia	3	Luxembourg	4
Portugal	1	Finland	3	New Zealand	4
Romania	1	France	3	Republic of Moldova	4
Ukraine	1	India	3	South Africa	4
Austria	2	Israel	3	Turkey	4
Bulgaria	2	Kazakhstan	3	United Kingdom	4
Czech Republic	2	Malta	3	United States of America	4
Germany	2	Netherlands	3	Uruguay	4
Greece	2	Norway	3	Viet Nam	4
Italy	2	Serbia	3	Australia	5
Morocco	2	Singapore	3	Croatia	5
Philippines	2	Slovenia	3	Georgia	5
Republic of Korea	2	Sweden	3	Panama	5
		Switzerland	3	Tunisia	5

Source: Global Innovation Database, Cornell, INSEAD, and WIPO.

TABLE A-IV.4

Indicator coverage improvement, from 2016 to 2020, in % and number

Economy	2016-2020	Improvement	Number
Yemen	from 29 to 18	11.24%	11
Algeria	from 17 to 7	19.89%	10
Honduras	from 17 to 7	14.93%	10
United Arab Emirates	from 21 to 11	19.89%	10
Bahrain	from 17 to 8	15.91%	9
Cambodia	from 18 to 9	13.88%	9
Jordan	from 20 to 11	17.18%	9
Mozambique	from 20 to 11	13.88%	9
Côte d'Ivoire	from 16 to 8	10.13%	8
Iran (Islamic Republic of)	from 18 to 10	15.91%	8
Montenegro	from 22 to 14	13.67%	8
Rwanda	from 22 to 14	10.68%	8
Tajikistan	from 23 to 15	10.68%	8
Belarus	from 10 to 3	14.54%	7
Benin	from 15 to 8	8.26%	7
Burkina Faso	from 18 to 11	8.67%	7
Malta	from 23 to 16	25.99%	7
Namibia	from 24 to 17	11.58%	7
Niger	from 26 to 19	7.23%	7
Togo	from 27 to 20	7.54%	7
Mali	from 8 to 2	9.64%	6
Morocco	from 10 to 4	29.29%	6
Viet Nam	from 18 to 12	20.47%	6
Ethiopia	from 7 to 2	8.94%	5
Ghana	from 8 to 3	8.94%	5
Jamaica	from 9 to 4	6.24%	5
Kenya	from 14 to 9	18.35%	5
Netherlands	from 16 to 11	21.75%	5
Oman	from 16 to 11	10.46%	5
Spain	from 22 to 17	26.89%	5

Source: Global Innovation Database, Cornell, INSEAD, and WIPO.
Notes: Annualized growth.

TABLE A-IV.5

Indicator coverage decline, from 2016 to 2020, in % and number

Economy	2016-2020	Improvement	Number
Japan	from 2 to 6	31.61%	4
Uganda	from 13 to 16	5.33%	3
Australia	from 3 to 5	13.62%	2
Bolivia (Plurinational State of)	from 12 to 14	3.93%	2
Madagascar	from 15 to 17	3.18%	2
South Africa	from 2 to 4	18.92%	2
Turkey	from 2 to 4	18.92%	2

Source: Global Innovation Database, Cornell, INSEAD, and WIPO.
Note: Annualized growth.

A detailed economy study based on the GII database and the economy profile over time, coupled with analytical work on the ground, including innovation actors and decision-makers, yields the best results in terms of grasping an economy's innovation performance over time as well as in identifying possible avenues for improvement.

Technical notes

Audit by the European Commission's Competence Centre on Composite Indicators and Scoreboards (COIN) at the Joint Research Centre (JRC)

The JRC-COIN has extensively researched the complexity of composite indicators that rank economies' performances along policy lines. For the tenth consecutive year, the JRC-COIN has performed a thorough "robustness" and "sensitivity" analysis of the GII to assess structural changes that are made to the list of indicators by the GII team (Table A-IV.1).

The recommendations from the JRC-COIN audit on the GII 2019 model were reviewed and incorporated into the GII 2020 model. This year, for an economy to feature in the GII 2020, the minimum symmetric data coverage is at least 35 indicators in the Innovation Input Sub-Index (66%) and 18 indicators in the Innovation Output Sub-Index (66%), with scores for at least two sub-pillars per pillar. In 2020, consideration was given to whether scores for all sub-pillars, for all pillars, would be required for economies to be considered in the GII. Ultimately, this rule was not applied this year but will be reviewed again in 2021 and implemented if applicable.

A final audit of the GII 2020 model was performed in May 2020 (Appendix V).

Composite indicators

The GII relies on seven pillars, each divided into three sub-pillars, of which each include two to five individual indicators. Sub-pillar scores are calculated using the weighted average of its individual indicators. Pillar scores are calculated using the weighted average of its sub-pillar scores.

The notion of weights as important coefficients was revised this year in more detail to ensure a greater statistical coherence of the model, following the recommendations of the JRC-COIN.[2]

The GII includes three indices:

1. The Innovation Input Sub-Index is the average of the first five pillar scores.
2. The Innovation Output Sub-Index is the average of the last two pillar scores.
3. The Global Innovation Index is the average of the Input and Output Sub-Indices.

Economy rankings are provided for indicators, sub-pillars, pillars, and index scores.

Individual indicators

The GII 2020 model includes 80 indicators, which fall into three categories:

1. quantitative/objective/hard data (58 indicators),
2. composite indicators/index data (18 indicators), and
3. survey/qualitative/subjective/soft data (4 indicators).

Hard data

Hard data (58 indicators) are drawn from a variety of public and private sources. These include, among others, the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Industrial Development Organization (UNIDO), the World Intellectual Property Organization (WIPO), the World Bank, the Joint Research Centre of the European Commission (JRC), PwC, Thomson Reuters, IHS Markit, Wikimedia Foundation, and AppAnnie.

This year an indicator showing which economies have the most valuable brands based on Brand Finance data is introduced. This indicator assesses the economy's brands in the top 5,000 global brand database and produces the sum of the brand values corresponding to that economy. This sum is then scaled by GDP.[3]

Indicators are often correlated with population, GDP, or some other size-related factor; they require scaling by a relevant size indicator for economy comparisons to be valid. Most indicators are either scaled at source or do not need to be scaled; for the rest, the scaling factor was chosen to represent a fair picture of economy differences. Scaling affected 42 indicators, which can be broadly divided into four groups:

1. Indicators 2.1.1, 2.3.2, 3.2.3, 4.1.2, 4.1.3, 4.2.2, 5.1.3, 5.2.3, 5.3.4, 6.2.3, and 6.3.4 are scaled by GDP in current US$.[4]

2. Indicators 3.3.3, 4.2.3, 5.2.4, 5.2.5, 6.1.1, 6.1.2, 6.1.3, 6.1.4, 6.2.4, 7.1.1, 7.1.2, 7.1.3, and 7.3.4 are scaled by GDP in purchasing power parity current international dollars. This choice of denominator was dictated by a willingness to appropriately account for differences in development stages; in addition, scaling these variables by population would improperly bias results to the detriment of economies with a large young or aging population.[5]

3. Indicators 3.2.1, 5.1.5, 6.2.2, 7.2.2, 7.2.3, 7.3.1, 7.3.2, and 7.3.3 are scaled by population. Total population for 3.2.1, population 25+ years old for 5.1.5, population 15–64 years old for 6.2.2, and population 15–69 years old for the remaining.[6]

4. Indicators 5.3.1, 5.3.2, 5.3.3, 6.3.1, 6.3.2, 6.3.3, 7.2.1, and 7.2.5 are scaled by total trade; and indicators 6.2.5 and 7.2.4 by the total unit used to measure the particular statistic.[7]

Indices

Composite indicators are collected from a series of specialized agencies and academic institutions, such as the World Bank, the UN Public Administration Network (UNPAN), and Yale and Columbia Universities. Statisticians discourage the use of an "index within an index" on two main grounds: the distorting effect of the different computing methodologies used and the risk of duplicating variables. The normalization procedure partially solves the former (more on this below). To avoid the mistake of including a particular indicator more than once (directly and indirectly through a composite indicator), only indices with a narrow focus (18 in total) were selected.

Any additional disadvantage is outweighed by what is gained with model parsimony, acknowledgment of expert opinion, and focus on multi-dimensional phenomena that can hardly be captured by a single indicator.[8]

Survey data

Survey data are drawn from the World Economic Forum's Executive Opinion Survey (EOS). Survey questions are drafted to capture subjective perceptions on specific topics. Four EOS questions were retained to capture phenomena strongly linked to innovative activities for which hard data are nonexistent or have low coverage for economies.

Economy coverage and missing data

This year the GII covers 131 economies, selected based on the availability of data, and achieves the same percentage of indicator coverage as in the GII 2019 (Appendix IV: Technical Notes).

For each economy, only the most recent yearly data was considered. As a rule, the GII enforced the cut-off year to be 2010 for considering data at the indicator level. A few exceptions were made for years prior to the cut-off year.[9]
For the sake of transparency and replicability of results, no additional effort was made to fill missing values. Missing values are indicated with "n/a" and are not considered in the sub-pillar score. However, the JRC-COIN audit assessed the robustness of the GII modeling choices (i.e., no imputation of missing data, fixed predefined weights, and arithmetic averages) by imputing missing data, applying random weights, and using geometric averages. Since 2012, based on this assessment, a confidence interval has been provided for each ranking in the GII as well as the Input and Output Sub-Indices (Appendix V).

Treatment of series with outliers

Potentially problematic indicators with outliers that could polarize results and unduly bias the rankings were treated according to the rules listed below, as per the recommendations of the JRC-COIN. This affected 29 indicators; 28 out of the 58 hard data indicators and 1 out of the 18 composite indicators.

First rule: selection

Problematic indicators were identified by skewness or kurtosis. The problematic indicators had either:

- an absolute value of skewness greater than 2.25, or
- a kurtosis greater than 3.5.[10]

Second rule: treatment

Series with one to five outliers (24 cases) were winsorized; the values distorting the indicator distribution were assigned the next highest value, up to the level where skewness and/or kurtosis entered within the ranges specified above.[11]

Series with five or more outliers, skewness and/or kurtosis entered within the ranges specified above after multiplication by a given factor *f* and transformation by natural logs.[12] Since only "goods" were affected (i.e., indicators for which higher values indicate better outcomes, as opposed to "bads"), the formula used was:

$$\ln\left[\frac{(Max \times f - 1)(\textit{economy value} - Min)}{Max - Min} + 1\right]$$ [13]

where "min" and "max" are the minimum and maximum indicator sample values.

Normalization

The 80 indicators were then normalized into the [0, 100] range, with higher scores representing better outcomes. Normalization was according to the min-max method; where the min and max values were given by the minimum and maximum indicator sample values, respectively. The exception for index and survey data, for which the original series range of values was kept as min and max values (for example, [0, 1] for UNPAN indices; [1, 7] for the World Economic Forum Executive Opinion Survey questions; [0, 100] for World Bank's World Governance Indicators; etc.). The following formula was applied:

$$\text{Goods:}\quad \frac{\textit{economy value} - Min}{Max - Min} \times 100$$

$$\text{Bads:}\quad \frac{Max - \textit{economy value}}{Max - Min} \times 100$$

Notes:

1 See: http://uis.unesco.org/sites/default/files/documents/unesco-framework-for-cultural-statistics-2009-en_0.pdf

2 Paruolo et al., 2013 show that a theoretical inconsistency exists between the real theoretical meaning of weights and the meaning generally attributed to them by the standard practice in constructing composite indicators that use them as importance coefficients in combination with linear aggregation rules. The approach followed in the GII this year, as last year, is to assign weights of 0.5 or 1 to each component in a composite to ensure the highest correlations between them (i.e., indicator/sub-pillar, sub-pillar/pillar, etc.). Two sub-pillars (7.2 Creative goods and services, and 7.3 Online creativity) and 27 indicators (1.1.1, 1.2.1, 1.2.2, 2.1.4, 2.1.5, 2.2.3, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.2.1, 3.2.2, 4.1.3, 4.3.1, 5.1.5, 5.2.1, 5.3.3, 5.3.4, 6.1.2, 6.2.2, 6.3.1, 6.3.4, 7.1.3, 7.2.1, 7.2.2, 7.2.3, and 7.2.4) are weighted 0.5; the rest have a weight of 1. This year the weights for 24 indicators were adjusted to provide higher statistical coherence (3.1.1 ICT access, 3.1.2 ICT use, 3.1.3 Government's online service, 3.1.4 E-participation, 4.1.3 Microfinance gross loans, 5.3.3 ICT services imports, 5.3.4 FDI net inflows, and 7.2.4 Printing & other media now have a weight of 0.5; 2.2.1 Tertiary enrolment, 3.3.3 ISO 14001 environmental certificates, 4.2.2 Market capitalization, 4.2.3 Venture capital deals, 4.3.2 Intensity of local competition, 5.1.3 GERD performed by business, 5.1.4 GERD financed by business, 5.2.4 JV–strategic alliance deals, 5.3.1 Intellectual property payments, 6.1.1 Patents by origin, 6.1.4 Scientific & technical articles, 6.2.3 Computer software spending, 6.2.4 ISO 9001 quality certificates, 6.2.5 High- & medium-high-tech manufacturing, 6.3.2 High-tech net exports, and 6.3.3 ICT services exports now have a full weight of 1).

3 Brand Finance's study is based on publicly available information on the largest brands in the world. Brand Finance calculates brand value using the Royalty Relief methodology, which determines the value a company would be willing to pay to license its brand as if it did not own it. The methodology is compliant with industry standards set in ISO 10668. This approach involves estimating the future revenue attributable to a brand and calculating a royalty rate that would be charged for the use of the brand.

4 These indicators are Expenditure on education (2.1.1); Gross expenditure on R&D (GERD) (2.3.2); Gross capital formation (3.2.3); Domestic credit to private sector (4.1.2); Microfinance institutions' gross loan portfolio (4.1.3); Market capitalization (4.2.2); GERD performed by business enterprise (5.1.3); GERD financed by abroad (5.2.3); Foreign direct investment net inflows (5.3.4); Total computer software spending (6.2.3); and Foreign direct investment net outflows (6.3.4).

5 These count variables are mainly indicators that increase disproportionately with economic growth. They include: ISO 14001 environmental certificates (3.3.3); Venture capital deals; (4.2.3) joint venture/strategic alliance deals; (5.2.4) Patent families filed in two or more offices (5.2.5); Patent applications by origin (6.1.1); PCT international applications by origin (6.1.2); Utility model applications by origin (6.1.3); Scientific and technical publications (6.1.4); ISO 9001 quality certificates (6.2.4); Trademark application class count by origin (7.1.1); Global brand value, top 5000 (7.1.2), Industrial designs by origin (7.1.3); and Mobile app creation (7.3.4).

6 These variables are Electricity output (3.2.1); Females employed with advanced degrees (5.1.5); New business density (6.2.2); National feature films produced (7.2.2); Entertainment and media market (7.2.3); Generic (7.3.1) and Country-code (7.3.2) top-level Internet domains; and Wikipedia yearly edits (7.3.3).

7 Intellectual property payments (5.3.1); High-tech net imports (5.3.2); ICT services imports (5.3.3); Intellectual property receipts (6.3.1); High-tech net exports (6.3.2); ICT services exports (6.3.3); Cultural and creative services exports (7.2.1); and Creative goods exports (7.2.5) were scaled by total trade; High-tech and medium-high-tech output (6.2.5) and Printing and other media (7.2.4) were scaled by total manufacturing output.

8 For example, GII sub-pillar 3.1 Information and communication technologies (ICTs) is composed of four indices: ICT Access and Use sub-indices, and UNPAN's Government Online Service and E-Participation indices. The first two, previously part of ITU's ICT Development Index, are now produced by the GII independently from other components from that original index, following the methodology of the ITU's ICT Development Index 2017. Similarly, the Online Service Index is a component of UNPAN's E-Government Development Index together with two indices on Telecommunication Infrastructure and Human Capital that were not considered, as they duplicate GII pillars 3 and 2, respectively. The e-Participation Index was developed separately by UNPAN in 2010.

9 A total of 18 economies in 11 indicators show data that is previous to 2010. These are Botswana (2009), Philippines (2009), and Morocco (2009), in Expenditure on education (2.1.1); Botswana (2009) and Qatar (2009) in Government funding per pupil (2.1.2); Kenya (2009) in School life expectancy (2.1.3); Israel (2009), Kenya (2009), and Trinidad and Tobago (2009) in Pupil-teacher ratio (2.1.5); Bangladesh (2009) in Tertiary inbound mobility (2.2.3); the Plurinational State of Bolivia (2009) in Gross expenditure on R&D (2.3.2); Botswana (2009), Chile (2009), Costa Rica (2009), Jamaica (2009), Mexico (2009), Panama (2009), and Trinidad and Tobago (2009) in Firms offering formal training (5.1.2); the Plurinational State of Bolivia (2009) and Burkina Faso (2009) in GERD financed by business (5.1.4); Tajikistan (2009) in Females employed with advanced degrees (5.1.5); Malawi (2009) in New businesses (6.2.2); and Cameroon (2009) in National feature films (7.2.2.).

10 Based on Groeneveld and Meeden (1984), which sets the criteria of absolute skewness above 1 and kurtosis above 3.5. The skewness criterion was relaxed to account for the small sample at hand (131 economies).

11 This distributional issue affects the following variables: 2.1.5, 3.2.1, 5.2.3, 5.3.2, 6.1.5, 7.1.1, 7.2.2, and 7.2.4, (1 outlier); 4.2.2, 4.2.3, 5.3.1, 6.1.3, 7.1.3, and 7.2.1 (2 outliers); 2.2.3, 6.3.3, 6.3.4, 7.3.2, and 7.3.4 (3 outliers); 6.3.1 (4 outliers); and 4.1.3, 5.2.5, 6.1.1, and 7.2.5 (5 outliers).

12 This distributional issue affects variables 2.3.3, 4.3.3, 5.3.4, 6.1.2, and 6.3.2 (factor *f* of 1).

13 These formulas achieve two things: converting all series into "goods" and scaling the series to the range [1, max] so that natural logs are positive starting at 0. Where "min" and "max" are the minimum and maximum indicator sample values.

The corresponding formula for bads is:

$$\ln\left[\frac{(Max \times f - 1)\,(Max - economy\ value)}{Max - Min}\right. + 1$$

References:

Groeneveld, R. A., & Meeden, G. (1984). Measuring Skewness and Kurtosis. *The Statistician, 33*, 391–99.

Paruolo P., Saisana, M., & Saltelli, A. (2013). Ratings and Rankings: Voodoo or Science? *Journal of the Royal Statistical Society, A 176*(2), doi: 0964–1998/13/176000.

APPENDIX V

JOINT RESEARCH CENTRE (JRC) STATISTICAL AUDIT OF THE 2020 GLOBAL INNOVATION INDEX

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Conceptual and practical challenges are inevitable when trying to understand and model the fundamentals of innovation at the national level worldwide. In its 13th edition, the Global Innovation Index (GII) 2020 considers these conceptual challenges in Chapter 1 and deals with practical challenges—related to data quality and methodological choices—by grouping economy-level data over 131 economies; and across 80 indicators into 21 sub-pillars, 7 pillars, 2 sub-indices and, finally, an overall index. This appendix offers detailed insights into the practical issues related to the construction of the GII, analyzing the statistical soundness of the calculations and assumptions made to arrive at the final index rankings. Statistical soundness should be regarded as a necessary but not sufficient condition for a sound GII; since the correlations underpinning the majority of the statistical analyses carried out herein "need not necessarily represent the real influence of the individual indicators on the phenomenon being measured".[1] Consequently, the development of the GII must be nurtured by a dynamic, iterative dialogue between the principles of statistical and conceptual soundness or, to put it another way, between the theoretical understanding of innovation and the empirical observations of the data underlying the variables.

The European Commission's Competence Centre on Composite Indicators and Scoreboards (COIN) at the Joint Research Centre (JRC) in Ispra has been invited for the tenth consecutive year to audit the GII. As in previous editions, the present JRC-COIN audit focuses on the statistical soundness of the multi-level structure of the index as well as on the impact of key modeling assumptions on the results.[2] The independent statistical assessment of the GII provided by the JRC-COIN guarantees the transparency and reliability of the index for both policymakers and other stakeholders, thus facilitating more accurate priority setting and policy formulation in the innovation field.

As in past GII reports, the JRC-COIN analysis complements the economy rankings with confidence intervals for the GII, the Innovation Input Sub-Index, and the Innovation Output Sub-Index, in order to better appreciate the robustness of these ranks to the computation methodology. Finally, the JRC-COIN analysis includes an assessment of the added value of the GII and a measure of distance to the efficient frontier of innovation by using data envelopment analysis.

Conceptual and statistical coherence in the GII framework

An earlier version of the GII model was assessed by the JRC-COIN in April/May 2020. Fine-tuning suggestions were taken into account in the final computation of the rankings in an iterative process with the JRC-COIN aimed at setting the foundation for a balanced index. The entire process followed four steps. (Figure A-V.1)

Step 1: Conceptual consistency

Eighty indicators were selected for their relevance to a specific innovation pillar based on literature review, expert opinion, economy coverage, and timeliness. To represent a fair picture of economy differences, indicators were scaled either at source or by the GII team, as appropriate, and where needed. For example, expenditure on education (indicator 2.1.1) is expressed as a percentage of GDP, while government funding per pupil at secondary level (indicator 2.1.2) is expressed as a percentage of GDP per capita.

Step 2: Data checks

The data, which were most recently released within the period 2009 to 2019, were used for each economy: 79% of the available data refer to 2018 or more recent years. The JRC-COIN recommendation was to offer an explanation behind the choice to use data that may not reflect recent advances in the relevant field in these economies (Appendix III). In past editions, until 2015, economies were included if data availability was at least 60% across all variables in the GII framework. More stringent criteria were adopted in 2016, following the JRC-COIN recommendation in past GII audits, where economies were only included if data availability was at least 66% within each of the two sub-indices (i.e., 35 out of 53 variables within the Input Sub-Index and 18 out of the 27 variables in the Output Sub-Index) and where at least two of the three sub-pillars in each pillar could be computed. These criteria aim to ensure that economy scores for the GII and for the two Input and Output Sub-Indices are not particularly sensitive to missing values (as was the case

FIGURE A-V.1

Conceptual and statistical coherence in the GII 2020 framework

**STEP 4.
QUALITATIVE REVIEW**

Internal qualitative review
(INSEAD, WIPO, and Cornell University)

External qualitative review
(JRC-COIN, international experts)

**STEP 3.
STATISTICAL COHERENCE**

Treatment of pairs of highly collinear variables as a single indicator

Assessment of grouping indicators into sub-pillars, pillars, sub-indices, and the GII

Use of weights as scaling coefficients to ensure statistical coherence

Assessment of arithmetic average assumption

Assessment of potential redundancy of information in the overall GII

**STEP 2.
DATA CHECKS**

Check for data recency (79% of available data refer to 2018 and 2019)

Availability requirements per economy: coverage ≥66% for the Input and the Output Sub-Indices, separately and data availability for at least two sub-pillars per pillar

Check for reporting errors (interquartile range)

Outlier identification (skewness and kurtosis) and treatment (winsorisation or logarithmic transformation)

Direct contact with data providers

**STEP 1.
CONCEPTUAL CONSISTENCY**

Compatibility with existing literature on innovation and pillar definition

Use of scaling factors (denominators) per indicator to represent a fair picture of country differences (e.g., GDP, population)

Source: European Commission, Joint Research Centre, 2020.

for the Output Sub-Index scores of several economies in past editions). In practice, data availability for all economies included in the GII 2020 is very good: 80% of data is available for 89% of the economies (equivalent to 117 economies out of 131). Potentially problematic indicators that could bias the overall results were identified on the basis of two measures related to the shape of the data distributions: skewness and kurtosis. Since 2011, and decided jointly with the JRC-COIN, values were treated if the indicators had absolute skewness greater than 2.0 and kurtosis greater than 3.5.[3] In 2017, and after having analyzed data in the GII 2011 to the GII 2017, a less stringent criterion was adopted. An indicator was only treated if the absolute skewness was greater than 2.25 and kurtosis greater than 3.5. These indicators were treated either by winsorization or by natural logarithm (in cases of more than five outliers; Appendix IV: Technical Notes). In 2018, an exceptional behavior for FDI net outflows (indicator 6.3.4) was observed (Chapter 1, Annex 3, JRC Audit, 2018) and from 2018 on, it was recommended to adjust the GII rule for the treatment of outliers as follows:

(a) for indicators with absolute skewness greater than 2.25 and kurtosis greater than 3.5, apply either winsorization or the natural logarithm (in case of more than five outliers);
(b) for indicators with absolute skewness of less than 2.25 and kurtosis greater than 10.0, produce scatterplots to identify potentially problematic values that need to be considered as outliers and treated accordingly.

Step 3: Statistical Coherence

Weights as scaling coefficients

Jointly decided between the JRC-COIN and the GII team in 2012, weights of 0.5 or 1.0 were to be scaling coefficients and not importance coefficients, with the aim of arriving at sub-pillar and pillar scores that were balanced in their underlying components (i.e., that indicators and sub-pillars can explain a similar amount of variance in their respective sub-pillars/pillars). Becker, W. et al. (2017) and Paruolo, P. et al. (2013) show that, in weighted arithmetic averages, the ratio of two nominal weights gives the rate of substitutability between two indicators, and hence can be used to reveal the relative importance of individual indicators. This importance can then be compared with ex-post measures of variables' importance, such as the non-linear Pearson correlation ratio. As a result of this analysis, 27 out of 80 indicators and two sub-pillars—7.2 Creative goods and services and 7.3 Creation of online content—were assigned half weights, while all other indicators and sub-pillars were assigned a weight of 1.0. Despite this weighting adjustment, only two indicators – (5.3.4 FDI net inflows and 6.2.1 Growth rate of PPP$ GDP/worker) were found to be non-influential in the GII framework, implying that they could not explain at least 9% of economy variation in the respective sub-pillar scores.[4] Yet, 78 out of the 80 indicators are found to be sufficiently influential in the GII framework, which is worthy of highlighting as a very positive feature of this year's GII framework.

Principal components analysis and reliability item analysis

Principal component analysis (PCA) was used to assess to what extent the conceptual framework is confirmed by statistical approaches. PCA results confirm the presence of a single latent dimension in each of the seven pillars (one component with an eigenvalue greater than 1.0) that captures between close to 59% (pillar 4: Market sophistication) up to 81% (pillar 1: Institutions) of the total variance in the three underlying sub-pillars. Furthermore, results confirm the expectation that the sub-pillars are more correlated to their own pillar than to any other pillar and that all correlation coefficients are close to or greater than 0.70. (Table A-V.1).

The five input pillars share a single statistical dimension that summarizes 77% of the total variance, and the five loadings (correlation coefficients) of these pillars are very similar to each other (0.76–0.93). This similarity suggests that the five pillars make roughly equal contributions to the variation of the Innovation Input Sub-Index scores, as envisaged by the developing team. Consequently, the reliability of the Input Sub-Index, measured by the Cronbach alpha value, is very high at 0.91—well above the 0.70 threshold for a reliable aggregate.[5]

The two output pillars—Knowledge and technology outputs and Creative outputs—are strongly correlated to each other (0.82); they are also both strongly correlated with the Innovation Output Sub-index (0.93 to 0.94).

Finally, an important part of the analysis relates to clarifying the importance of the Input and Output Sub-Indices with respect to variation in the GII scores. The GII is built as a simple arithmetic average of the five Input sub-pillars and the two Output sub-pillars, which implies that the Input-related pillars have a weight of 5/7 versus a weight of 2/7 for the Output-related pillars. Yet this does not imply that the Input aspect is more important than the Output aspect in determining the variation of the GII scores. In fact, the Pearson correlation coefficient of either the Input or the Output Sub-Index with the overall GII is 0.98 (and the two sub-indices have a correlation of 0.82), which suggests that the sub-indices are effectively placed on equal footing.

Overall, the tests so far show that the grouping of variables into sub-pillars, pillars, and an overall index is statistically coherent in the GII 2020 framework, and that the GII has a balanced structure at each aggregation level. Furthermore, this year, all but two of the 80 indicators are found to be sufficiently influential in the GII framework, namely each indicator explains at least 9% of countries variation in the respective sub-pillar scores, which is worthy highlighting as a very positive feature of this year's GII framework.[6]

Added value of the GII

As already discussed, the Input and Output Sub-Indices correlate strongly with each other and with the overall GII. Furthermore, the five pillars in the Input Sub-Index have a very high statistical reliability. These results—the strong correlation

TABLE A-V.1

Statistical coherence in the GII: correlations between sub-pillars and pillars

	Sub-pillar	Institutions	Human capital and research	Infrastructure	Market sophistication	Business sophistication	Knowledge & technology outputs	Creative outputs
Innovation Input Sub-index	11.1. Political environment	0.94	0.82	0.86	0.69	0.81	0.72	0.82
	1.2. Regulatory environment	0.92	0.67	0.70	0.61	0.68	0.61	0.71
	1.3. Business environment	0.84	0.70	0.70	0.61	0.64	0.67	0.61
	2.1. Education	0.60	0.81	0.65	0.46	0.55	0.56	0.57
	2.2. Tertiary education	0.67	0.83	0.75	0.50	0.56	0.57	0.61
	2.3. Research and development (R&D)	0.75	0.89	0.76	0.67	0.89	0.86	0.78
	3.1. Information and communication technologies (ICTs)	0.80	0.85	0.94	0.67	0.74	0.72	0.78
	3.2. General infrastructure	0.54	0.57	0.68	0.41	0.54	0.47	0.49
	3.3. Ecological sustainability	0.68	0.63	0.80	0.44	0.62	0.68	0.69
	4.1. Credit	0.66	0.60	0.57	0.88	0.59	0.51	0.61
	4.2. Investment	0.43	0.31	0.29	0.75	0.37	0.31	0.42
	4.3. Trade, competition, and market scale	0.54	0.68	0.67	0.66	0.66	0.67	0.62
	5.1. Knowledge workers	0.77	0.85	0.80	0.66	0.92	0.81	0.80
	5.2. Innovation linkages	0.71	0.68	0.64	0.58	0.88	0.73	0.77
	5.3. Knowledge absorption	0.59	0.64	0.63	0.56	0.86	0.78	0.72
Innovation Output Sub-index	6.1. Knowledge creation	0.71	0.83	0.71	0.63	0.85	0.91	0.81
	6.2. Knowledge impact	0.65	0.71	0.74	0.55	0.67	0.87	0.67
	6.3. Knowledge diffusion	0.58	0.62	0.63	0.46	0.77	0.88	0.66
	7.1. Intangible assets	0.63	0.64	0.65	0.60	0.72	0.68	0.91
	7.2. Creative goods and services	0.66	0.65	0.71	0.63	0.73	0.68	0.84
	7.3. Online creativity	0.83	0.79	0.80	0.62	0.81	0.77	0.85

Source: European Commission Joint Research Centre, 2020.

TABLE A-V.2

Statistical coherence in the GII: correlations between sub-pillars and pillars

	Innovation Input Sub-Index					Innovation Output Sub-Index	
Rank differences (positions)	Institutions %	Human capital and research %	Infrastructure %	Market sophistication %	Business sophistication %	Knowledge & technology outputs %	Creative outputs %
More than 30	13.74%	9.2%	4.6%	29.0%	12.2%	11.5%	3.8%
20-29	16.03%	15.27%	14.50%	19.08%	11.45%	9.92%	9.92%
10-19	25.2%	28.2%	29.0%	16.0%	25.2%	25.2%	25.2%
10 or more *	55.0%	52.7%	48.1%	64.1%	48.9%	46.6%	38.9%
5-9	31.3%	22.9%	22.1%	13.7%	28.2%	23.7%	21.4%
Less than 5	12.2%	22.9%	26.7%	21.4%	21.4%	24.4%	33.6%
Same rank	1.5%	1.5%	3.1%	0.8%	1.5%	5.3%	6.1%
Total **	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Pearson correlation coefficient with the GII	0.90	0.90	0.89	0.78	0.92	0.93	0.92

Source: European Commission Joint Research Centre, 2020.
Notes: *This column is the sum of the prior three rows. **This column is the sum of all white rows.

between Input and Output Sub-Indices and the high statistical reliability of the five input pillars—may be interpreted by some as a sign of redundancy of information in the GII. The tests conducted by the JRC-COIN confirm that this is not the case. In fact, for more than 38% (up to 64%) of the 131 economies included in the GII 2020, the GII ranking and any of the seven pillar rankings differ by 10 positions or more (Table A-V.2). This is a desired outcome because it demonstrates the added value of the GII ranking, which helps to highlight other aspects of innovation that do not emerge directly by looking into the seven pillars separately. At the same time, this result points to the value of duly taking into account the GII pillars, sub-pillars, and individual indicators on their own merit. By doing so, economy-specific strengths and bottlenecks on innovation can be identified and serve as an input for evidence-based policymaking.

Step 4: Qualitative Review

Finally, the GII results—including overall economy classifications and relative performances in terms of the Innovation Input or Output Sub-Indices—were evaluated to verify that the overall results are, to a great extent, consistent with current evidence, existing research, and prevailing theory. Notwithstanding these statistical tests and the positive outcomes on the statistical coherence of the GII structure, the GII model is and has to remain open for future improvements as better data, more comprehensive surveys and assessments, and new relevant research studies become available.

The impact of modeling assumptions on the GII results

An important part of the GII statistical audit is to check the effect of varying assumptions inside plausible ranges. Modeling assumptions with a direct impact on the GII scores and rankings relate to:

- setting up an underlying structure for the index based on a battery of pillars,
- choosing the individual variables to be used as indicators,
- deciding whether (and how) or not to impute missing data,
- deciding whether (and how) or not to treat outliers,
- selecting the normalization approach to be applied,
- choosing the weights to be assigned, and
- deciding on the aggregation rule to be implemented.

The rationale for these choices is manifold. For instance, expert opinion coupled with statistical analysis is behind the selection of the individual indicators, common practice and ease of interpretation suggest the use of a min-max normalization approach in the [0–100] range, the treatment of outliers is driven by statistical analysis, and simplicity and parsimony criteria seem to advocate for not imputing missing data. The unavoidable uncertainty stemming from the above-mentioned modeling choices is accounted for in the robustness assessment carried out by the JRC-COIN. More precisely, the methodology applied herein allows for the joint and simultaneous analysis of the impact of such choices on the aggregate scores, resulting in error estimates and confidence intervals calculated for the GII 2019 individual economy rankings.

As suggested in the relevant literature on composite indicators,[7] the robustness assessment was based on Monte Carlo simulation and multi-modeling approaches, applied to "error-free" data where potential outliers, eventual errors and typos have already been corrected in a preliminary stage. In particular, the three key modeling issues considered in the assessment of the GII were the treatment of missing data, the pillar weights, and the aggregation formula used at the pillar level.

Monte Carlo simulation comprised 1,000 runs of different sets of weights for the seven pillars in the GII. The weights were assigned to the pillars based on uniform continuous distributions centered in the reference values. The ranges of simulated weights were defined by considering both the need for a wide enough interval to allow for meaningful robustness checks and the need to respect the underlying principle of the GII that the Input and the Output Sub-Indices should be placed on equal footings. As a result of these considerations, the limit values of uncertainty for the five input pillars are between 10% and 30%; the limit values for the two output pillars are between 40% and 60%. (Table A-V.3).

The GII developing team, for transparency and replicability, has always opted not to estimate missing data. The "no imputation" choice, which is common in similar contexts, might encourage economies not to report low data values. Yet this is not the case for the GII. After 13 editions of the GII, the index-developing team has not encountered any intentional no-reporting strategy. The consequence of the no imputation choice in an arithmetic average is that it is equivalent to replacing an indicator's missing value for a given economy with the respective sub-pillar score. Hence, the available data (indicators) in the incomplete pillar may dominate, sometimes biasing the ranks up or down. To test the impact of the no imputation choice, the JRC-COIN estimated missing data using the Expectation Maximization (EM) algorithm that was applied within each GII pillar.[8]

Regarding the aggregation formula, decision-theory practitioners challenge the use of simple arithmetic averages because of their fully compensatory nature, in which a comparative high advantage on a few indicators can compensate for a comparative disadvantage on many indicators.[9] To assess the impact of this compensability issue, the JRC-COIN relaxed the strong perfect substitutability assumption inherent in the arithmetic average and considered instead the geometric average, which is a partially compensatory approach that rewards economies with balanced profiles and motivates economies to improve in the GII pillars in which they perform poorly, and not just in any GII pillar.[10]

Four models were tested based on the combination of no imputation versus EM imputation, and arithmetic versus geometric average, combined with 1,000 simulations per model (random weights versus fixed weights), for a total of 4,000 simulations for the GII and each of the two sub-indices (Table A-V.3 for a summary of the uncertainties considered).

Uncertainty analysis results

The main results of the robustness analysis are shown in Figure A-V.2 with median ranks and 90% confidence intervals computed across the 4,000 Monte Carlo simulations for the GII and the two sub-indices. The figure orders economies in ascending order (best to worst) according to their reference rank (blue line), the dot being the median rank over the simulations.

TABLE A-V.3

Uncertainty parameters: missing values, aggregation and weights

	Reference	Alternative
I. Uncertainty in the treatment of missing values	No estimation of missing data	Expectation Maximization (EM)
II. Uncertainty in the aggregation formula at pillar level	Arithmetic average	Geometric average
III. Uncertainty intervals for the GII pillar weights		

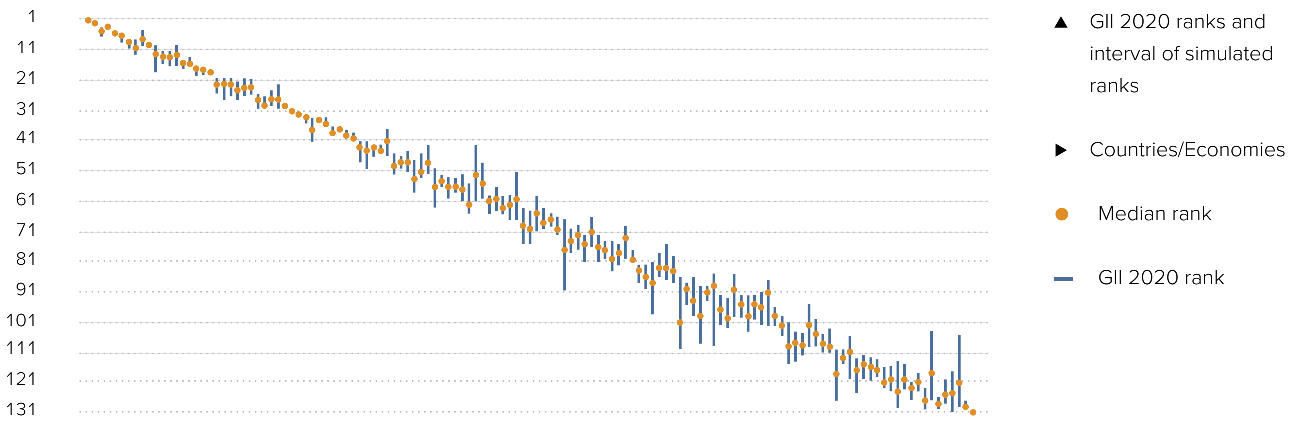
GII Sub-Index	Pillar	Reference value for the weight	Distribution assigned for robustness analysis
Innovation Input	Institutions	0.2	U[0.1,0.3]
	Human capital and research	0.2	U[0.1,0.3]
	Infrastructure	0.2	U[0.1,0.3]
	Market sophistication	0.2	U[0.1,0.3]
	Business sophistication	0.2	U[0.1,0.3]
Innovation Output	Knowledge and technology outputs	0.5	U[0.4,0.6]
	Creative outputs	0.5	U[0.4,0.6]

Source: European Commission Joint Research Centre, 2020.

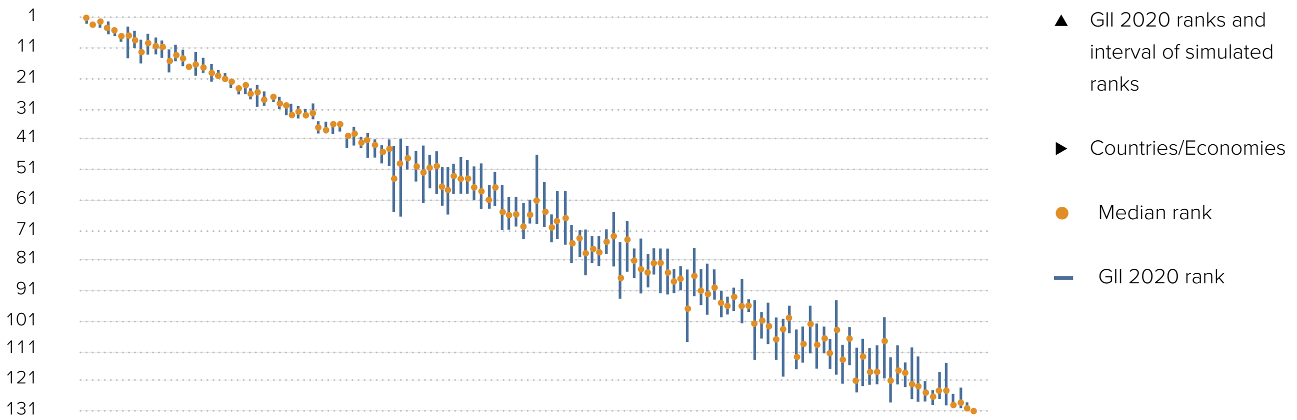
FIGURE A-V.2

Robustness analysis of the GII and Input and Output Sub-Indices

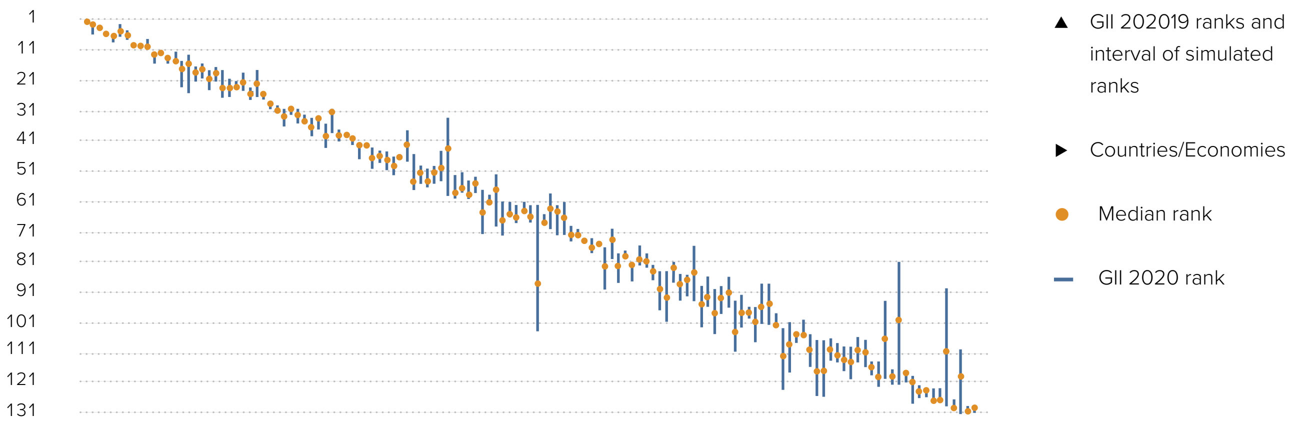
GII rank vs. median rank, 90% confidence intervals



Input rank vs. median rank, 90% confidence intervals



Output rank vs. median rank, 90% confidence



Source: European Commission Joint Research Centre, 2020.
Note: Median ranks and intervals are calculated over 4,000 simulated scenarios combining simulated weights, imputation versus no imputation of missing values, and geometric versus arithmetic average at the pillar level. The Spearman rank correlation between the median rank and the GII 2020 rank is 0.997; between the median rank and Innovation Input 2020 rank is 0.997; and between the median rank and the Innovation Output 2020 rank is 0.993.

All published GII 2020 ranks lay within the simulated 90% confidence intervals, and for most economies these intervals are narrow enough for meaningful inferences to be drawn: there is a shift of fewer than 10 positions for 102 of the 131 economies. However, it is also true that ranks for a few economies vary significantly with changes in weights and aggregation formula and because of the estimation of missing data. Five economies—Brunei Darussalam, the United Republic of Tanzania, Uzbekistan, Togo, and Myanmar—have 90% confidence interval widths over 20 positions (up to 24 positions). Consequently, their GII ranks—between the 71st (Brunei Darussalam) and 129th position (Myanmar) in the GII classification—should be interpreted cautiously and certainly not taken at face value. This is a remarkable improvement compared to GII versions until 2016, where more than 40 economies had confidence interval widths of more than 20 positions. The improvement in the confidence that one can attach to the GII 2020 ranks is the direct result of the developers' choice since 2016 to adopt a more stringent criterion for an economy's inclusion, which requires at least 66% data availability within each of the two sub-indices. Some caution is also warranted in the Input Sub-Index for 5 economies—North Macedonia, Mauritius, Belarus, Nepal, and Algeria—that have 90% confidence interval widths over 20 (up to 26 for Mauritius). Some caution is also needed in the Output Sub-Index for 6 economies, Mongolia, the United Republic of Tanzania, Uzbekistan, Myanmar, Togo, and the Niger, that have 90% confidence interval widths over 20 (up to 42 for Tanzania). Compared to last year's edition, the higher data availability in the Output Sub-Index this year had led to a much lower number of countries with very wide intervals (6 compared to 13 in last year's edition), which is a noteworthy improvement.

Although ranks for a few economies, in the GII 2020 overall or in the two sub-indices, appear to be sensitive to the methodological choices, the published rankings for the vast majority can be considered as representative of the plurality of scenarios simulated herein. Taking the median rank as the yardstick for an economy's expected rank in the realm of the GII's unavoidable methodological uncertainties, 75% of the economies are found to shift fewer than three positions with respect to the median rank in the GII, or in the Input and Output Sub-Index.

For full transparency and information, Table A-V.4 reports the GII 2020 Index and Input and Output Sub-Indices economy ranks together with the simulated 90% confidence intervals in order to better appreciate the robustness of the results to the choice of weights, of the aggregation formula and the impact of estimating missing data (where applicable).

Emphasizing the identification of and relation between input and output indicators seems irresistible from a policy perspective since doing so may possibly shed light on the effectiveness of innovation systems and policies. Yet, the 2018 statistical audit concluded that innovation efficiency ratios, calculated as ratios of indices, have to be approached with care. The reason was that the simulated 90% confidence intervals for most economies were too wide for meaningful inferences to be drawn: there was a shift of more than 20 positions for 50% of the economies. Hence, whilst propagating the uncertainty in the two GII sub-indices over to their sum the GII had a modest impact to the rankings, this same uncertainty propagation over to their ratio had a very high impact on the economy ranks. This is not a challenge specific to the GII framework per se but a statistical property that comes with ratios of composite indicators. In this present audit, the JRC-COIN complements the GII team for having opted to drop the Efficiency Ratio since the 2019 edition, drawing instead policy inference on the Input-Output performance in a similar way as per the plot of GII scores against the economies' level of economic development and commenting on those pairs/groups of economies that have similar Innovation Input level but very different Innovation Output level, and vice versa.

Sensitivity analysis results

Complementary to the uncertainty analysis, sensitivity analysis has been used to identify which of the modeling assumptions have the highest impact on certain country ranks. Table A-V.5 summarizes the impact of changes of the EM imputation method and/or the geometric aggregation formula, with fixed weights at their reference values (as in the original GII). Similar to last year's results, this year neither the GII nor the Input or Output Sub-Index are found to be heavily influenced by the imputation of missing data, or the aggregation formula. Depending on the combination of the choices made in Table A-V.5, only four economies, Myanmar, Uzbekistan, Togo, and the United Republic of Tanzania, shift rank by over 20 positions.

All in all, the published GII 2020 ranks are reliable and, for most economies, the simulated 90% confidence intervals are narrow enough for meaningful inferences to be drawn. Nevertheless, the readers of the GII 2020 report should consider economy ranks in the GII 2020 and in the Input and Output Sub-Indices not only at face value but also within the 90% confidence intervals in order to better appreciate to what degree an economy's rank depends on the modeling choices. These confidence intervals have to be taken into account also when comparing economy rank changes from one year to another at the GII or Innovation Sub-indices level in order to avoid drawing erroneous conclusions on economies' ascent or descent in the overall classifications. Since 2016, following the JRC-COIN recommendation in past GII audits, the developers' choice to apply the 66% indicator coverage threshold separately to the Input and Output Sub-Indices in the GII 2020 has led to a net increase in the reliability of economy ranks for the GII and the two sub-indices. Furthermore, the adoption in 2017 of less stringent criteria for the skewness and kurtosis (greater than 2.25 in absolute value and greater than 3.5, respectively) has not introduced any bias in the estimates.

TABLE A-V.4

GII 2020 and Input/Output Sub-Indices: ranks and 90% confidence intervals

	GII 2020		Input Sub-Index		Output Sub-Index	
	Rank	Interval	Rank	Interval	Rank	Interval
Switzerland	1	[1, 1]	2	[2, 3]	1	[1, 1]
Sweden	2	[2, 2]	3	[1, 4]	2	[2, 5]
United States of America	3	[3, 6]	4	[2, 6]	5	[5, 8]
United Kingdom	4	[3, 4]	6	[6, 9]	3	[3, 3]
Netherlands	5	[4, 6]	11	[7, 13]	4	[4, 6]
Denmark	6	[6, 8]	5	[4, 7]	9	[8, 10]
Finland	7	[7, 10]	8	[5, 11]	8	[8, 10]
Singapore	8	[7, 12]	1	[1, 3]	15	[14, 23]
Germany	9	[4, 9]	14	[10, 15]	7	[4, 7]
Republic of Korea	10	[8, 10]	10	[6, 13]	10	[7, 10]
Hong Kong, China	11	[9, 18]	7	[4, 14]	16	[12, 25]
France	12	[11, 15]	16	[16, 18]	12	[11, 13]
Israel	13	[11, 16]	17	[12, 20]	13	[12, 15]
China	14	[9, 16]	26	[23, 30]	6	[2, 6]
Ireland	15	[14, 17]	20	[18, 21]	11	[11, 15]
Japan	16	[13, 16]	12	[8, 14]	18	[15, 20]
Canada	17	[16, 19]	9	[8, 16]	22	[20, 26]
Luxembourg	18	[17, 19]	24	[22, 26]	14	[11, 15]
Austria	19	[18, 19]	18	[14, 19]	23	[21, 24]
Norway	20	[20, 25]	15	[11, 17]	28	[28, 30]
Iceland	21	[20, 27]	23	[23, 26]	19	[17, 24]
Belgium	22	[20, 26]	21	[19, 21]	25	[23, 27]
Australia	23	[21, 27]	13	[11, 19]	31	[29, 32]
Czech Republic	24	[20, 26]	28	[26, 29]	17	[16, 21]
Estonia	25	[20, 25]	25	[24, 28]	20	[16, 21]
New Zealand	26	[25, 30]	19	[16, 22]	33	[32, 35]
Malta	27	[26, 30]	31	[29, 34]	21	[17, 26]
Italy	28	[24, 29]	33	[31, 34]	24	[18, 24]
Cyprus	29	[22, 30]	30	[29, 33]	26	[17, 26]
Spain	30	[28, 30]	27	[25, 30]	27	[24, 27]
Portugal	31	[31, 31]	32	[30, 34]	29	[29, 31]
Slovenia	32	[32, 33]	29	[27, 31]	39	[38, 39]
Malaysia	33	[32, 35]	34	[29, 34]	36	[35, 43]
United Arab Emirates	34	[33, 41]	22	[22, 24]	55	[52, 60]
Hungary	35	[33, 35]	37	[35, 39]	32	[30, 35]
Latvia	36	[33, 36]	35	[35, 39]	35	[32, 37]
Bulgaria	37	[36, 39]	45	[41, 50]	30	[30, 36]
Poland	38	[36, 38]	38	[35, 38]	40	[40, 42]
Slovakia	39	[37, 40]	43	[41, 47]	34	[33, 39]
Lithuania	40	[38, 40]	36	[35, 39]	42	[41, 43]
Croatia	41	[41, 48]	44	[43, 49]	43	[43, 50]
Viet Nam	42	[41, 50]	62	[56, 71]	38	[37, 41]
Greece	43	[42, 46]	40	[37, 43]	52	[49, 55]
Thailand	44	[42, 45]	48	[43, 51]	44	[44, 48]
Ukraine	45	[37, 46]	71	[58, 76]	37	[28, 38]
Romania	46	[45, 52]	51	[46, 57]	46	[46, 52]
Russian Federation	47	[46, 50]	42	[39, 47]	58	[53, 58]
India	48	[44, 51]	57	[48, 59]	45	[44, 50]
Montenegro	49	[47, 58]	53	[50, 63]	49	[45, 57]
Philippines	50	[45, 53]	70	[58, 74]	41	[41, 47]
Turkey	51	[42, 52]	52	[45, 59]	53	[44, 54]
Mauritius	52	[50, 63]	47	[41, 66]	60	[59, 62]
Serbia	53	[52, 56]	58	[50, 61]	56	[51, 58]
Chile	54	[53, 60]	41	[40, 44]	66	[62, 68]
Mexico	55	[53, 58]	61	[52, 63]	57	[54, 60]
Costa Rica	56	[52, 61]	66	[61, 69]	51	[50, 56]
North Macedonia	57	[55, 65]	46	[43, 65]	63	[61, 66]
Mongolia	58	[42, 61]	65	[62, 74]	54	[33, 59]
Republic of Moldova	59	[48, 60]	75	[73, 82]	48	[37, 48]
South Africa	60	[59, 65]	49	[45, 55]	68	[65, 69]
Armenia	61	[56, 64]	83	[79, 90]	47	[45, 47]
Brazil	62	[59, 65]	59	[49, 64]	64	[62, 68]
Georgia	63	[59, 67]	54	[50, 66]	71	[61, 72]
Belarus	64	[51, 67]	67	[46, 69]	61	[52, 69]
Tunisia	65	[63, 75]	78	[65, 83]	59	[57, 72]
Saudi Arabia	66	[64, 75]	50	[43, 62]	77	[76, 90]

CONTINUED

TABLE A-V.4

GII 2020 and Input/Output Sub-Indices: ranks and 90% confidence intervals, continued

	GII 2020		Input Sub-Index		Output Sub-Index	
	Rank	Interval	Rank	Interval	Rank	Interval
Iran (Islamic Republic of)	67	[59, 71]	90	[77, 93]	50	[49, 55]
Colombia	68	[63, 70]	56	[47, 59]	74	[73, 75]
Uruguay	69	[65, 69]	69	[66, 75]	65	[61, 65]
Qatar	70	[66, 72]	64	[60, 70]	72	[69, 74]
Brunei Darussalam	71	[67, 90]	39	[39, 44]	113	[109, 120]
Jamaica	72	[70, 78]	86	[77, 92]	62	[61, 72]
Panama	73	[69, 77]	82	[74, 92]	70	[62, 72]
Bosnia and Herzegovina	74	[72, 81]	72	[69, 82]	75	[73, 78]
Morocco	75	[66, 76]	85	[77, 86]	69	[58, 70]
Peru	76	[72, 81]	55	[49, 59]	98	[96, 100]
Kazakhstan	77	[74, 80]	60	[56, 64]	94	[89, 98]
Kuwait	78	[74, 84]	73	[71, 80]	79	[78, 88]
Bahrain	79	[75, 82]	63	[60, 71]	89	[85, 92]
Argentina	80	[69, 80]	80	[68, 85]	73	[70, 73]
Jordan	81	[77, 81]	77	[71, 79]	81	[81, 87]
Azerbaijan	82	[82, 88]	76	[73, 83]	86	[84, 101]
Albania	83	[82, 90]	74	[71, 86]	91	[89, 103]
Oman	84	[81, 98]	68	[55, 70]	109	[107, 126]
Indonesia	85	[78, 86]	91	[84, 96]	76	[75, 76]
Kenya	86	[75, 87]	92	[82, 99]	78	[70, 80]
Lebanon	87	[79, 88]	93	[84, 94]	80	[77, 80]
United Republic of Tanzania	88	[86, 110]	112	[109, 122]	67	[62, 104]
Botswana	89	[88, 95]	84	[77, 86]	105	[104, 108]
Dominican Republic	90	[86, 99]	94	[91, 100]	85	[84, 97]
Rwanda	91	[89, 108]	79	[75, 94]	112	[109, 117]
El Salvador	92	[89, 94]	95	[93, 99]	87	[81, 88]
Uzbekistan	93	[85, 109]	81	[77, 87]	118	[94, 120]
Kyrgyzstan	94	[92, 102]	88	[83, 91]	107	[105, 116]
Nepal	95	[93, 103]	89	[84, 108]	106	[100, 106]
Egypt	96	[85, 99]	104	[96, 105]	82	[76, 82]
Paraguay	97	[92, 99]	98	[94, 98]	92	[86, 96]
Trinidad and Tobago	98	[92, 104]	87	[84, 92]	111	[108, 114]
Ecuador	99	[92, 100]	96	[90, 98]	97	[92, 103]
Cabo Verde	100	[91, 102]	99	[94, 114]	90	[76, 94]
Sri Lanka	101	[87, 102]	107	[96, 112]	83	[78, 83]
Senegal	102	[96, 102]	102	[100, 114]	84	[82, 87]
Honduras	103	[99, 105]	100	[98, 107]	102	[98, 103]
Namibia	104	[101, 115]	101	[95, 109]	104	[101, 118]
Bolivia (Plurinational State of)	105	[104, 114]	97	[87, 102]	117	[114, 122]
Guatemala	106	[105, 112]	110	[107, 117]	96	[94, 111]
Pakistan	107	[95, 109]	118	[100, 120]	88	[85, 94]
Ghana	108	[100, 109]	113	[103, 116]	93	[90, 105]
Tajikistan	109	[105, 111]	108	[102, 117]	99	[96, 107]
Cambodia	110	[103, 111]	117	[109, 122]	101	[88, 101]
Malawi	111	[110, 127]	114	[110, 125]	103	[103, 123]
Côte d'Ivoire	112	[110, 115]	105	[104, 117]	115	[107, 116]
Lao People's Democratic Republic	113	[106, 120]	127	[115, 129]	95	[86, 96]
Uganda	114	[113, 124]	103	[100, 120]	123	[122, 126]
Madagascar	115	[112, 120]	125	[124, 129]	100	[88, 101]
Bangladesh	116	[113, 120]	119	[113, 128]	114	[106, 114]
Nigeria	117	[114, 119]	115	[107, 120]	121	[117, 121]
Burkina Faso	118	[116, 123]	106	[103, 115]	124	[123, 126]
Cameroon	119	[116, 124]	120	[109, 122]	119	[117, 122]
Zimbabwe	120	[114, 129]	123	[113, 128]	108	[107, 125]
Algeria	121	[115, 123]	111	[94, 119]	126	[123, 127]
Zambia	122	[121, 127]	109	[103, 112]	128	[127, 130]
Mali	123	[118, 124]	126	[118, 127]	116	[114, 118]
Mozambique	124	[123, 130]	122	[110, 127]	125	[123, 128]
Togo	125	[104, 127]	121	[115, 123]	127	[90, 129]
Benin	126	[126, 130]	116	[110, 122]	131	[129, 131]
Ethiopia	127	[120, 128]	130	[128, 130]	110	[107, 114]
Niger	128	[118, 131]	124	[121, 128]	129	[110, 131]
Myanmar	129	[105, 129]	129	[123, 130]	120	[81, 122]
Guinea	130	[127, 130]	128	[125, 130]	122	[119, 128]
Yemen	131	[130, 131]	131	[131, 131]	130	[129, 131]

Source: European Commission Joint Research Centre, 2020.
Notes: Confidence intervals are calculated over 4,000 simulated scenarios combining simulated weights, imputation versus no imputation of missing values, and geometric versus arithmetic average at the pillar level.

TABLE A-V.5

Sensitivity analysis: impact of modeling choices on countries with most sensitive ranks

Index or Sub-Index	Uncertainty tested (pillar level only)	Spearman rank correlation between the two series	Number of economies that improve		Number of economies that deteriorate	
			by more than 20 positions	between 10 and 20 positions	by more than 20 positions	between 10 and 20 positions
GII	Geometric vs. arithmetic average	0.994	0	1	0	5
	EM imputation vs. no imputation of missing data	0.992	0	5	1 [4]	1
	Geometric average and EM imputation vs. arithmetic average and missing values	0.986	1 [1]	9	0	6
Input	Geometric vs. arithmetic average	0.995	0	1	0	3
Sub-Index	EM imputation vs. no imputation of missing data	0.994	0	2	0	3
	Geometric average and EM imputation vs. arithmetic average and missing values	0.990	0	3	0	5
Output	Geometric vs. arithmetic average	0.998	0	0	0	0
Sub-Index	EM imputation vs. no imputation of missing data	0.976	3 [2]	6	1 [5]	9
	Geometric average and EM imputation vs. arithmetic average and missing values	0.976	3 [3]	6	1 [6]	10

Source: European Commission Joint Research Centre, 2020.
Notes:
1 Myanmar
2 Uzbekistan, Togo, Myanmar
3 Uzbekistan, Togo, Myanmar
4 the United Republic of Tanzania
5 the United Republic of Tanzania
6 the United Republic of Tanzania

Efficiency frontier in the GII by Data Envelopment Analysis

Is there a way to benchmark economies' multidimensional performance on innovation without imposing a fixed and common set of weights that may not be fair to a particular economy?

Several innovation-related policy issues at the national level entail an intricate balance between global priorities and economy-specific strategies. Comparing the multidimensional performance on innovation by subjecting economies to a fixed and common set of weights may prevent acceptance of an innovation index on grounds that a given weighting scheme might not be fair to a particular economy. An appealing feature of the Data Envelopment Analysis (DEA) literature applied in real decision-making settings is to determine endogenous weights that maximize the overall score of each decision-making unit given a set of other observations.

In this segment, the assumption of fixed pillar weights common to all economies is relaxed once more; this time economy-specific weights that maximize an economies' global innovation score are determined endogenously by DEA.[11] In theory, each economy is free to decide on the relative contribution of each innovation pillar to its score, so as to achieve the best possible score in a computation that reflects its innovation strategy. In practice, the DEA method assigns a higher (lower) contribution to those pillars in which an economy is relatively strong (weak). Reasonable constraints on the weights are applied to preclude the possibility of an economy achieving a perfect score by assigning a zero weight to weak pillars: for each economy, the share of each pillar score (i.e., the pillar score multiplied by the DEA weight over the total score) has upper and lower bounds of 5% and 20% respectively. The DEA score is then measured as the weighted average of all seven innovation pillar scores, where the weights are the economy-specific DEA weights, compared to the best performance among all other economies with those same weights. The DEA score can be interpreted as a measure of the "distance to the efficient frontier".

Table A-V.6 presents the pie shares and DEA scores for the top 25 economies in the GII 2020, next to the GII 2020 ranks. All pie shares are in accordance with the starting point of granting leeway to each economy when assigning shares, while not violating the (relative) upper and lower bounds. The pie shares are quite diverse, reflecting the different national innovation strategies. These pie shares can also be seen to reflect economies' comparative advantage in certain GII pillars vis-à-vis all other economies and all pillars. For example, Switzerland

TABLE A-V.6

Pie shares (absolute terms) and efficiency scores for the top 25 economies in the GII 2020

	Input pillars					Output pillars					
	Institutions	Human capital and research	Infrastructure	Market sophistication	Business sophistication	Knowledge and technology outputs	Creative outputs	Efficient frontier score (DEA)	Efficient frontier rank DEA)	GII rank	Difference from GII rank
Switzerland	0.05	0.13	0.13	0.11	0.19	0.19	0.19	1.00	1	1	0
Sweden	0.20	0.20	0.20	0.05	0.20	0.10	0.05	1.00	1	2	1
United States of America	0.20	0.20	0.10	0.20	0.20	0.05	0.05	0.97	3	3	0
United Kingdom	0.20	0.20	0.20	0.20	0.05	0.05	0.10	0.95	5	4	-1
Netherlands	0.20	0.20	0.20	0.05	0.20	0.05	0.10	0.93	8	5	-3
Denmark	0.20	0.20	0.20	0.20	0.10	0.05	0.05	0.94	6	6	0
Finland	0.20	0.20	0.20	0.05	0.20	0.10	0.05	0.94	6	7	1
Singapore	0.20	0.20	0.10	0.20	0.20	0.05	0.05	0.96	4	8	4
Germany	0.20	0.20	0.20	0.05	0.20	0.05	0.10	0.90	11	9	-2
Republic of Korea	0.20	0.20	0.20	0.10	0.20	0.05	0.05	0.92	9	10	1
Hong Kong, China	0.20	0.10	0.20	0.20	0.05	0.05	0.20	0.91	10	11	1
France	0.20	0.20	0.20	0.20	0.10	0.05	0.05	0.87	14	12	-2
Israel	0.20	0.20	0.05	0.20	0.20	0.10	0.05	0.87	14	13	-1
China	0.05	0.20	0.20	0.10	0.20	0.20	0.05	0.82	22	14	-8
Ireland	0.20	0.10	0.20	0.05	0.20	0.20	0.05	0.86	16	15	-1
Japan	0.20	0.10	0.20	0.20	0.20	0.05	0.05	0.88	12	16	4
Canada	0.20	0.20	0.20	0.20	0.10	0.05	0.05	0.88	12	17	5
Luxembourg	0.20	0.05	0.20	0.10	0.20	0.05	0.20	0.84	20	18	-2
Austria	0.20	0.20	0.20	0.10	0.20	0.05	0.05	0.85	17	19	2
Norway	0.20	0.20	0.20	0.20	0.10	0.05	0.05	0.85	17	20	3
Iceland	0.20	0.10	0.20	0.05	0.20	0.05	0.20	0.81	24	21	-3
Belgium	0.20	0.20	0.20	0.10	0.20	0.05	0.05	0.83	21	22	1
Australia	0.20	0.20	0.20	0.20	0.10	0.05	0.05	0.85	17	23	6
Czech Republic	0.20	0.20	0.20	0.10	0.20	0.05	0.05	0.77	26	24	-2
Estonia	0.20	0.10	0.20	0.20	0.05	0.05	0.20	0.79	25	25	0

Source: European Commission, Joint Research Centre, 2020.
Notes: Pie shares are in absolute terms, bounded by 0.05 and 0.20 for all seven innovation pillars. In the GII 2020, however, the five input pillars each have a fixed weight of 0.10; the two output pillars each have a fixed weight of 0.25. Darker colors represent higher contribution of those pillars to the overall DEA score as a result of a country's stronger performance in those pillars, which may help to evidence economy-specific strategies. Countries are ordered by their GII 2020 rank.

and Sweden are the only economies this year that obtain a perfect DEA score of 1.00, followed closely by the U.S. and the United Kingdom (DEA score of 0.97 and 0.95 respectively). In the case of Switzerland, this is achieved by assigning 19% of its DEA score to a mix of input and output pillars, namely Business sophistication, Knowledge and technology outputs, and Creative outputs. Instead, merely 5% to 11% of Switzerland's DEA score comes from two input pillars, namely Institutions, and Market sophistication. Using a different mix, Sweden would assign 20% of its DEA score to four input pillars—Institutions, Human capital and research, Infrastructure, and Business sophistication—while merely 5 to 10% of its DEA score comes from the two output pillars capturing Knowledge and technology outputs, and Creative Outputs, and from the input pillar measuring Market sophistication. Switzerland and Sweden are closely followed by the United States of America (0.97), and the United Kingdom (0.95) in terms of efficiency. Figure A-V.3 shows how close the DEA scores and the GII 2020 scores are for all 131 economies (Pearson correlation of 0.994).

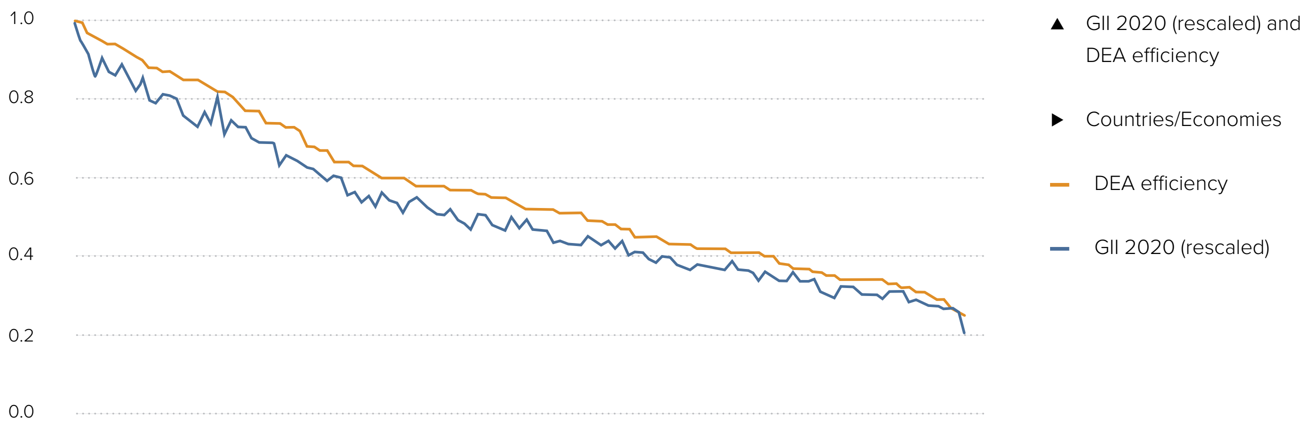
Conclusion

The JRC-COIN analysis suggests that the conceptualized multi-level structure of the GII 2020—with its 80 indicators, 21 sub-pillars, 7 pillars, 2 sub-indices, up to an overall index—is statistically sound and balanced: that is, each sub-pillar makes a similar contribution to the variation of its respective pillar. This year, the refinements made by the developing team have helped to enhance the already strong statistical coherence in the GII framework, where for all 80 (but two) indicators, their capacity to distinguish economies' performance is maintained at the sub-pillar level or higher.

The no-imputation choice for not treating missing values, common in relevant contexts and justified on grounds of transparency and replicability, can at times have an undesirable impact on some economy scores, with the additional negative side-effect that it may encourage economies not to report low data values. The adoption, since 2016, by the GII team of a

FIGURE A-V.3

GII 2020 scores and DEA "distance to the efficient frontier" scores



Source: European Commission Joint Research Centre, 2020.
Note: For comparison purposes, the GII scores were rescaled by dividing them with the best performer (Switzerland) in the overall GII 2020.

more stringent data coverage threshold (at least 66% for the input- and output-related indicators, separately) has notably improved the confidence in the economy ranks for the GII and the two sub-indices.

Additionally, the choice of the GII team, which was made in 2012, to use weights as scaling coefficients during the index development constitutes a significant departure from the traditional, yet erroneous, vision of weights as a reflection of indicators' importance in a weighted average. It is hoped that such a consideration will be made also by other developers of composite indicators to avoid situations where bias sneaks in when least expected.

The strong correlations between the GII components are proven not to be a sign of redundancy of information in the GII. For more than 46% (up to 64%) of the 131 economies included in the GII 2020, the GII ranking and the rankings of any of the seven pillars differ by 10 positions or more. This demonstrates the added value of the GII ranking, which helps to highlight other components of innovation that do not emerge directly by looking into the seven pillars separately. At the same time, this finding points to the value of duly considering the GII pillars, sub-pillars, and individual indicators on their own merit. By doing so, economy-specific strengths and bottlenecks in innovation can be identified and serve as an input for evidence-based policymaking.

All published GII 2020 ranks lie within the simulated 90% confidence intervals that consider the unavoidable uncertainties in the estimation of missing data, the weights (fixed vs. simulated), and the aggregation formula (arithmetic vs. geometric average) at the pillar level. For the vast majority of economies these intervals are narrow enough for meaningful inferences to be drawn: the intervals comprise fewer than 10 positions for 76% (98 out of 131) of the economies. Some caution is needed mainly for five countries—Brunei Darussalam, the United Republic of Tanzania, Uzbekistan, Togo, and Myanmar—with GII ranks that are highly sensitive to the methodological choices. The Input and the Output Sub-Indices have the same modest degree of sensitivity to the methodological choices related to the imputation method, weights, or aggregation formula. Economy ranks, either in the GII 2020 or in the two sub-indices, can be considered representative of the many possible scenarios: 75% of economies shift fewer than three positions with respect to the median rank in the GII or either of the Input and Output Sub-Indices.

All things considered, the present JRC-COIN audit findings confirm that the GII 2020 meets international quality standards for statistical soundness, which indicates that the GII index is a reliable benchmarking tool for innovation practices at the economy level around the world.

Finally, the "distance to the efficient frontier" measure calculated with Data Envelopment Analysis can be used as a measure of efficiency, and a suitable approach to benchmark economies' multidimensional performance on innovation without imposing a fixed and common set of weights that may not be fair to a particular economy. The choice of the GII team to abandon the efficiency ratio (ratio of Output to Input Sub-index) is particularly applaudable. In fact, ratios of composite indicators (Output to Input Sub-Index in this case) come with much higher uncertainty than the sum of the components (Input plus Output Sub-Index, equivalent to the GII). For this reason, developers and users of indices alike need to take efficiency ratios of this nature with great care. The GII should not be the ultimate and definitive ranking of economies with respect to innovation. On the contrary, the GII best represents an ongoing attempt by Cornell University, INSEAD, and the World Intellectual Property Organization to find metrics and approaches that better capture the richness of innovation, continuously adapting the GII framework to reflect the improved availability of statistics and the theoretical advances in the field. In any case, the GII should be regarded as a sound attempt, based on the principle of transparency, matured over 13 years of constant refinements, to pave the way for better and more informed innovation policies worldwide.

Notes:

1 OECD/EC JRC, 2008.

2 The JRC analysis was based on the recommendations of the OECD/EC JRC (2008) *Handbook on Composite Indicators* and on more recent research from the JRC. The JRC audits on composite indicators are conducted upon request of the index developers and are available at https://ec.europa.eu/jrc/en/coin and https://composite-indicators.jrc.ec.europa.eu

3 Groeneveld, R.A., et al., 1984: set the criteria for absolute skewness above 1 and kurtosis above 3.5. The skewness criterion was relaxed in the GII case after having conducted ad-hoc tests in the GII 2008-2018 timeseries.

4 An indicator can explain 9% of the economy's variation in the GII sub-pillar scores if the Pearson correlation coefficient between the two series is 0.3.

5 Nunnally, 1978.

6 See footnote 4.

7 Saisana et al., 2005; Saisana et al., 2011; Vértesy, 2016; Vértesy et al., 2016; Montalto et al., 2019.

8 Little et al., 2002; Schneider, 2001; The Expectation-Maximization (EM) algorithm is an iterative procedure that finds the maximum likelihood estimates of the parameter vector by repeating two steps: (1) The expectation E-step: Given a set of parameter estimates, such as a mean vector and covariance matrix for a multivariate normal distribution, the E-step calculates the conditional expectation of the complete-data log likelihood given the observed data and the parameter estimates. (2) The maximization M-step: Given a complete-data log likelihood, the M-step finds the parameter estimates to maximize the complete-data log likelihood from the E-step. The two steps are iterated until the iterations converge.

9 Munda, 2008.

10 In the geometric average, pillars are multiplied as opposed to summed in the arithmetic average. Pillar weights appear as exponents in the multiplication. All pillar scores were greater than zero, hence there was no reason to rescale them to avoid zero values that would have led to zero geometric averages.

11 A question that arises from the GII approach is whether there is a way to benchmark economies' multidimensional performance on innovation without imposing a fixed and common set of weights that may not be fair to an economy. The original question in the DEA literature was how to measure each unit's relative efficiency in production compared to a sample of peers, given observations on input and output quantities and, often, no reliable information on prices (Charnes, A. et al., 1985). A notable difference between the original DEA question and the one applied here is that no differentiation between inputs and outputs is made (Cherchye, L. et al., 2008; Melyn, W. et al., 1991). To estimate DEA-based distance to the efficient frontier scores, we consider the *m* = 7 pillars in the GII 2019 for *n* = 131 economies, with y_{ij} the value of pillar *j* in economy *i*. The objective is to combine the pillar scores per economy into a single number, calculated as the weighted average of the m pillars, where w_i represents the weight of the *i*-th pillar. In absence of reliable information about the true weights, the weights that maximize the DEA-based scores are endogenously determined. This gives the following linear programming problem for each economy *j*:

$$Y_i = \max_{wij} \frac{\sum_{j=1}^{7} y_{ij} w_{ij}}{\max\limits_{y_c \in \{dataset\}} \sum_{j=1}^{7} y_{cj} w_{ij}} \qquad \text{(bounding constraint)}$$

Subject to

$$w_{ij} \geq 0 \text{ , where } j = 1,\dots,7 \text{ , } i = 1,\dots\dots,129 \qquad \text{(non-negativity constraint)}$$

In this basic programming problem, the weights are non-negative and an economy's score is between 0 (worst) and 1 (best).

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APPENDIX VI

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Giacomo Damioli
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is the Secretary of the Department of Science and Technology (DOST) of the Republic of the Philippines. He started his professional career at the then ESSO Standard Eastern as a cost and operations engineer in 1969 after graduating with a Bachelor of Science in Chemical Engineering from the University of the Philippines (UP). He earned a Master of Science in Industrial Engineering. He joined the UP College of Engineering faculty as an instructor in 1973 and rose to become a full professor in 1988. He served UP in various capacities: as Chairman of the Department of Industrial Engineering & Operations Research, as Assistant to the Executive Director of the National Engineering Center, as Director of the Institute for Small Scale Industries, and as System Vice President for Planning & Development. He taught industrial engineering and operations research at the University of the Philippines for 43 years, from 1973 to 2016. He was seconded three times to the National Science & Technology Authority (NSTA), which later became the DOST: as Head of Planning Service, as Director of the Technology Application & Promotion Institute, and as Undersecretary for Scientific & Technical Services, after which he retired in 2014. In 2016 he was appointed DOST Secretary.

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is Professor of Management and the former founding dean of the Cornell SC Johnson College of Business. Previously, he was the Anne and Elmer Lindseth Dean of the Samuel Curtis Johnson Graduate School of Management. Prior to coming to Cornell in 2012, he was on the faculty and leadership team of INSEAD, a leading international business school in France and Singapore. He is an authority on technology and innovation policy and is the co-editor and author of the *Global Information Technology Report*, published by the Portulans Institute, and the *Global Innovation Index*, published by the World Intellectual Property Organization (WIPO)—two influential reports in technology and innovation policy. Mr. Dutta is on the global boards of Sodexo and Dassault Systèmes. He is also a member of the Shareholder Council of Chicago-based ZS Associates. In addition, he is a member of the advisory boards of several business schools, including HEC (Montreal), ESADE (Barcelona), and ESCP (Paris). He has co-founded two firms, including Fisheye Analytics, which WPP group acquired. He is currently Chair of the Board of Directors of the Global Business School Network, a Washington, D.C. based not-for-profit organization focused on improving management capacity in emerging markets. He was previously the Chair of AACSB, the leading global body for the accreditation of business schools. Mr. Dutta is a member of the Davos Circle, an association of long-time participants in the Annual Davos meeting of the World Economic Forum, and has engaged in a number of multi-stakeholder initiatives to shape global, regional, and industry agendas. He also co-chaired the World Economic Forum's Global Future Council on Innovation Ecosystems. Mr. Dutta received a Bachelor of Technology in Electrical Engineering and Computer Science from the Indian Institute of Technology (IIT), New Delhi, a Master of Science in both Business Administration and Computer Science, and a PhD in Computer Science from the University of California at Berkeley. In 2017, he received the Distinguished Alumnus Award from his alma mater, IIT Delhi.

Jerome Engel
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Silvana Jirotková
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Patrick Johnson
is Senior Vice President of Corporate Science & Research at 3DS. His mission is to define the scientific bases of the company's solutions, invent new disruptive technologies for the Industry Renaissance, and animate the group's global research ecosystem. After joining in 1996, he held various positions in R&D, from Product Lifecycle Management infrastructure to virtual product design solutions for the CATIA flagship brand. In 2001, he became head of the Artificial Intelligence department and played an instrumental role with new engineering practices now adopted in multiple sectors, such as smart morphing templates, and industrial processes capitalization & reuse automation. As Head of Corporate Research in 2004, he launched the development of original technologies for all brands, and significantly grew the global innovation ecosystem of public/private partnerships with prestigious research bodies. In addition, he launched a strategic diversification for 3DS, following a very large European research program (BioIntelligence), resulting in a suite of collaborative applications for the life sciences sector and the creation of the BIOVIA brand with a worldwide R&D lab in modeling, simulation, and big data for life sciences. This has been the launchpad for a wider move for 3DS with MEDIDATA, enabling the first end to end scientific platform for life sciences. A graduate of ENSAE, Mr. Johnson is based at 3DS headquarters near Paris. He is or has been a member the National Academy of Technology as well as of the scientific boards of INRIA, IMT, ARISS, International Society of Computational Biology, IRCAM, Comité de Culture Mathematics of the Institut Henri Poincaré, and Associate Personality of the Economic, Social and Environmental Council (CESE).

Bruno Lanvin
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Josh Lerner
graduated from Yale College with a special divisional major. He worked for several years on issues concerning technological innovation and public policy at the Brookings Institution, for a public-private task force in Chicago, and on Capitol Hill. He then earned a PhD from Harvard's Economics Department. Much of his research focuses on venture capital and private equity organizations. This research is collected in three books: *The Venture Capital Cycle, The Money of Invention,* and *Boulevard of Broken Dreams*. He also examines policies on innovation and how they impact firm strategies—with his research discussed in the books *Innovation and Its Discontents*, *The Comingled Code*, and *The Architecture of Innovation*. He co-directs the National Bureau of Economic Research's Productivity, Innovation, and Entrepreneurship Program and serves as co-editor of their publication, *Innovation Policy and the Economy*. He founded and runs the Private Capital Research Institute, a nonprofit devoted to encouraging access to data and research, and has been a frequent leader of and participant in the World Economic Forum projects and events. In the 1993-1994 academic year, he introduced an elective course for second-year MBAs. Over the past two decades, "Venture Capital and Private Equity" has consistently been one of the largest elective courses at Harvard Business School. The course materials are collected in *Venture Capital and Private Equity: A Casebook*, now in its fifth edition, and the textbook *Venture Capital, Private Equity, and the Financing of Entrepreneurship*. He also established and teaches doctoral courses on entrepreneurship, teaches in the Owners-Presidents-Managers Program, and leads executive courses on private equity. He is the Jacob H. Schiff Professor and Chair of the Entrepreneurial Management unit. Among other recognitions, he is the winner of the Swedish government's Global Entrepreneurship Research Award and Cheng Siwei Award for Venture Capital Research.

Kevin Levillain
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Sébastien Massart
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Valentina Montalto
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James Mwangi
CBS, is the Managing Director & Chief Executive Officer of Equity Group Holdings Plc, whose subsidiaries include bank subsidiaries in Kenya, Uganda, South Sudan, Rwanda, Tanzania, DR Congo, Ethiopia (Representative Office), and (soon) Zambia and Mozambique, as well as non-bank subsidiaries across insurance, investment banking, fintech (Finserve and Equitel MVNO brand) and Equity Group Foundation. Dr. Mwangi holds five honorary doctorate degrees in recognition of his contributions to the Kenyan society. He holds a Bachelor of Commerce degree and is a certified public accountant (CPA). Mr. Mwangi has been honored twice with Presidential national awards; he was vested the First Class Chief of the Order of the Burning Spear (CBS) national decoration—the highest presidential award to a civilian, for outstanding contributions in economic development. He was also awarded the Moran of the Burning Spear. He was named the World Entrepreneur of the Year by Ernst & Young in 2012, the Forbes Africa Person of the Year in 2012, and is a holder of the 2007 Global Vision Award as an "initiator of concepts of the future that will shape the world economy''. He is the Founding Chairman of Kenya's Vision 2030 Delivery Board, charged with the responsibility of ensuring Kenya becomes a middle-income country with global high standards of living by the year 2030. He serves on several international bodies as an advisor. He is an Economic Advisor to the IFC board. He is a board member of Columbia Global Center, the Africa Leadership Academy in South Africa, and the Global Alliance for Food Security and Nutrition, among others. He serves as the Chancellor of Meru University College of Science and Technology. He has wide experience in the banking industry and inclusive finance.

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Michaela Saisana
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In 2020, the Global Innovation Index (GII) presents its 13th edition dedicated to the theme *Who Will Finance Innovation?* This edition sheds light on the state of innovation financing by investigating the evolution of financing mechanisms for entrepreneurs and other innovators, and by pointing to progress and remaining challenges—including in the context of the economic slowdown induced by the coronavirus disease (COVID-19) crisis.

Innovation is widely recognized as a central driver of economic growth and development.

The aim of the Global Innovation Index is to provide insightful data on innovation and, in turn, to assist economies in evaluating their innovation performance and making informed innovation policy considerations.

Since its creation in 2007, the GII has been impactful on three fronts. First, policymakers are now referring regularly to innovation and their innovation rankings as part of their economic policy strategies. Additionally, the GII is now considered a yardstick for measuring innovation by the UN General Assembly, as noted in its resolution on Science, Technology and Innovation for achieving Sustainable Development Goals (SDGs) at its 74th session in 2019.

Second, the GII allows economies to assess their innovation performance. Economies invest resources to analyze their GII results in cross-ministerial task forces and use the GII to design appropriate innovation and intellectual property (IP) policies.

Third, the GII continues to give a strong impetus for economies to prioritize and collect innovation metrics. By experimenting with new data and evaluating existing innovation metrics, the GII also aims to shape the innovation measurement agenda.

The GII is co-published by Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO), a specialized agency of the United Nations. The 2020 edition of the GII draws on the expertise of its Knowledge Partners: the Confederation of Indian Industry (CII), Dassault Systèmes—The 3DEXPERIENCE Company, and the Brazilian National Confederation of Industry (CNI), as well as an Advisory Board of eminent experts. For the tenth consecutive year, the Joint Research Centre (JRC) of the European Commission audited the GII rankings and associated calculations.

The full report and the GII Mobile Apps—Android and iOS—can be downloaded at **https://globalinnovationindex.org**.

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