CHAPTER 1

THE GLOBAL INNOVATION INDEX 2020

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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.

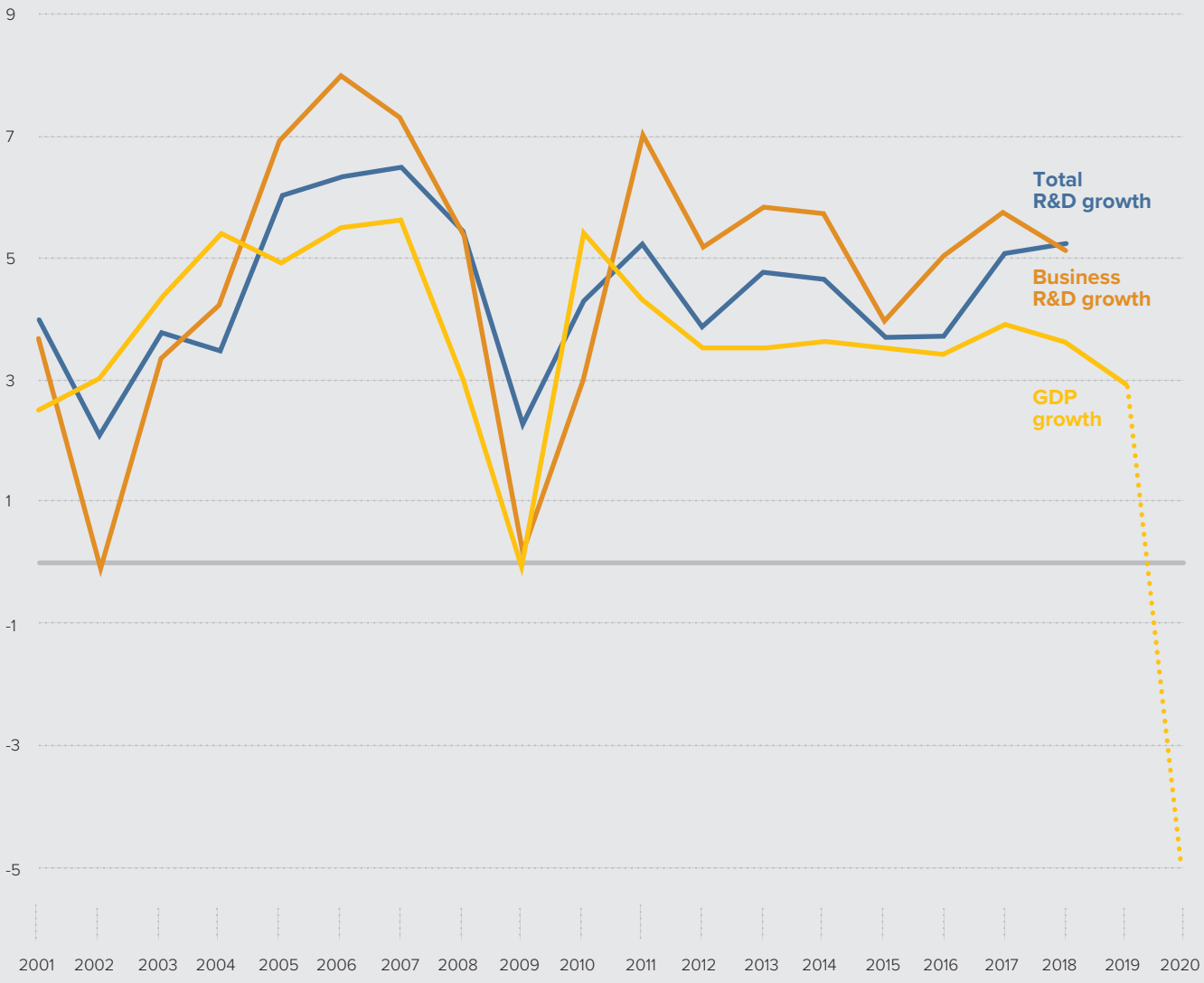
China's R&D expenditure grew 8.6% in 2018, higher than the prior year. India's R&D spending growth in 2018 is estimated at 5.5%. In high-income economies, real R&D expenditure grew 3.8% in 2018.[2] Expenditures grew 8.3% in the Republic of Korea, 3.4% in the United States of America (U.S.), 3.7% in Germany,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



▲ %
► Year
GDP growth forecast

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.

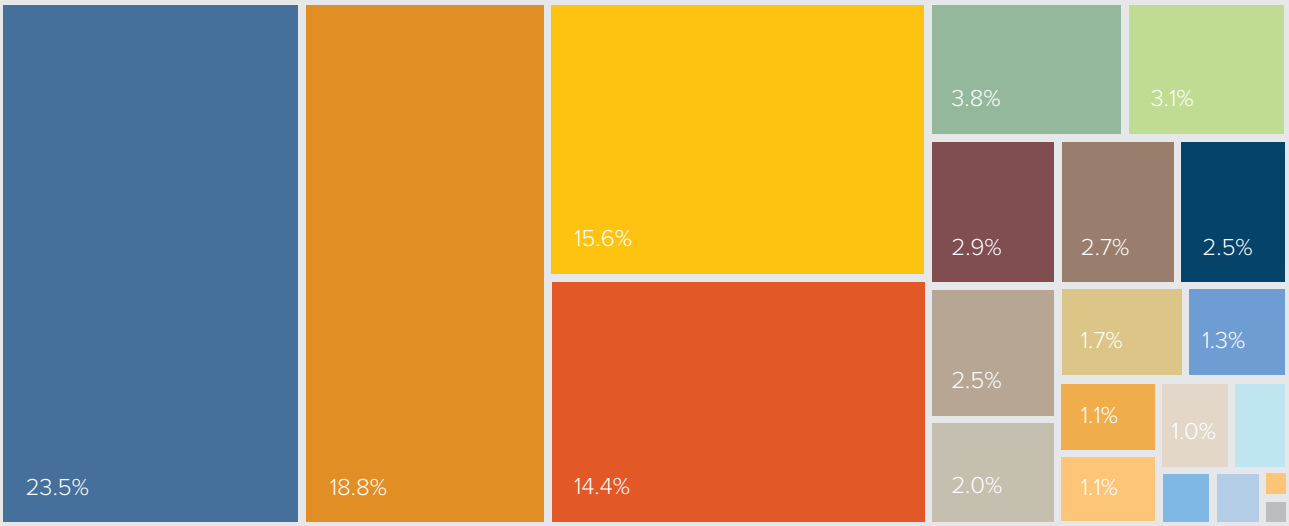
Following the 2008–2009 financial crisis, a number of economies never experienced aggregate R&D declines, including Argentina, China, Costa Rica, Egypt, France, India, the Republic of Korea, Mexico, Poland, and Turkey.[15] For other economies, including Brazil, Chile, Germany, Israel, the United Kingdom (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.

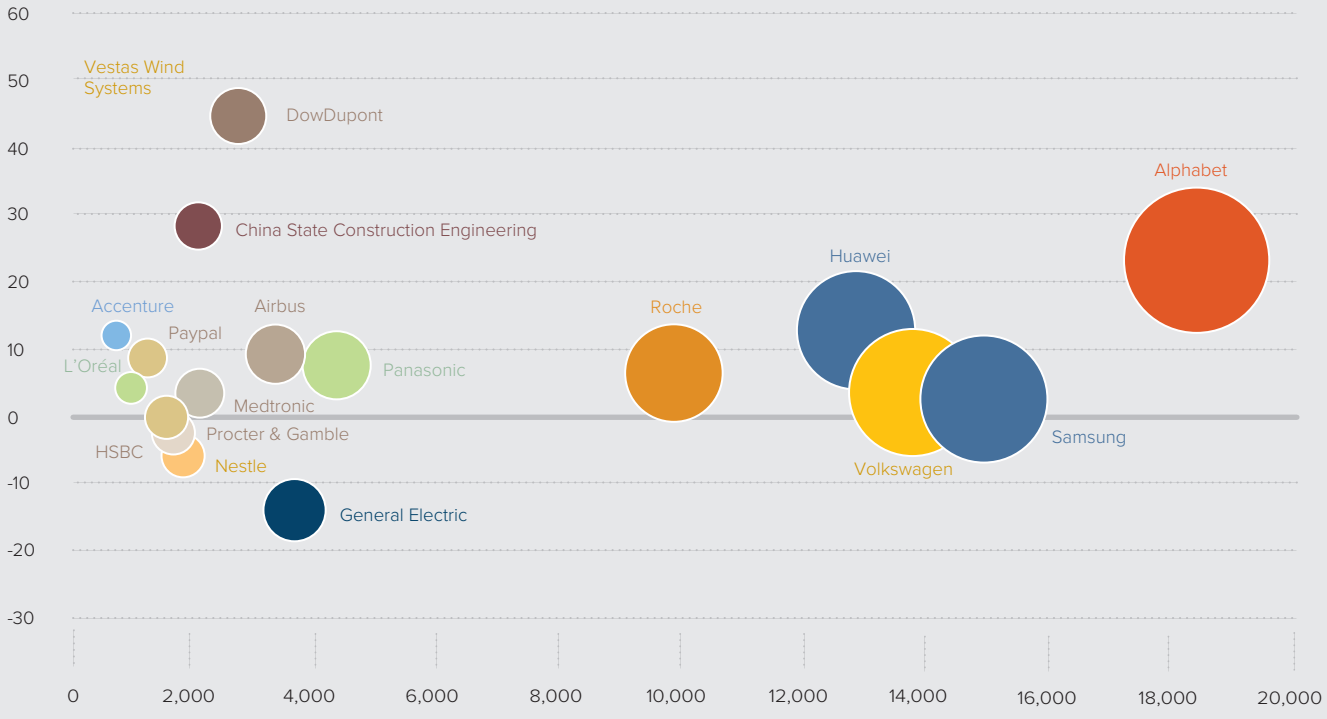
Past crises have had very heterogeneous effects on different sectors and countries, with some increasing innovation and others decreasing innovation and related expenditures after an economic downturn.[18] This is possible again today.

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



▲ R&D one-year growth (%), 2018
▶ R&D investment (€ million), 2018–2019
● Bubbles sized as total R&D volume per company

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]

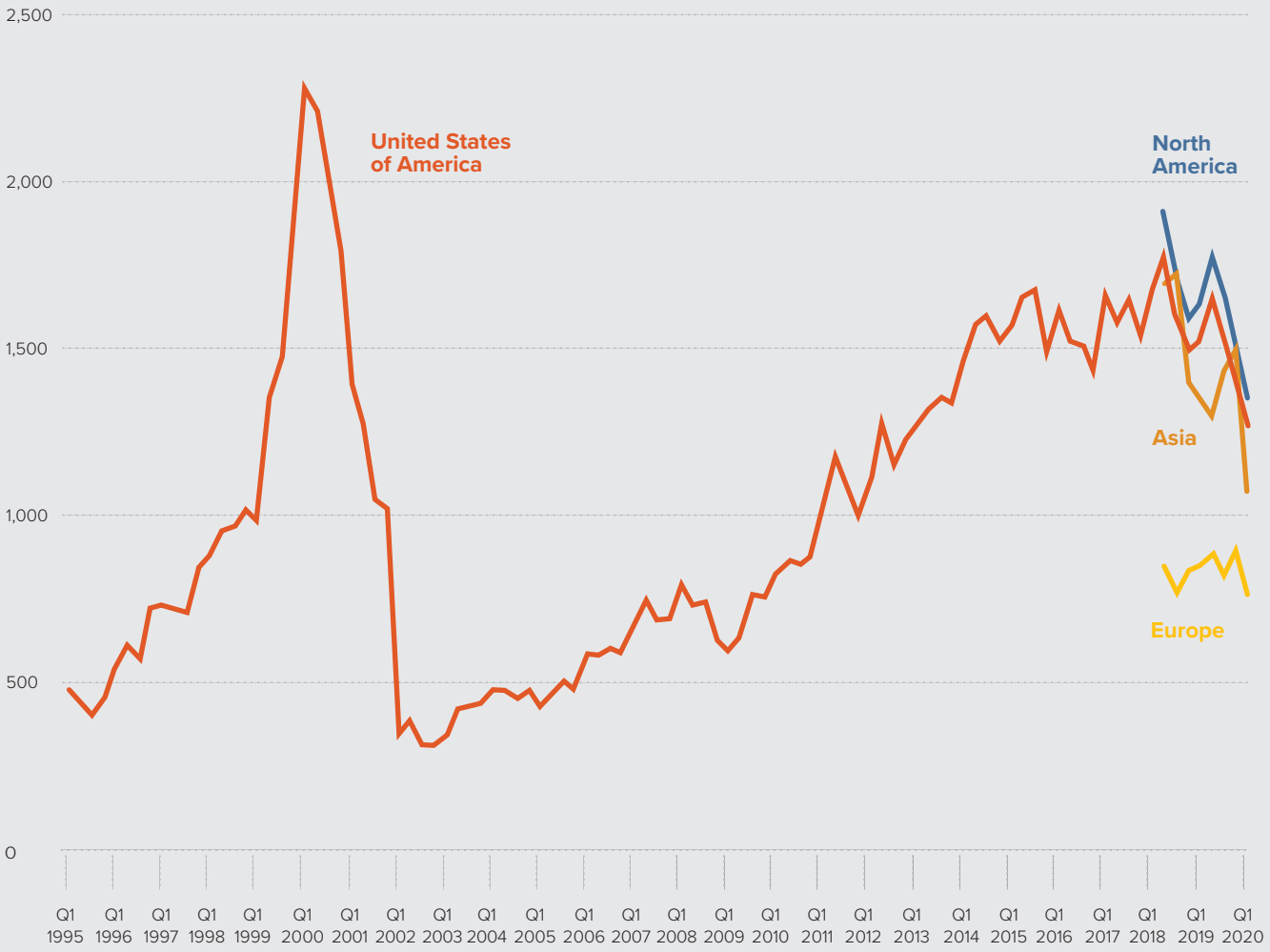
Most of the new spending packages are geared toward preventing short- to medium-term harm to economies. This is needed and sensible. The immediate focus is on 1) injecting liquidity, 2) supporting businesses via loan guarantees and other measures to avert bankruptcies, 3) helping households and workers 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.

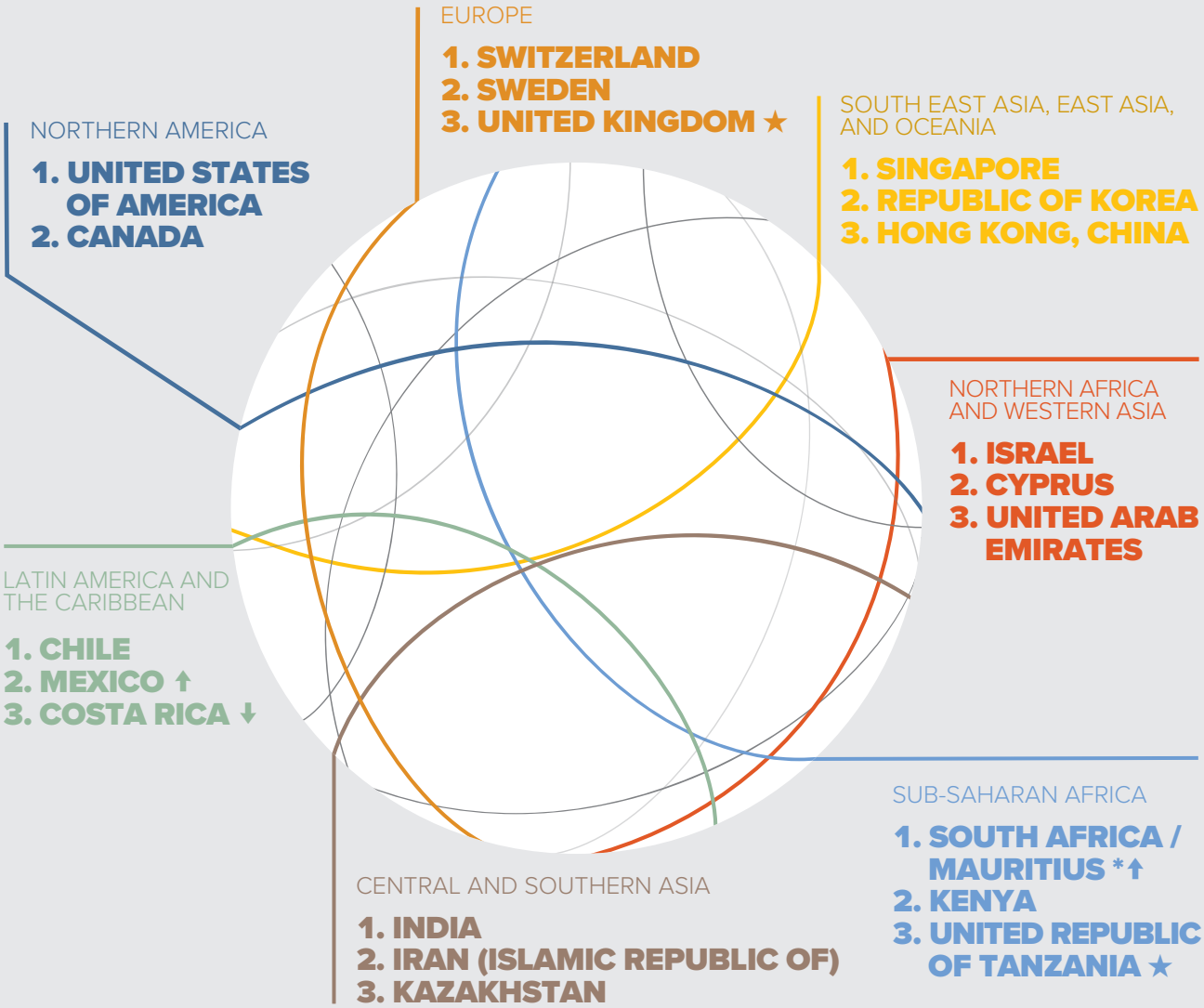
Now more than ever—in particular, as the world seeks a vaccine and/or treatment for COVID-19—innovation and the use of innovation policies in a countercyclical fashion is humanity's best hope to overcome the economic lockdown.

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



* 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).

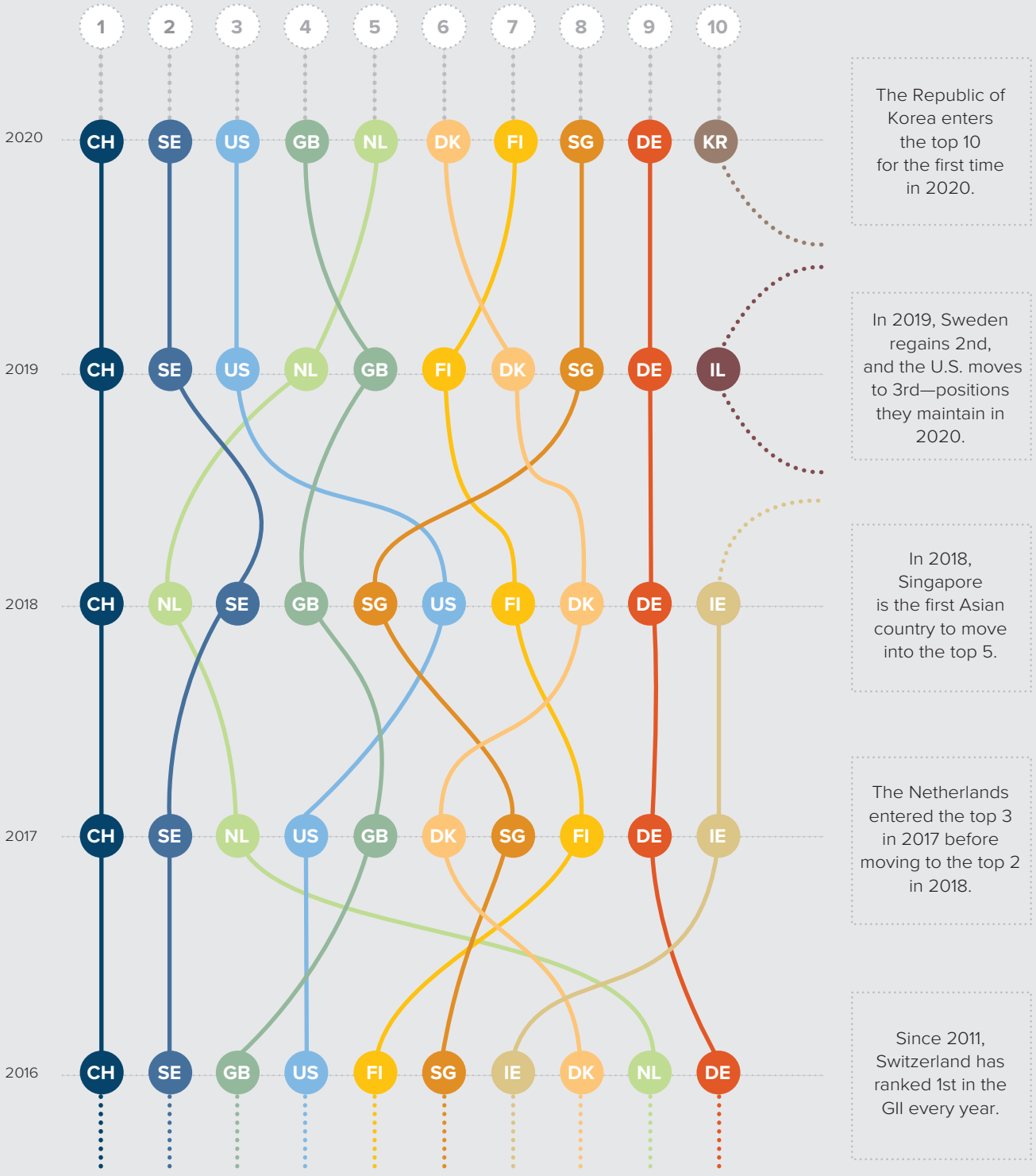
Some outlier rank movements, such as Mauritius (positive), Georgia (negative), and Kuwait (positive) are explained by a mix of new data availability, data revisions at the source, and performance effects.

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)

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)

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.

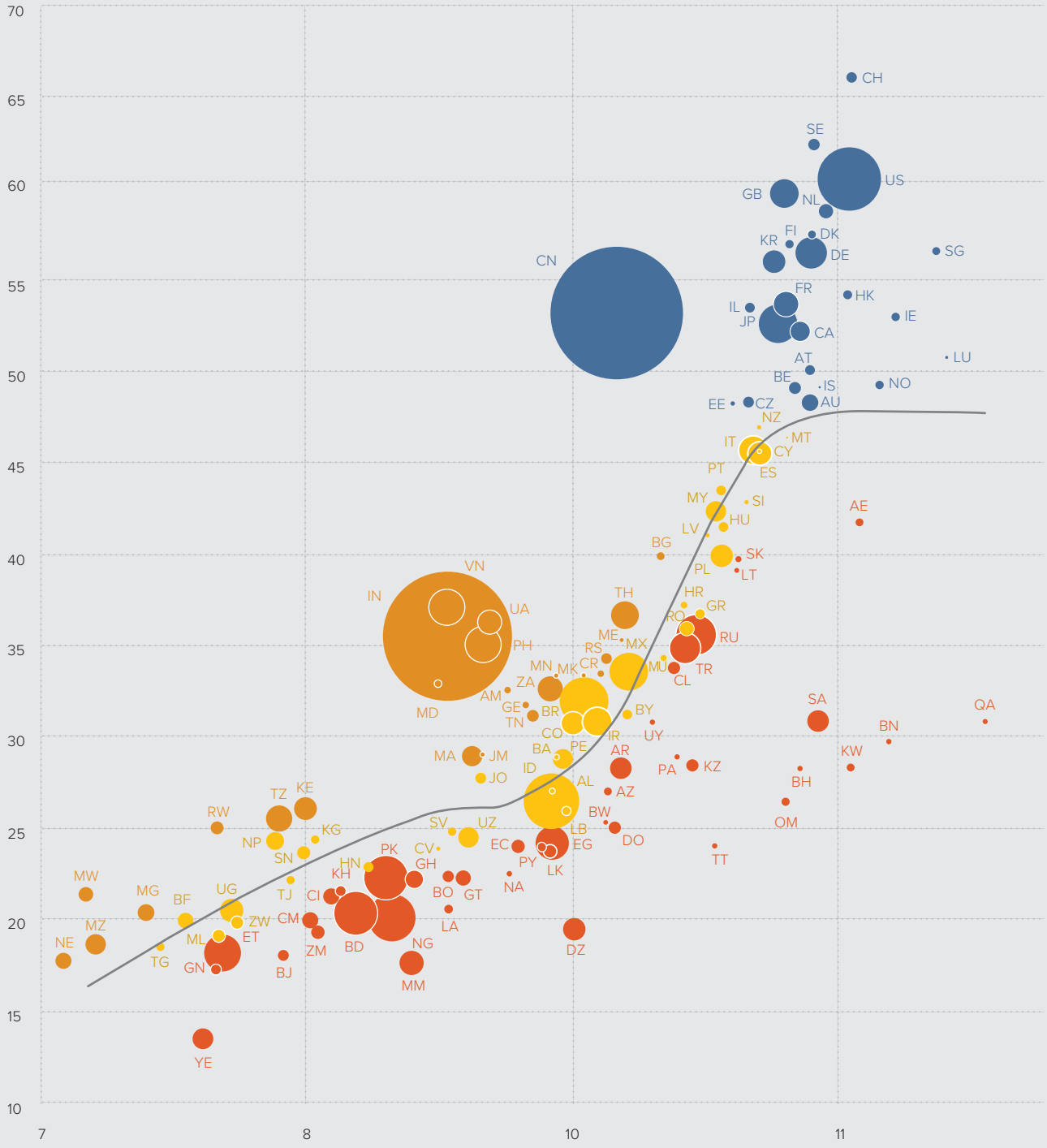
Innovation achievers are those economies that outperform their peers (in orange). There are 25 economies in this group this year, the largest number ever (Table 1.3). Jamaica and the Niger become innovation achievers for the first time.

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.

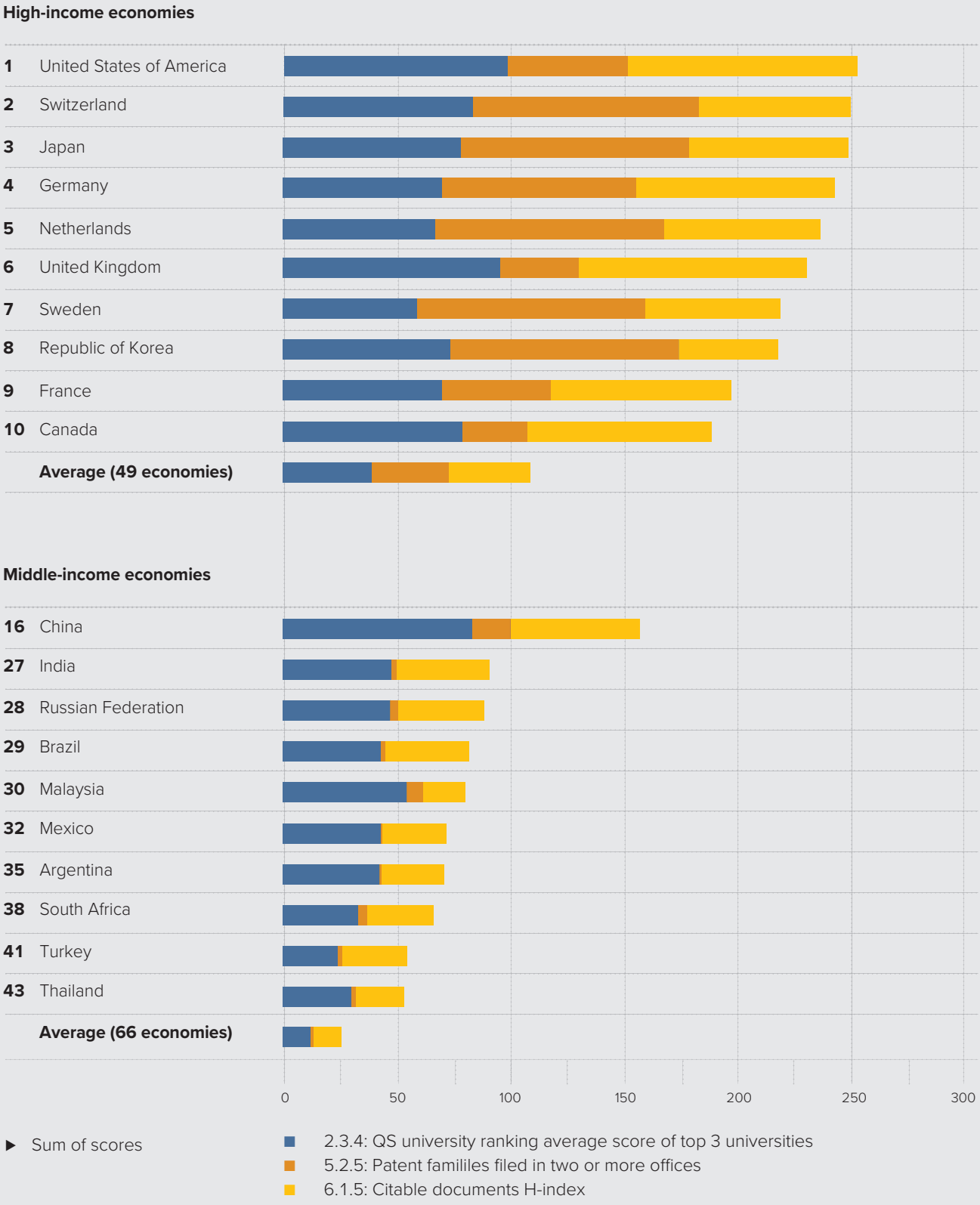
China remains the top middle-income economy in the quality of innovation for the eighth consecutive year. It ranks 3rd in the quality of its universities, with Tsinghua University, Peking University, and Fudan University ranking within the top 50 universities worldwide. **India** ranks 2nd for the fifth 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]

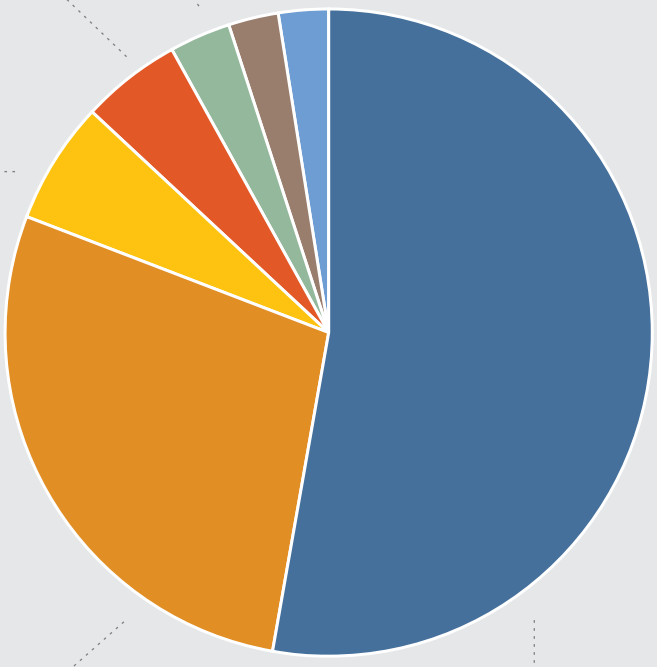
Which economies get the most bang for their buck on their innovation investments?

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

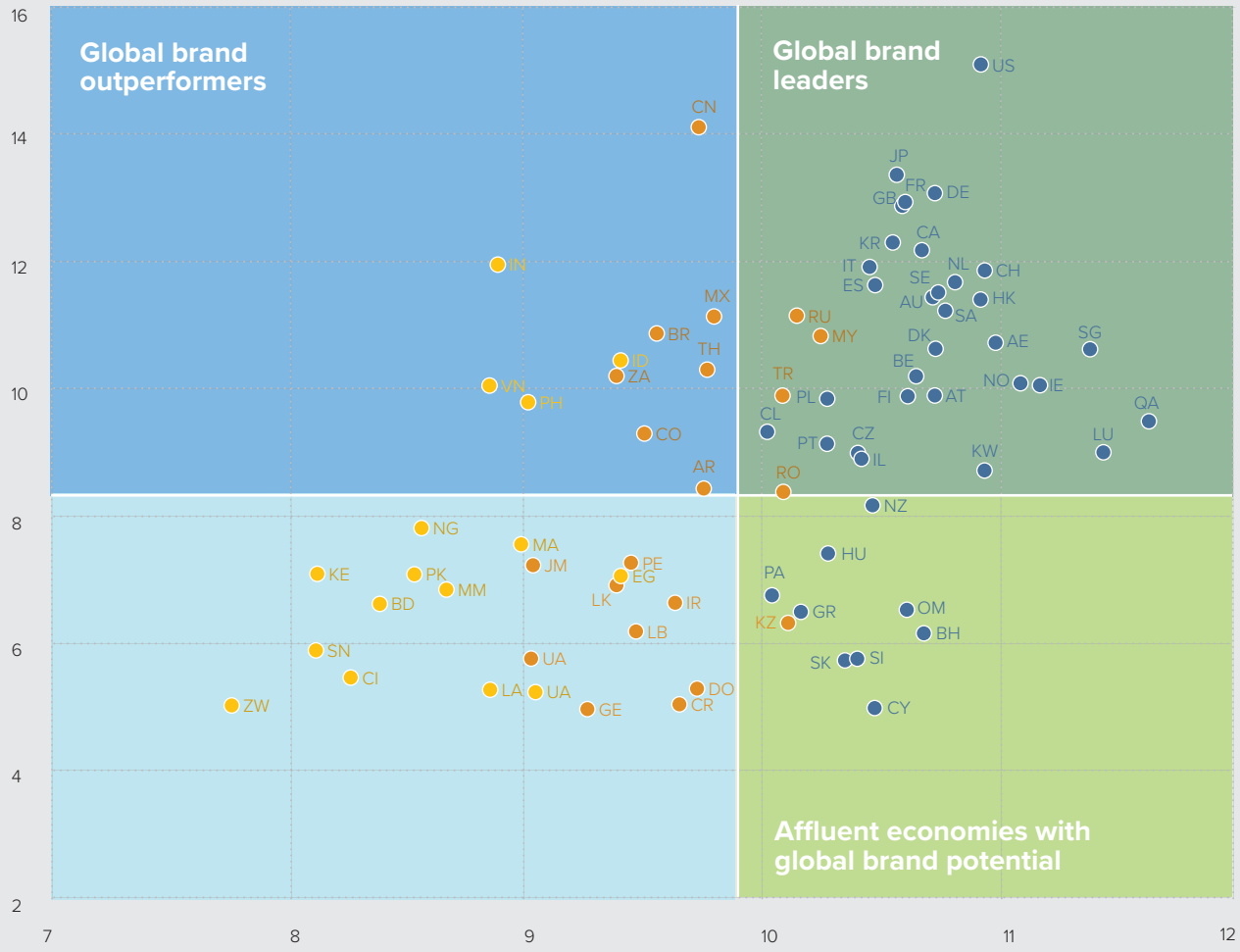
United States of America
$1,024,859

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



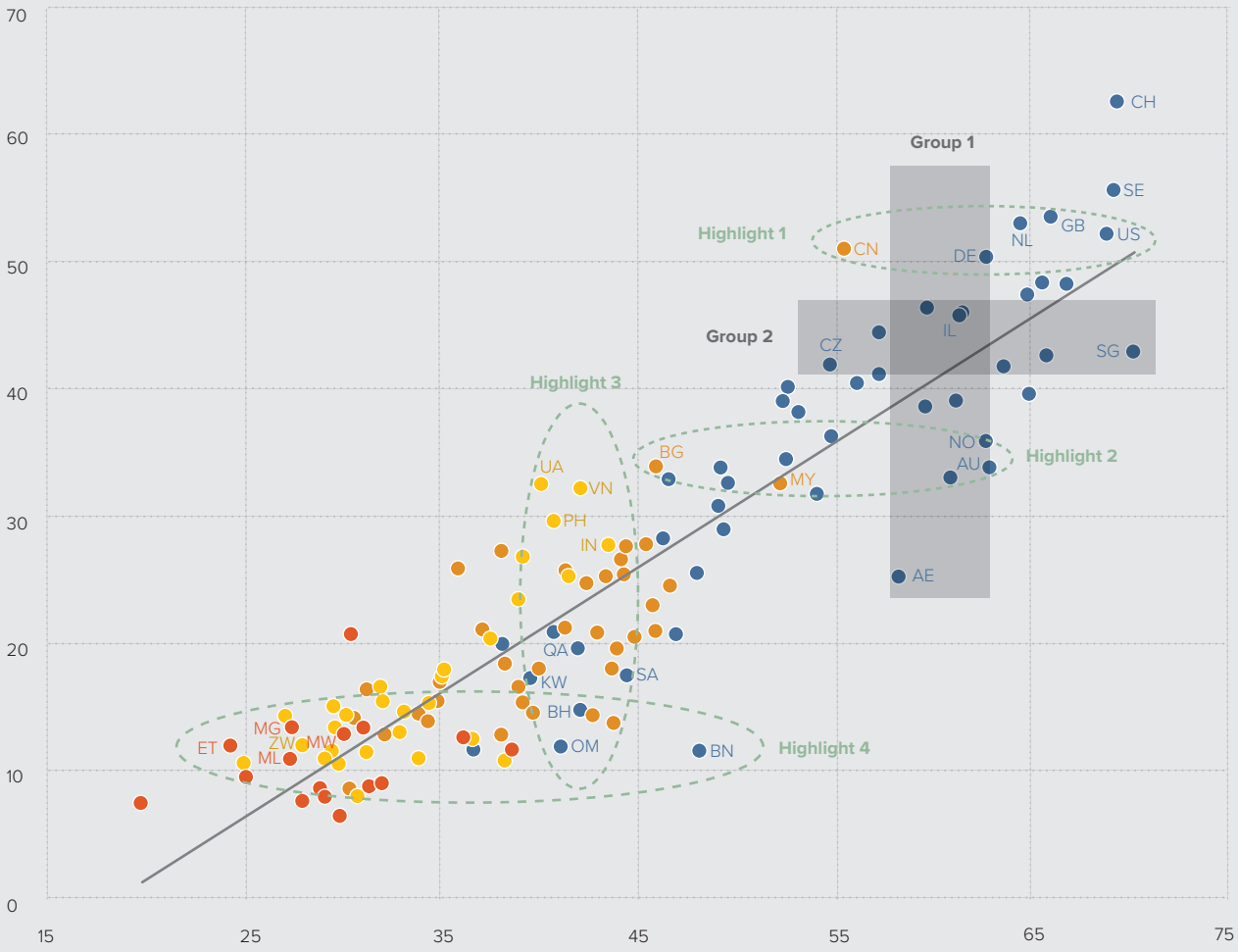
▲ Value of an economy's top brands, amongst the top 5,000 global brands (logarithmic scale)
▶ GDP per capita (logarithmic scale)

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

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)

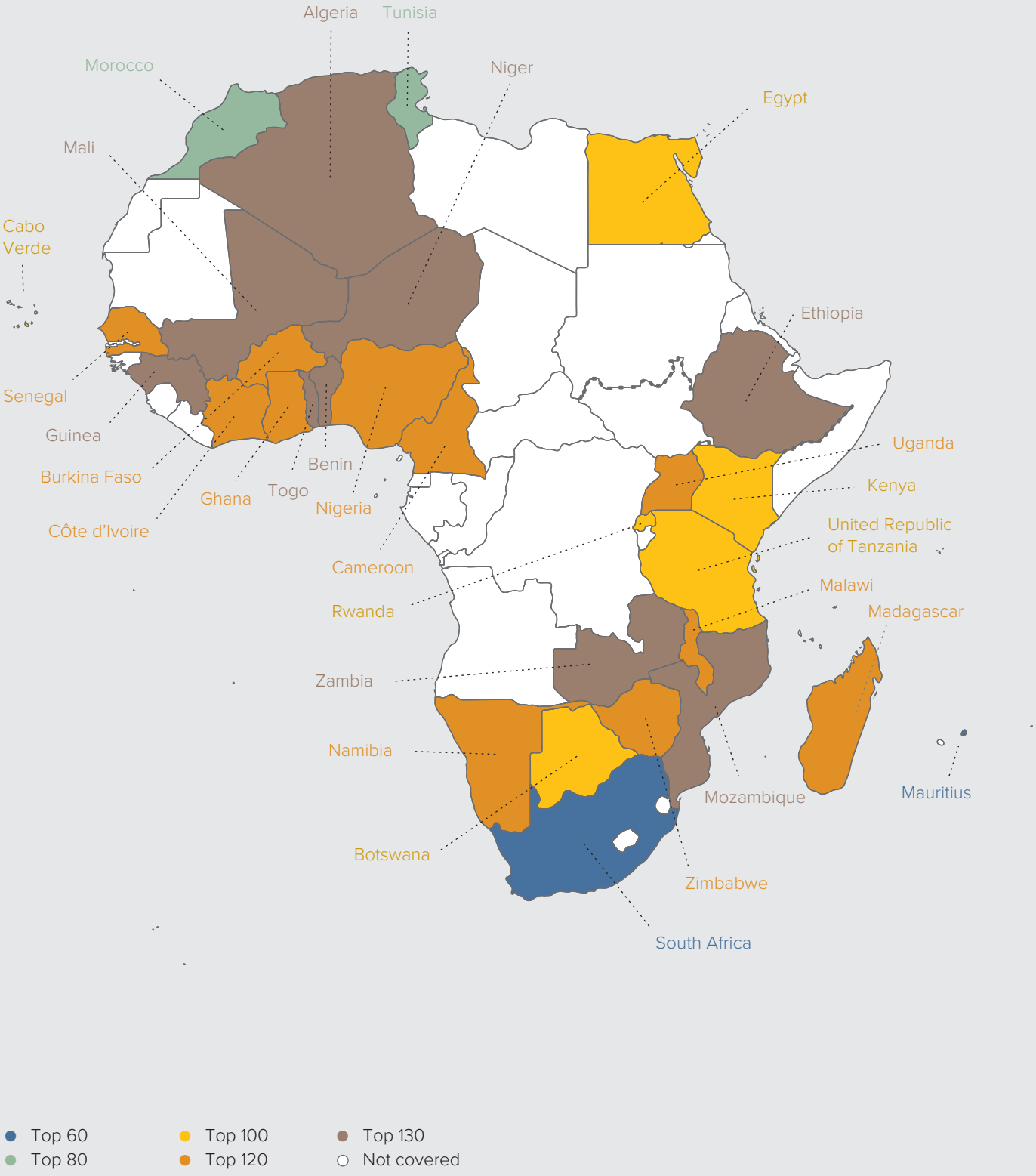
Figure 1.11 shows the regional performance differences in Sub-Saharan Africa: two economies rank in the top 60 (dark blue), while eight economies are in the top 130 (brown). The majority of all other economies covered in the region (11), rank in the top 120 (orange).

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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