



Cornell
SC Johnson College of Business



GLOBAL INNOVATION INDEX 2019

Creating Healthy Lives—The Future of Medical Innovation

KEY FINDINGS



Confederation of Indian Industry

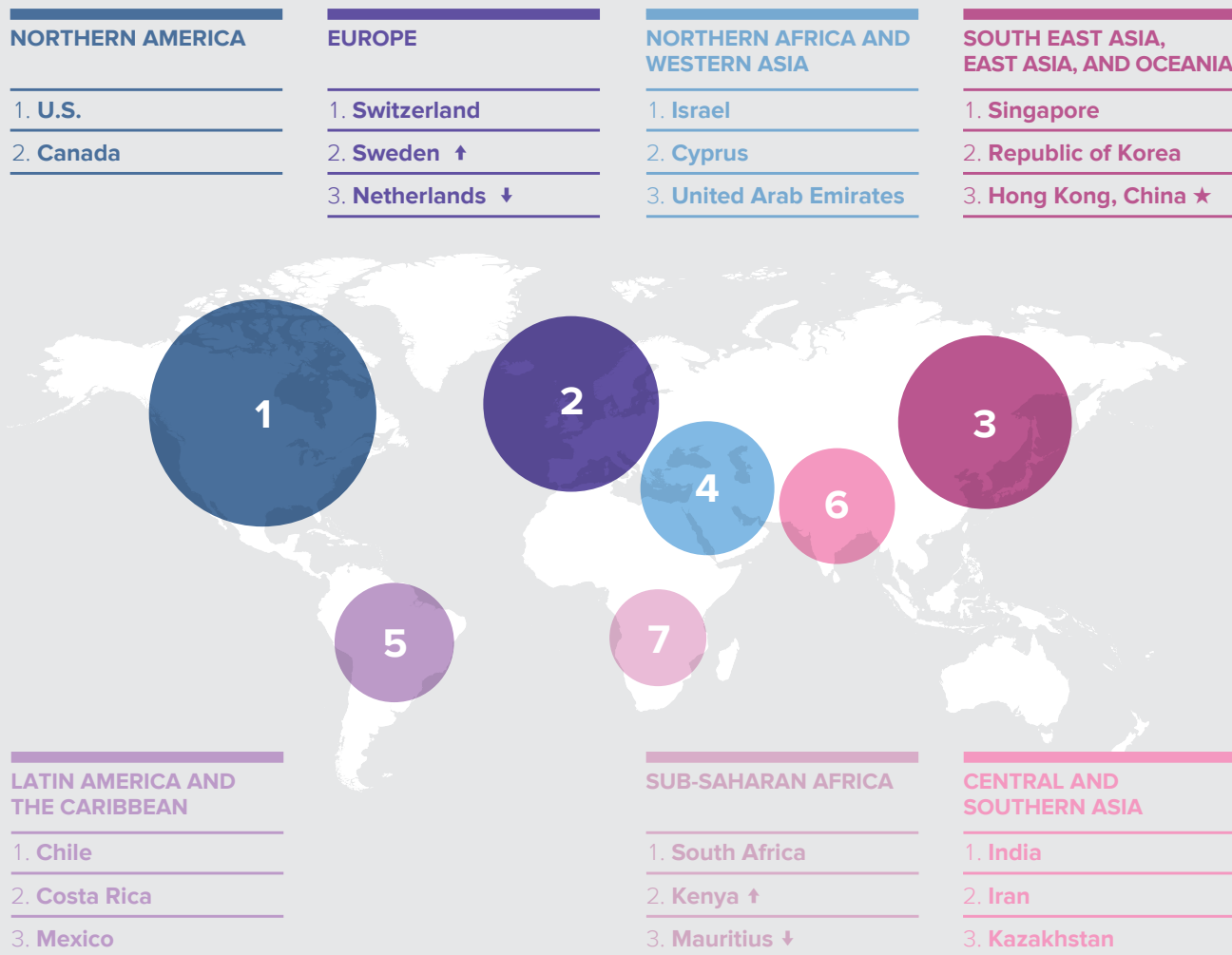


FIGURE A

Global leaders in innovation in 2019

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

Top 3 innovation economies by region



↑↓ indicates the movement of rank within the top 3 relative to 2018, and ★ indicates a new entrant into the top 3 in 2019.

Top 3 innovation economies by income group

HIGH INCOME	UPPER-MIDDLE INCOME	LOWER-MIDDLE INCOME	LOW INCOME
1. Switzerland	1. China	1. Viet Nam ↑	1. Rwanda ↑
2. Sweden ↑	2. Malaysia	2. Ukraine ↓	2. Senegal ↑
3. U.S. ★	3. Bulgaria	3. Georgia ★	3. Tanzania ↓

Source: Global Innovation Index Database; Cornell, INSEAD, and WIPO, 2019.

Notes: World Bank Income Group Classification (July 2018); Year-on-year GII rank changes are influenced by performance and methodological considerations; some economy data are incomplete (Appendix IV).

KEY FINDINGS 2019

The main messages of the Global Innovation Index 2019 can be summarized in seven key findings.

1: Amid economic slowdown, innovation is blossoming around the world; but new obstacles pose risks to global innovation

Global economic growth appears to be losing momentum relative to last year. Productivity growth is at a record low. Trade battles are brewing. Economic uncertainty is high.

Despite this gloomy perspective, innovation is blossoming around the world. In developed and developing economies alike, formal innovation—as measured by research and development (R&D) and patents—and less formal modes of innovation are thriving.

Today, developed and developing economies of all types promote innovation to achieve economic and social development. It is now also better understood that innovation is taking place in all realms of the economy, not only in high-tech companies and technology sectors. As a result, economies are firmly centering their attention on the creation and upkeep of sound and dynamic innovation ecosystems and networks.

The world witnessed an increase in innovation investments over recent years, as measured by the average investments of economies across all levels of development. The use of intellectual property (IP) reached record highs in 2017 and 2018.

Global R&D expenditures have been growing faster than the global economy, more than doubling between 1996 and 2016. In 2017, global government expenditures in R&D (GERD) grew by about 5% while business R&D expenditures grew by 6.7%, the largest increase since 2011 (Figure B and C). Never in history have so many scientists worldwide labored at solving the most pressing global scientific challenges.

What can we expect in terms of innovation efforts in the years to come?

Despite economic uncertainty, innovation expenditures have been growing and seem resilient in light of the current economic cycle.

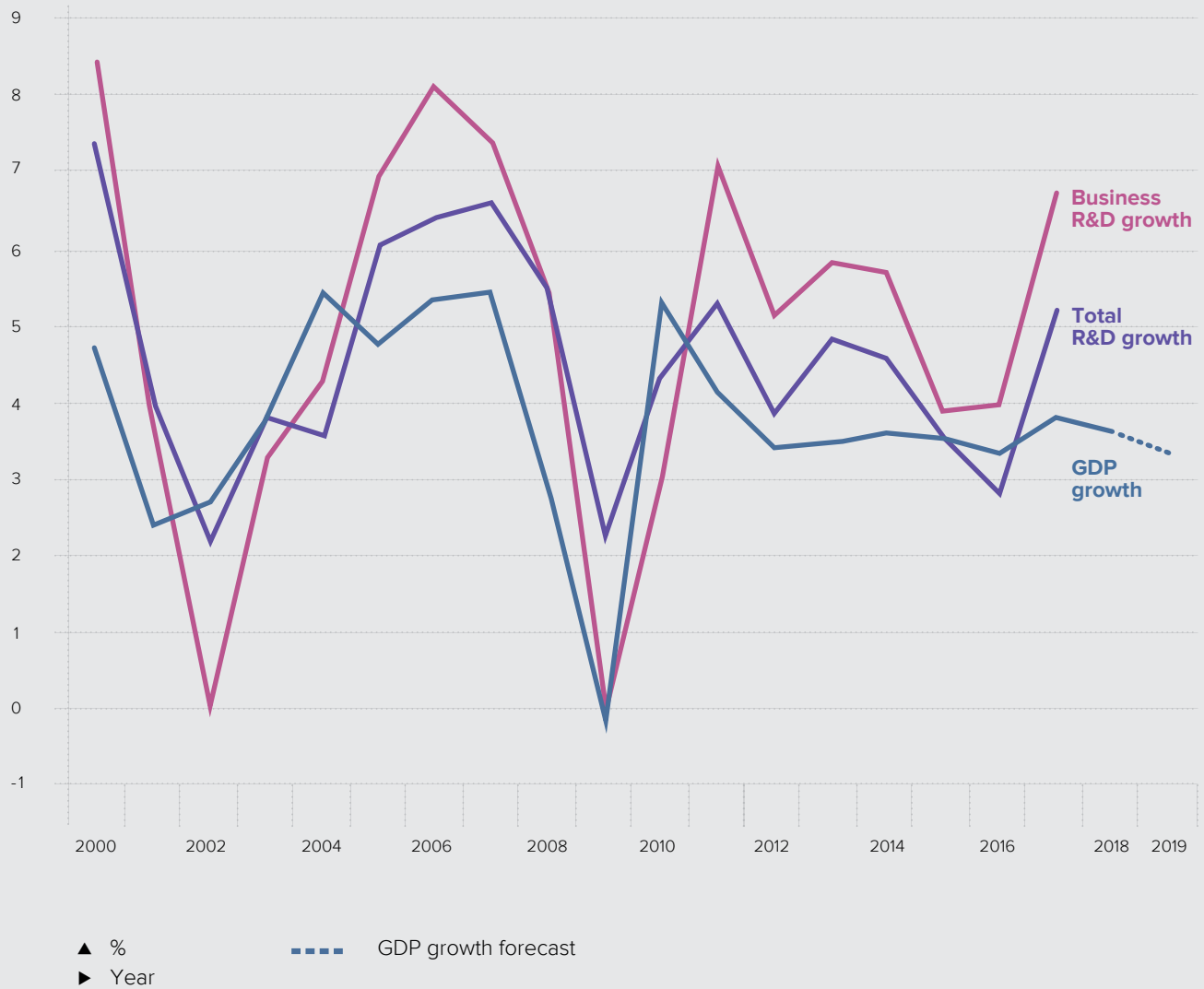
As global economic growth declines in 2019, the question is whether this trend will continue. Two concerns stand out:

First, the GII 2019 shows that public R&D expenditures—in particular, in some high-income economies responsible for driving the technology frontier—are growing slowly or not at all. Waning public support for R&D in high-income economies is concerning given its central role in funding basic R&D and other blue sky research, which are key to future innovations—including for health innovation, this year's GII theme.

Second, increased protectionism—in particular, protectionism that impacts technology-intensive sectors and knowledge flows—poses risks to global innovation networks and innovation diffusion. If left uncontained, these new obstacles to international trade, investment, and workforce mobility will lead to a slowdown of growth in innovation productivity and diffusion across the globe.

FIGURE B

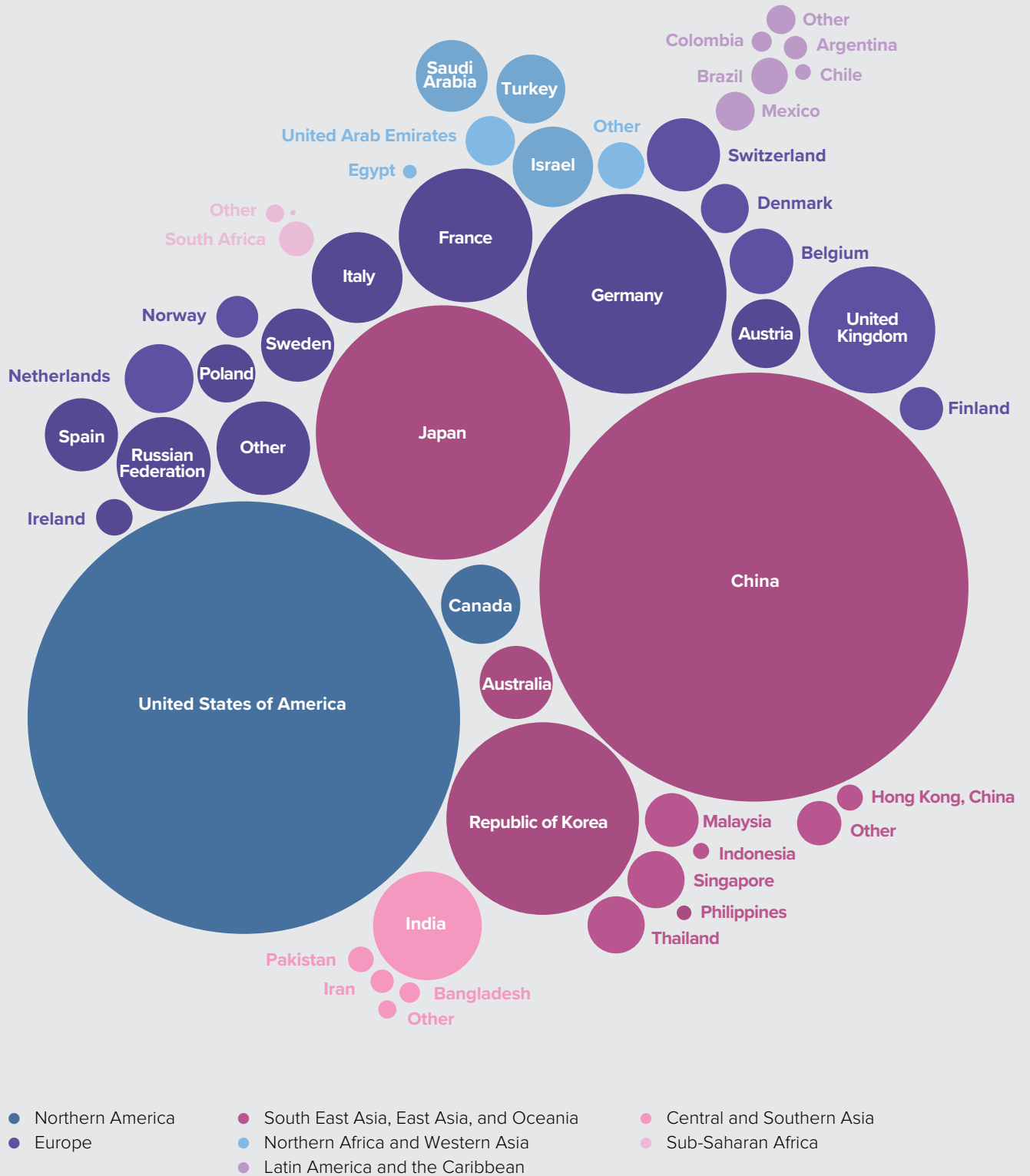
R&D expenditure growth, 2000-2017



Source: Authors' estimate based on the UNESCO Institute for Statistics (UIS) database, OECD Main Science and Technology Indicators (MSTI), Eurostat, and the IMF World Economic Outlook database.

FIGURE C

Regional and economy shares in world business expenditures, 2017



Source: Authors' estimate based on the UNESCO Institute for Statistics (UIS) database, OECD Main Science and Technology Indicators (MSTI), Eurostat, and the IMF World Economic Outlook database.
 Note: In PPP US\$ in constant prices, 2015.

2: Shifts in the global innovation landscape are materializing; some middle-income economies are on the rise

This year, again, the geography of innovation is changing.

In the top echelon, Switzerland, Sweden, and the United States of America (U.S.) lead the innovation rankings, with the latter two moving up in GII 2019. Other European nations, such as the Netherlands and Germany, along with Singapore in Asia, remain consistent members of the GII top 10. This year, Israel moves up to the 10th position, marking the first time an economy from the Northern Africa and Western Asia region cracks the top 10 rankings.

In the top 20, the Republic of Korea edges closer to the top 10. China, continues its upward rise, moving to 14th (from 17th in 2018), and thus firmly establishing itself in the group of leading innovative nations. China remains the only middle-income economy in the top 30. China's innovation strengths become evident in numerous areas; it maintains top ranks in Patents by origin, Industrial designs, and Trademarks by origin as well as High-tech net exports and Creative goods exports.

Notable moves in GII rankings this year include the United Arab Emirates (36th); Viet Nam (42nd), and Thailand (43rd) getting closer to the top 40; India (52nd) getting closer to the top 50; the Philippines (54th) breaking into the top 55; and the Islamic Republic of Iran (61st) getting closer to the top 60.

The performance improvement of India is particularly noteworthy. India continues to be the most innovative economy in Central & Southern Asia—a distinction held since 2011 (Figure A)—improving its global rank to 52nd in 2019. India is consistently among the top in the world in innovation drivers such as ICT services exports, Graduates in science & engineering, the quality of universities, Gross capital formation—a measure of economy-wide investments—and Creative goods exports. India also stands out in the GII ranking of the world's top science and technology clusters (Key Finding #6), with Bengaluru, Mumbai, and New Delhi featuring prominently among the global top 100 clusters. Given its size—and if progress is upheld—India will make a true impact on global innovation in the years to come.

As always, it must be noted that for year-on-year comparisons of the above type, GII ranks are influenced by various factors, such as changes in metrics and data availability.

When comparing levels of innovation to the level of economic development, India, Viet Nam, Kenya, and the Republic of Moldova stand out for outperforming on innovation relative to GDP for the ninth consecutive year—a record.

Other economies also outperform in innovation relative to their GDP, catching-up with innovation leaders more quickly than their peers (Table A). Middle-income economies outperforming

on innovation relative to their level of development include, for example, Costa Rica—the only country in Latin America and the Caribbean—South Africa, Thailand, Georgia, and the Philippines. Burundi, Malawi, Mozambique, and Rwanda stand out as thriving economies within the low-income group.

As in previous years, Africa shines in terms of innovation relative to level of development. Out of the 18 innovation achievers identified in the GII 2019, six (the most from any one region) are from the Sub-Saharan African region. Importantly, Kenya, Rwanda, Mozambique, Malawi, and Madagascar stand out for being innovation achievers at least three times in the previous eight years.

3: Innovation inputs and outputs are still concentrated in very few economies; a global innovation divide persists

The geography of innovation is shifting from high-income to middle-income economies. Nonetheless, innovation expenditures remain concentrated in a few economies and regions. Moving from a successful middle-income economy with innovation potential into an innovation powerhouse remains hard; an impermeable innovation glass ceiling exists that divides middle- and high-income economies. Most of the drive to break through that ceiling comes from China and to some extent India, Brazil, and the Russian Federation.

In terms of innovation scores and ranks, the innovation divide is evident across the GII—existing between income groups and across all GII pillars, from Institutions to Creative outputs (Figure E).

On a regional level, continuous innovation performance improvements are primarily happening in Asia. Other world regions struggle to catch up with Northern America, Europe, and South East Asia, East Asia, and Oceania.

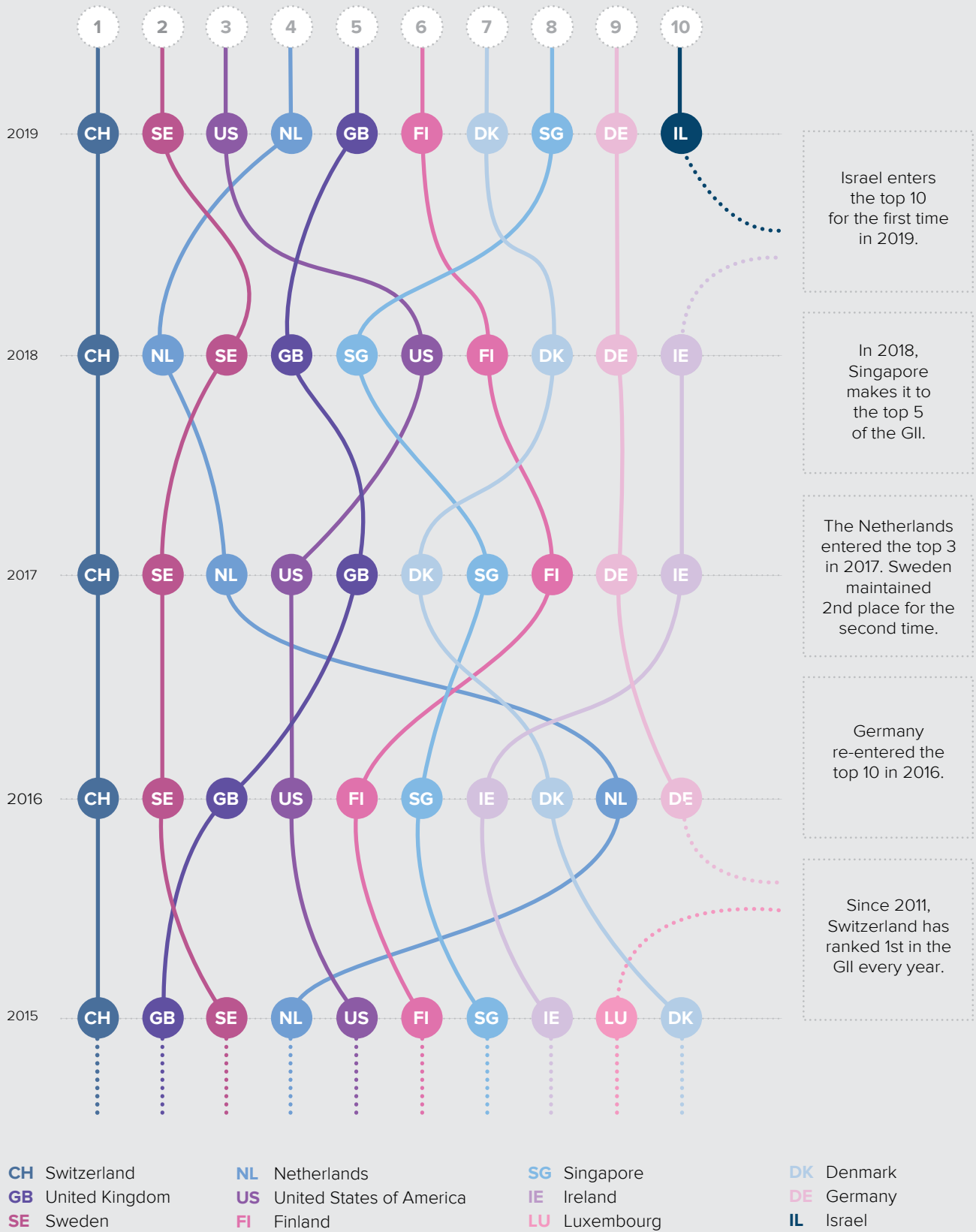
It will take time and persistence, perhaps over decades, for the innovation policy ambitions of economies at all levels to influence the global innovation landscape.

4: Some economies get more return on their innovation investments than others

A divide also exists in how effective economies are in translating innovation inputs into innovation outputs (Figure F); some economies simply achieve more with less. This discrepancy exists even among high-income economies: while Switzerland, the Netherlands, and Sweden effectively translate their innovation inputs into a higher level of outputs, Singapore (8th) and the United Arab Emirates (36th), for example, produce lower levels of output relative to their innovation inputs.

FIGURE D

Movement in the GII, top 10, 2019



Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2019.
 Note: Year-on-year comparisons of the GII ranks are influenced by changes in the GII model and data availability.

TABLE A

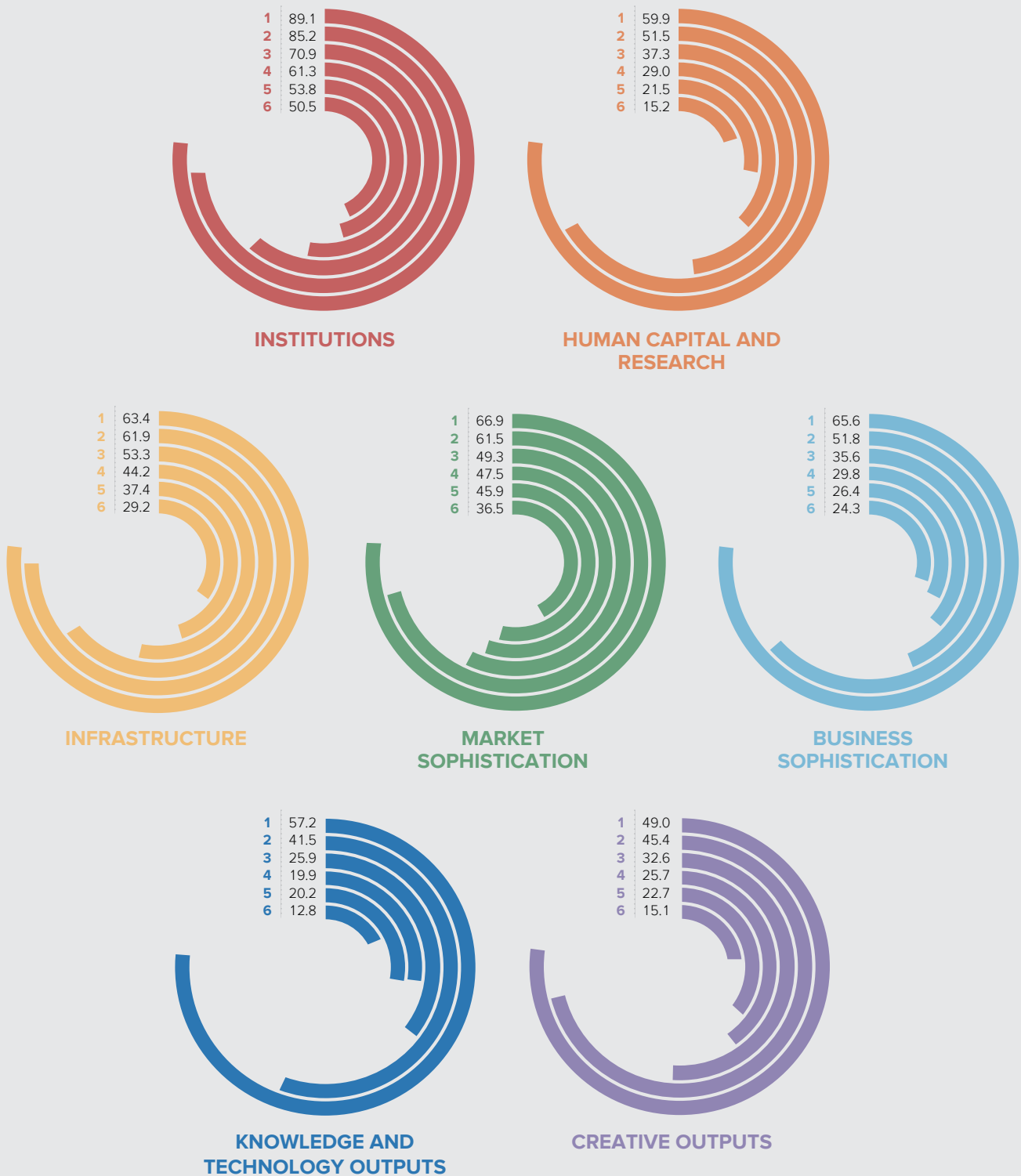
Innovation performance at different income levels, 2019

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

Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2019.

FIGURE E

Innovation divide across income groups, 2019

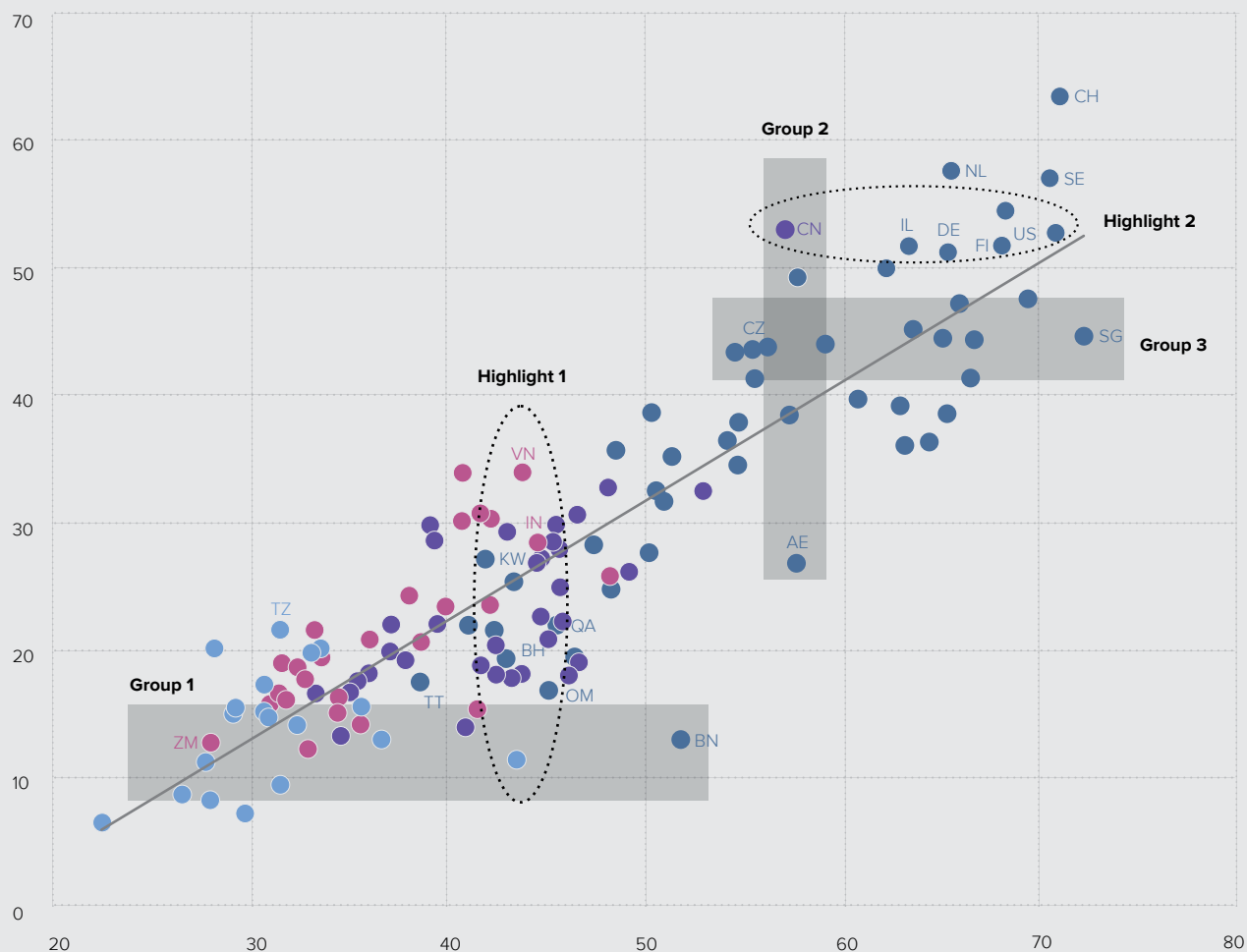


- 1** Top 10 high income
- 2** 11 to 25 high and upper-middle income
- 3** Other high income
- 4** Other upper-middle income
- 5** Lower-middle income
- 6** Low income

Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2019.

FIGURE F

Innovation input/output performance by income group, 2019



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

AE United Arab Emirates	CZ Czech Republic	NL Netherlands	TZ United Republic of Tanzania
BH Bahrain	DE Germany	OM Oman	US United States of America
BN Brunei Darussalam	FI Finland	QA Qatar	VN Viet Nam
CH Switzerland	IL Israel	SE Sweden	ZM Zambia
CN China	IN India	SG Singapore	
	KW Kuwait	TT Trinidad and Tobago	

Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2019.

China (CN), Malaysia, and Bulgaria are the only middle-income economies that perform as well on most GII innovation input and output measures as the high-income group. China stands out for producing innovation output that is equivalent to Germany (DE), the U.K., Finland (FI), Israel (IL), and the United States of America (US)—but with considerably lower levels of input.

Among lower middle-income economies, Viet Nam (VN) and India (IN) are among a small group of countries that achieve high impact for their innovation efforts. In the low-income group, the United Republic of Tanzania (TZ) achieves the same (Figure F).

5: Shifting focus from innovation quantity to innovation quality remains a priority

Assessing the quality, rather than only the quantity, of innovation inputs and outputs has become an overarching concern to the innovation policy community.

The GII makes a modest attempt at measuring innovation quality by looking at 1) the quality of local universities (QS university ranking); 2) the internationalization of patented inventions (Patent families 2+ offices); and 3) the quality of scientific publications (Citable documents H-index).

Among the high-income economies, the U.S. regains the top rank—moving ahead of Japan, which moves down to 3rd this year (Figure G). For the first time, Germany has moved up to 2nd.

The ranking of middle-income economies in these innovation quality indicators remains steady, with China, India, and the Russian Federation in the top 3 positions. Positioned 15th globally, China is the only middle-income economy that is closing the gap with the high-income group in all three indicators. India ranks 2nd among the middle-income economies, with top positions in quality of universities and in quality of scientific publications.

With regards to the quality of universities, the U.S. and the U.K. occupy the top 2 positions in the GII 2019, followed by China, which takes the 3rd spot this year (moving up from the 5th position in 2018). In the middle-income group, China is followed by Malaysia and India, thanks to the high scores for their top universities. The Russian Federation, Mexico, and Brazil also appear in the top 10, due largely to the quality of their universities (Table B).

Regarding the quality of publications, rankings are rather stable with the U.S., the U.K., and Germany leading the GII rankings. Among middle-income economies, China takes the top position, followed by India.

Regarding international patents, European countries take seven of the top 10 positions—with the three remaining spots going to Israel, Japan, and the Republic of Korea. Among the middle-income economies, China and South Africa take the top two positions, with India and Turkey registering improvements in this indicator.

TABLE B

Top 10 universities in middle-income economies

Location	University	Score
China	Tsinghua University	87.2
China	Peking University	82.6
China	Fudan University	77.6
Malaysia	Universiti Malaya (UM)	62.6
Russian Federation	Lomonosov Moscow State University	62.3
Mexico	Universidad Nacional Autónoma de México (UNAM)	56.8
Brazil	Universidade de São Paulo (USP)	55.5
India	Indian Institute of Technology Bombay (IITB)	48.2
India	Indian Institute of Science (IISc) Bengaluru	47.1
India	Indian Institute of Technology Delhi (IITD)	46.6

Source: QS Quacquarelli Symonds Ltd, QS World University Ranking 2018/2019

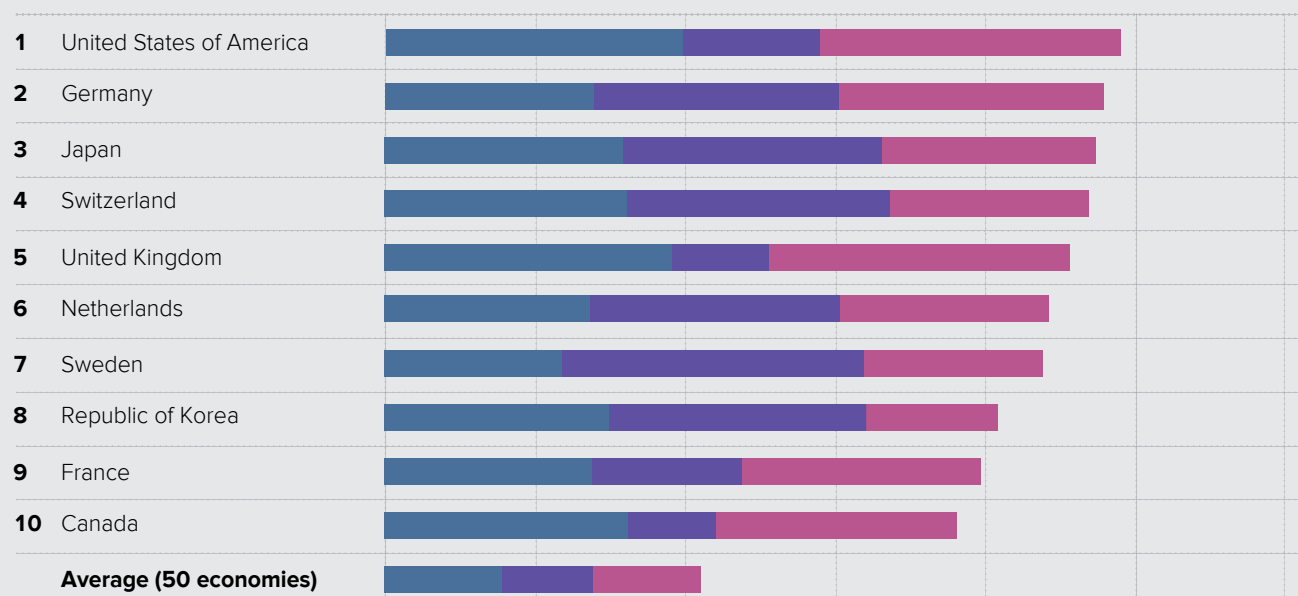
Notes: Only universities among the top 3 in each economy are considered. *Shares the same rank (87th worldwide) with Rice University in the U.S.

**Shares the same rank (172nd worldwide) with the University of Aberdeen in the U.K. and University of Twente in the Netherlands.

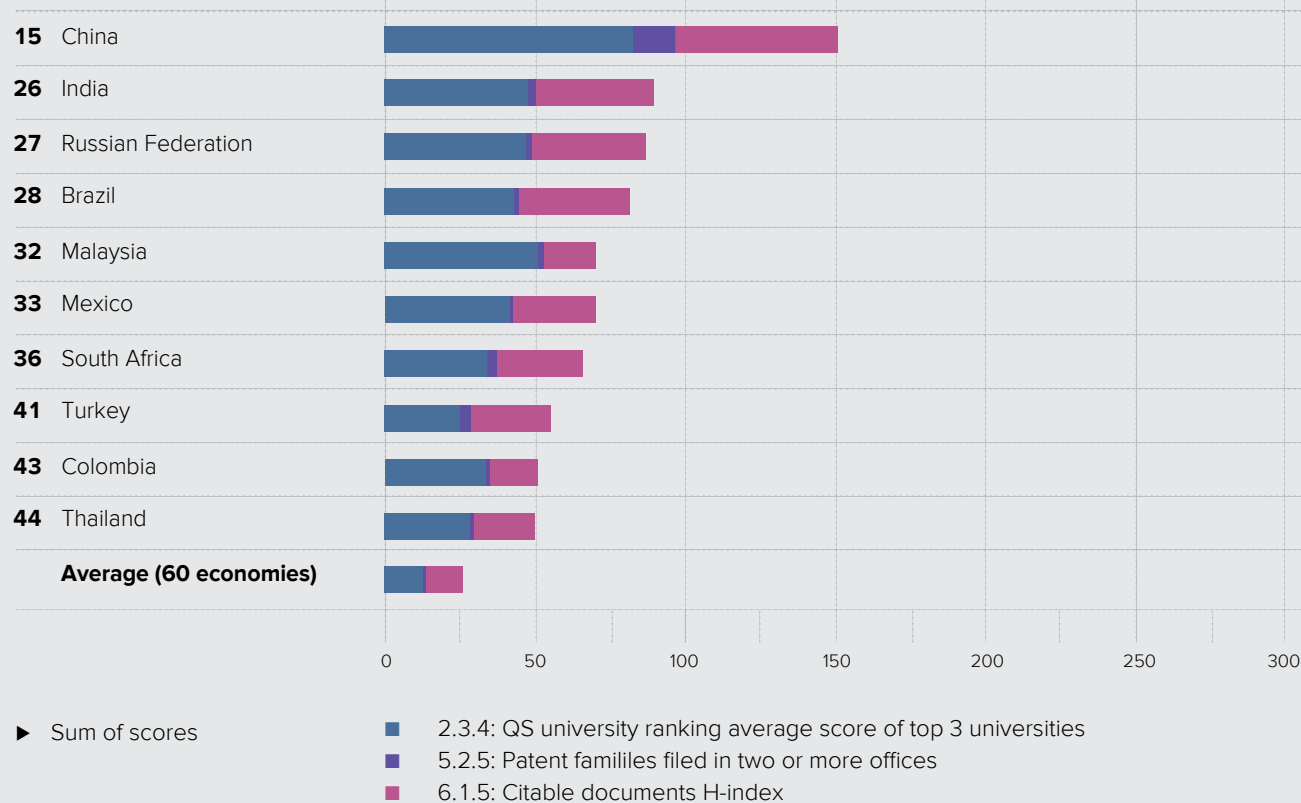
FIGURE G

Metrics for quality of innovation: top 10 high- and middle-income economies, 2019

High-income economies



Middle-income economies



Source: Global Innovation Index Database, Cornell, INSEAD, and WIPO, 2019.

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 (July 2018). Upper- and lower middle-income categories are grouped together as middle-income economies.

6: Most top science and technology clusters are in the U.S., China, and Germany; Brazil, India, Iran, the Russian Federation, and Turkey also make the top 100 list

As in the previous two years, the GII 2019 includes a Special Section, which presents the latest ranking of the world's largest science and technology (S&T) clusters.

The top 10 clusters are the same as last year (Table C). Tokyo–Yokohama tops this ranking, followed by Shenzhen–Hong Kong. Figure H shows the concentration of top science and technology clusters worldwide. The U.S. continues to host the largest number of clusters (26), followed by China (18, two more than in 2018), Germany (10), France (5), the U.K. (4), and Canada (4). Australia, India, Japan, the Republic of Korea, and Switzerland all hosted three clusters each. In addition, there are clusters from five middle-income economies in the top 100—Brazil, India, the Islamic Republic of Iran, the Russian Federation, and Turkey.

TABLE C

Top cluster of economies or cross-border regions within the top 50, 2019

Rank	Cluster name	Economy(ies)
1	Tokyo-Yokohama	JP
2	Shenzhen-Hong Kong	CN/HK
3	Seoul	KR
4	Beijing	CN
5	San Jose-San Francisco, CA	US
9	Paris	FR
15	London	GB
18	Amsterdam-Rotterdam	NL
20	Cologne	DE
23	Tel Aviv-Jerusalem	IL
28	Singapore	SG
31	Eindhoven	BE/NL
32	Stockholm	SE
33	Moscow	RU
35	Melbourne	AU
39	Toronto, ON	CA
40	Brussels	BE
42	Madrid	ES
46	Tehran	IR
48	Milan	IT
50	Zürich	CH/DE

Source: Special Section: Identifying and ranking the world's largest science and technology clusters (Cluster Rankings).

Compared to last year, almost all Chinese clusters moved up the ranks.

Also, compared to last year, there is a notable shift in the distribution of top patenting fields. Coinciding with this year's GII theme, medical technology is now the most frequent patenting field—present in 19 clusters. Pharmaceuticals dropped to second place.

Beijing is the top collaborating cluster for scientific co-authorships, followed by Washington, DC–Baltimore, MD; New York City, NY; Boston–Cambridge, MA; and Cologne, Germany. San Jose–San Francisco, CA is the most frequent top co-inventing cluster, followed by Beijing; Shenzhen–Hong Kong; and New York City, NY. The Chinese Academy of Sciences was the top academic entity for all of Beijing's collaborations. Entities that also drove their clusters' collaborations were Johns Hopkins University (8, Washington, DC–Baltimore, MD), Columbia University (7, New York City, NY), and Harvard University (6, Boston–Cambridge, MA).

7: Creating healthy lives through medical innovation requires more investment in innovation and increased diffusion efforts

The 2019 GII theme is *Creating Healthy Lives—The Future of Medical Innovation*, which explores the role of medical innovation as it shapes the future of healthcare. In the years to come, medical innovations such as artificial intelligence (AI), genomics, and mobile health applications will transform the delivery of healthcare in both developed and emerging nations.

The key questions addressed in this edition of the GII include:

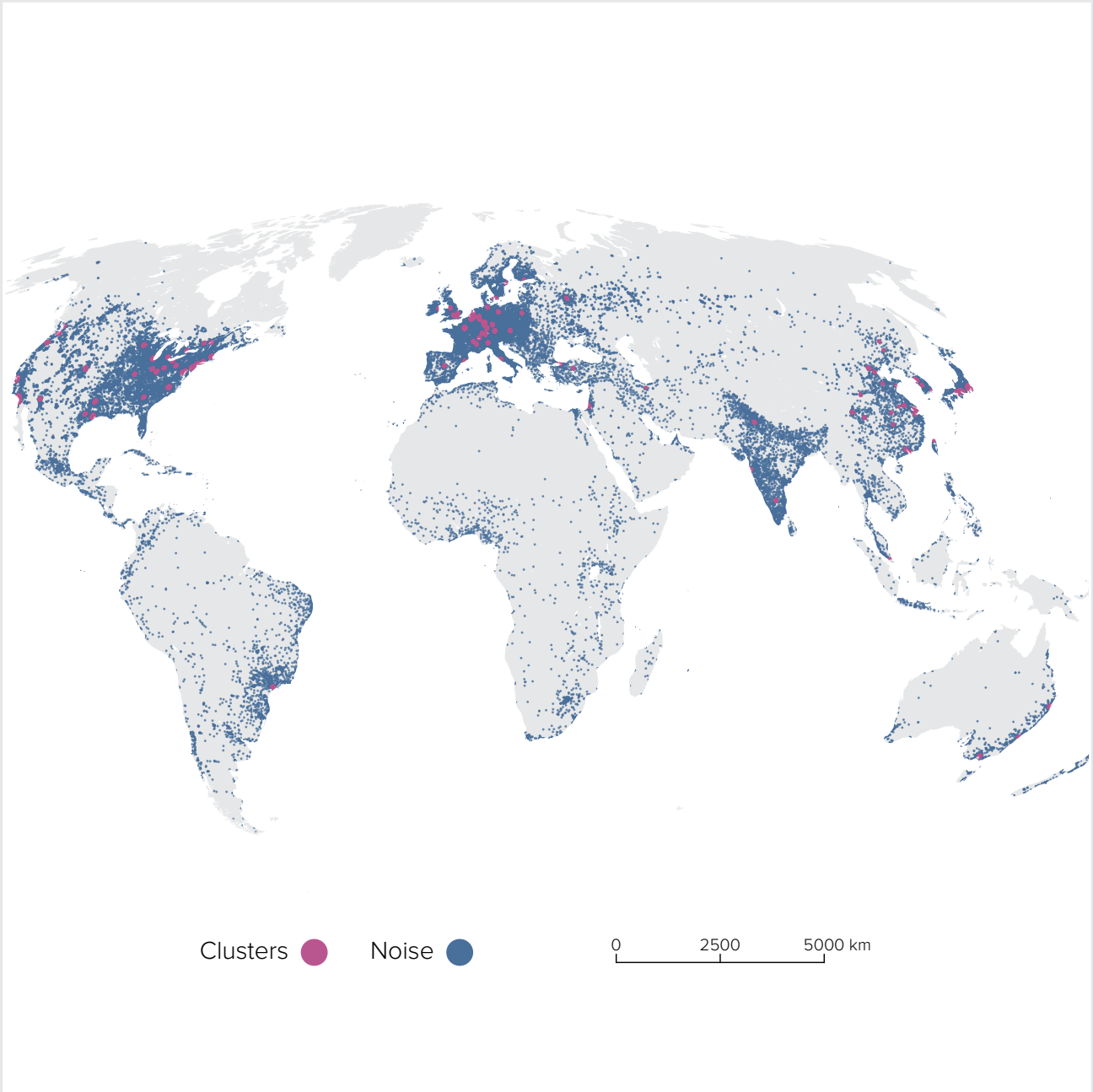
- What is the potential impact of medical innovation on society and economic growth, and what obstacles must be overcome to reach that potential?
- How is the global landscape for R&D and medical innovation changing?
- What health challenges do future innovations need to address and what types of breakthroughs are on the horizon?
- What are the main opportunities and obstacles to future medical innovation and what role might new policies play?

The following six learnings emerge:

- High quality and affordable healthcare for all is important for sustainable economic growth and the overall quality of life of citizens. While significant progress has been achieved across many dimensions over the last decades, significant gaps in access to quality healthcare for large parts of the global population remain.

FIGURE H

Top science and technology clusters worldwide, 2019



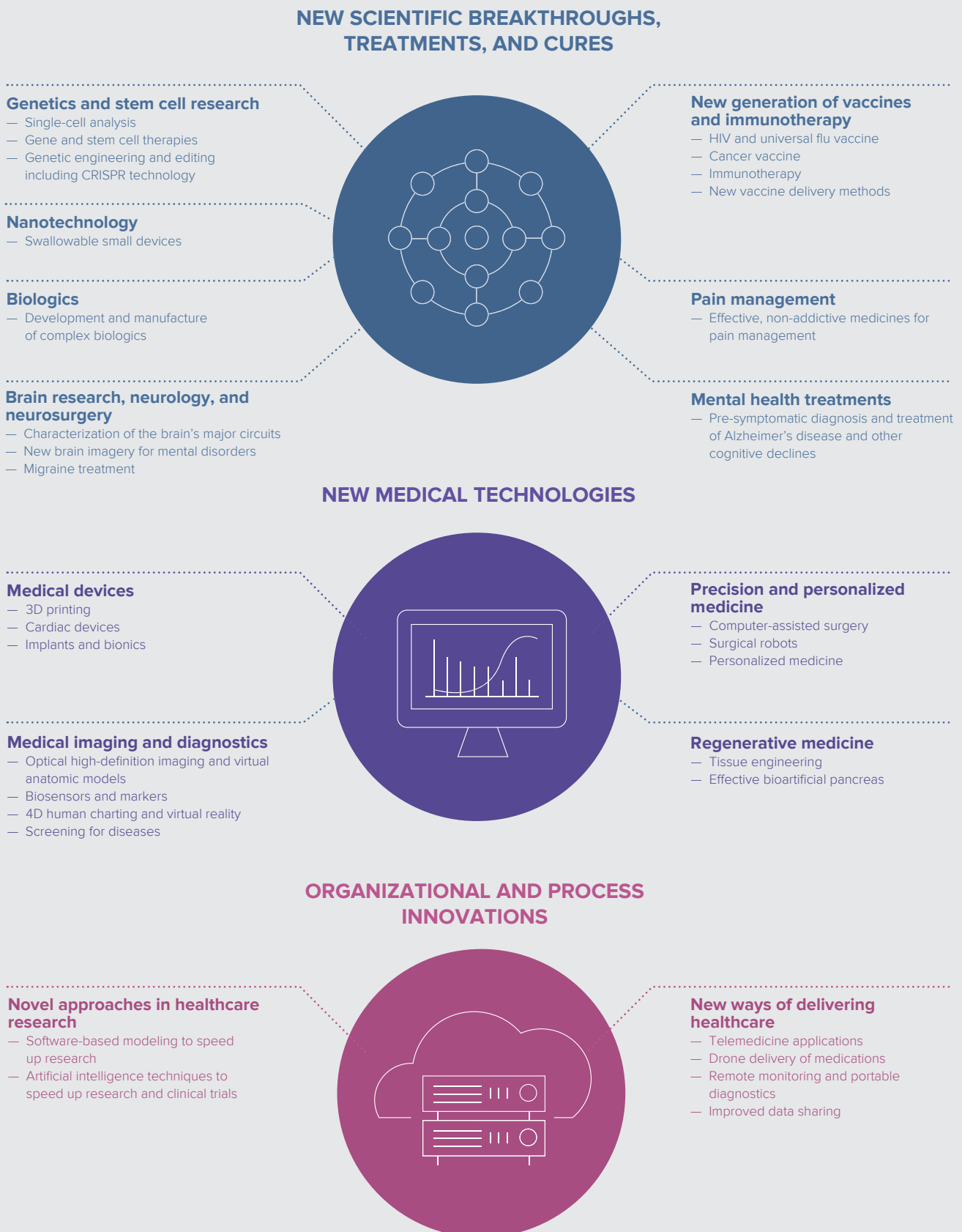
Source: WIPO Statistics Database, March 2019.

Note: Noise refers to all inventor / author locations not classified in a cluster.

- Medical innovations are critical for closing the gaps in global healthcare provision. Yet, nowadays, there are obstacles to health innovation and its diffusion which urgently need to be overcome. First, in the recent past, productivity in healthcare R&D has slowed; the identification of new cures for new diseases is painstakingly long. As a result, many acute and chronic conditions, such as cancer, depression, or Alzheimer's, have not yet been matched with breakthrough cures. Second, innovations in healthcare generally diffuse more slowly relative to other sectors. Moving medical innovations from “bench to bedside” is a long process, sometimes over decades. This is due to the complexity of the health innovation ecosystem and the diverging incentives of healthcare actors at play.
- Thankfully, a resurgence of health R&D and health innovation is taking place, possibly helping to overcome the innovation productivity decline of the pharmaceutical industry in the past decades. These innovations are happening across multiple dimensions, including core sciences, drug development, care delivery, and organizational and business models. Figure I shows the most promising fields for medical innovation in the years to come. In particular, medical technology related innovations are blossoming, with medical technology patents more numerous and growing at a faster path than pharmaceutical patents for the last decade (Figure J).
- The convergence of digital and biological technologies is disrupting healthcare and increasing the importance of data integration and management across the healthcare ecosystem. Innovation in the field of health now massively evolves around big data, the internet of things and artificial intelligence, entailing huge power shifts within and away from the health sector. This phenomenon will also drive future health-related innovation into non-technological fields, such as business model reorganization and new processes, rather than new technologies alone.
- Emerging markets have a unique opportunity to leverage medical innovations and invest in new healthcare delivery models to close the healthcare gap with more developed markets. Caution should be taken to ensure that new health innovations, and their related costs, do not exacerbate the health gap between the rich and poor. The true challenge for developing economies is often the lack of minimally functional health systems—and not necessarily a need for more R&D or new technologies. Low-tech or adapted technology applications can save more lives than the latest high-tech solutions.
- Finally, the GII 2019 report suggests a few key health innovation policy priorities, including the importance of ensuring sufficient medical innovation funding, in particular for public sector research; building functional medical innovation systems; facilitating the innovation path from “bench to bedside”; establishing and maintaining a skilled health workforce; moving from research on cures to innovation in the field of prevention; carefully evaluating the costs and benefits of medical innovations; supporting new data infrastructure and digital health strategies to focus on creating data infrastructure; and developing processes for efficient and safe data collection, management, and sharing.

FIGURE I

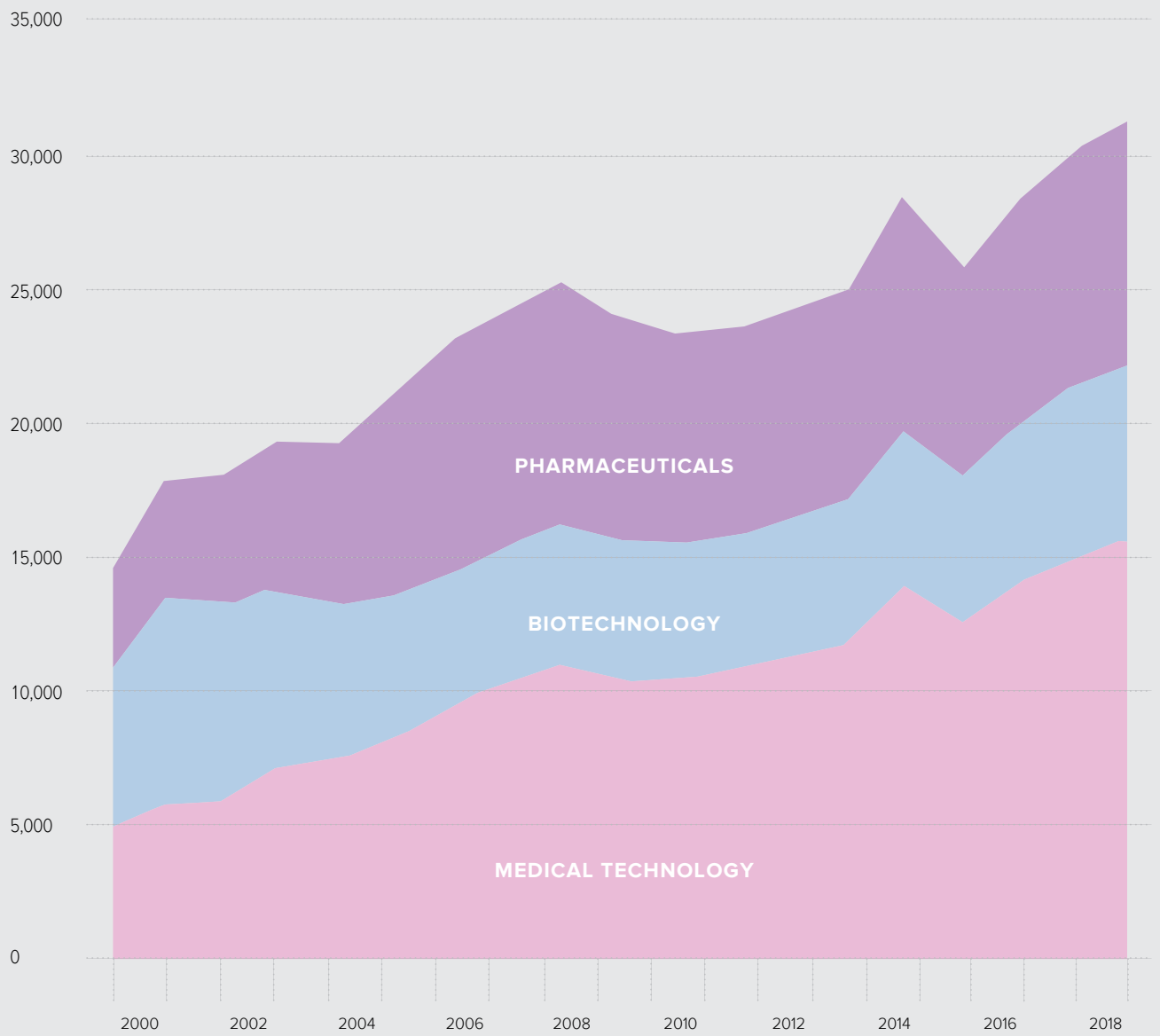
Promising fields for medical innovation and technologies



Sources: GII 2019 chapters, in particular Collins, 2010; Collins, 2019. Also, Kraft, 2019; Nature, 2018; Nature, 2019; Frost & Sullivan, 2018; Frost & Sullivan, 2019; European Commission, 2007; Medical Futurist, 2017; Mesko, 2018.

FIGURE J

Patent Cooperation Treaty (PCT) filings by technology, 2000-2018



- ▲ Patent publications
- Year

Source: WIPO Statistics Database, March 2019.

