Statistical Annex to the International IP Index, 7th Edition

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The U.S. Chamber of Commerce's Global Innovation Policy Center (www.theglobalipcenter.com) is working around the world to champion intellectual property rights as vital to creating jobs, saving lives, advancing global economic growth, and generating breakthrough solutions to global challenges.

The U.S. Chamber of Commerce is the world's largest business federation representing the interests of more than 3 million businesses of all sizes, sectors, and regions, as well as state and local chambers and industry associations.

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This report was conducted by Pugatch Consilium, (www.pugatch-consilium.com) a boutique consultancy that provides evidence-based research, analysis, and intelligence on the fastest growing sectors of the knowledge economy. Authors of this report are Meir Pugatch and David Torstensson.

Professor Meir Pugatch, Managing Director and Founder

Prof. Pugatch founded Pugatch Consilium in 2008. He specializes in intellectual property policy, management and exploitation of knowledge assets, technology transfer, market access, pharmacoeconomics and political economy of public health systems. He has extensive experience in economic and statistical modeling and indexing, valuation of assets and design of licensing agreements, and providing strategic advice to international institutions, multinational corporations, and SMEs from all sectors of the knowledge economy. In addition to his work at Pugatch Consilium, he is an IPKM Professor of Valorisation, Entrepreneurship and Management at the University of Maastricht in the Netherlands, as well as the Chair of the Health Systems Administration and Policy Division at the School of Public Health, University of Haifa in Israel. He is author and editor of an extensive number of publications and serves as a referee and editorial board member of numerous peer review journals.

David Torstensson, Partner

Dr. Torstensson specializes in innovation, tax and intellectual property policy, with a particular focus on the health care, information and communication technology and content industries. He has wide experience in policy and economic analysis, as well as data sampling and creation of strategic operational and advocacy plans. He is the author of a number of academic and commissioned reports and publications and is the co-author of all 7 editions of the U.S. Chamber International IP Index.

INTRODUCTION

What role do IP rights play in access to innovation and economic development? Do IP rights encourage or hinder access to innovation, technology transfer, free trade, and the flow of foreign investments?

Thirty years ago, these were largely theoretical discussions with both limited data and limited country-specific experience. But over the past two decades, a growing number of empirical studies have been published on the positive and cumulative economic effects of IP rights. There is now an accumulated body of evidence that suggests a positive link between the strengthening of IP rights and economic development, job creation, technology transfer, increased investment, and innovation. This includes works from international institutions such as the Organisation for Economic Co-operation and Development (OECD) and World Intellectual Property Organization (WIPO), and from national IP offices such as the European Patent Office (EPO) and U.S. Patent and Trademark Office (USPTO), as well as the independent work conducted by academics and research institutes around the world.

The U.S. Chamber's International IP Index and its sister publications are part of this body of evidence. Since 2015, the Index has included a Statistical Annex that investigates the correlation or the statistical likelihood of 2 variables occurring together between the strength of national IP environments, as measured by the Index scores, and different types of economic activity, including rates of R&D spending, innovation, technology creation, and creativity. The 1st Annex, which was published with the 3rd edition of the Index, tested the relationships between the Index scores of 30 economies and 15 economic variables. This year's Annex mirrors the growth of the wider Index and surveys the relationship between the Index scores of 50 economies and a set of 29 economic variables—an increase of 66% in the number of economies sampled and close to a doubling in the number of economic variables.

As more economies and more social and economic variables are added to the Statistical Annex, the picture becomes more vivid and sharp: IP protection is a critical instrument for economies seeking to enhance access to innovation, grow domestic innovative output, and enjoy the dynamic growth benefits of an innovative economy. Conversely, weak IP protection stymies long-term strategic aspirations regarding innovation and development.

What's new in 2019?

This edition of the Annex provides a new set of correlations on the relationship between levels of IP protection and economies' readiness for leadership in the face of an emerging technological revolution. As innovative and highly complex technologies—from the integration of the biological and physical sciences with computer technologies to the Internet of Things, artificial intelligence, and virtual reality—rapidly evolve and fuse the digital with the physical and biological fields, traditional production and economic growth models are being challenged. The sum of all these changes is what Professor Klaus Schwab—founder and executive chairman of the World Economic Forum—has termed the "Fourth Industrial Revolution."[1] A new research stream and report by the World Economic Forum, *Readiness for the Future of Production*, gauges economies' current production capabilities and the existence and levels of critical drivers of production that position economies to best capitalize on the new growth opportunities presented by the Fourth Industrial Revolution.[2] By benchmarking the Index scores against economies' performance in the *Readiness for the Future of Production* report, this year's Annex highlights how robust IP environments constitute an essential enabling factor in increasing economies' ability to succeed in the face of this revolution.

Within this context, this year's Annex has been split into two halves:

- The first set of correlations explores the relationship between the Index scores and an array of measures of economies' preparedness and readiness for the Fourth Industrial Revolution and the knowledge-based economy. This includes economies' access and ability to capitalize on human, financial, and technological resources.

- The second set of correlations examines the relationship between both overall and sector-specific Index scores and economic outputs. This includes economic competitiveness, business sophistication, early adoption of new technologies, innovation and knowledge outputs, biomedical innovation, creative outputs, and overall economic complexity.

Table 1 presents the main findings of the analysis in this Annex.

Table 1: Economic benefits of improving IP protection: Findings from 29 correlations

	2017 (strength of correlation)	2018 (strength of correlation)	2019 (strength of correlation)	Economies with robust IP protection (scoring above 50% on the Index) on average tend to experience the following benefits compared with economies scoring below 50%
Readiness for the Fourth Industrial Revolution				
Drivers of production	NA	NA	.85	40% more likely to adapt to the Fourth Industrial Revolution and secure new growth opportunities
Technology and innovation	NA	NA	.87	55% more likely to be able to transform their economies using sophisticated, state-of-the-art technologies
Global trade and investment	NA	NA	.71	39% more open for business and attractive to foreign investment
Resources to innovate				
Innovation capability	NA	NA	.88	70% more likely to maintain sophisticated environments capable of producing innovative outputs
Enabling infrastructure	NA	NA	.79	53% more likely to experience the benefits of an innovation-driven economy, ranging from high-skilled and high-paid workers to increased research and development (R&D) activity
Availability of R&D funding	.70	.71	.71	33% more likely to see private-sector investment in R&D activities
Access to venture capital and private equity funds	.77	.79	.78	38% more likely to attract venture capital and private equity funds compared with economies whose IP regimes lag behind
Availability of skilled researchers	.82	.82	.81	Nearly 6 times more highly skilled researchers in a given labor force
Talent competitiveness	NA	NA	.82	78% average increase in the competitiveness of human capital
Quality of local scientific and technical knowledge	NA	NA	.85	Over 7 times more knowledge output in terms of scientific and technical journal articles
Growth of knowledge-based economies	.82	.83	.83	35% more likely to fully leverage information and communications technology (ICT)
Global networking impact	NA	NA	.84	47% more likely to support a dynamic ICT sector and experience the indirect benefits it generates

	2017 (strength of correlation)	2018 (strength of correlation)	2019 (strength of correlation)	Economies with robust IP protection (scoring above 50% on the Index) on average tend to experience the following benefits compared with economies scoring below 50%
Outputs of a competitive knowledge-based economy				
Global competitiveness	NA	NA	.86	Economies are 26% more competitive
Economic complexity	NA	NA	.82	Twice as likely to produce and export complex, knowledge-intensive products
Innovation	.88	.86	.85	76% more innovation as measured by the Global Innovation Index
Triadic patenting	NA	.68	.65	Over 500 more high-value inventions per million population in top-performing Index economies than lowest quartile
Employment in knowledge-intensive sectors	.72	.67	.69	Share of workforce employed in knowledge-intensive sectors is higher by 67%
Growth of high-tech sectors	.80	.75	.79	Production of over 80% more knowledge and technology outputs
Biotech innovation	.77	.78	.79	Twice as likely to provide environments that are conducive to biotech innovation
Biomedical activity	.67	.72	.73	14 times more clinical trial activity
Cutting-edge clinical trials	.73	.76	.77	19 times more early-phase clinical trials
Development of biotech therapies	.70	.75	.76	12 times more clinical research on biologic therapies
Value added and creativity				
Creative outputs	.86	.84	.82	64% more likely to benefit from the growth in both volume and value of the dynamic content and media sectors
Online creativity	.85	.84	.81	Generate over 4 times more online and mobile content
Added value of licensed software	.85	.82	.81	Higher contribution of licensed software to gross domestic product (GDP)
Global reach of local brands	NA	NA	.86	Significantly higher levels of international trademark applications
Access to licensed music outlets	.78	.79	.75	Provide 2–3 times wider access to new music through legitimate and secure platforms
Video-on-demand (VOD) penetration	.61	.66	.66	Generate twice as many VOD and streaming services
Consumption of audiovisual content	.73	.72	.72	Generate 2.5 times more theatrical screenings of feature films

METHODOLOGY

The Pearson Correlation Coefficient is the statistical analysis used to test the relationship between the Index's scores and other economic variables in this Annex. Simply put, the Pearson Correlation Coefficient is a widely used statistical method of establishing whether two variables are related to each other. This statistical test provides a value between –1 and 1, which represents the strength of this correlation. Thus, the Pearson Correlation Coefficient shows whether a linear relationship exists between two variables and if it is positive or negative.

In this Annex, the strength of a given positive correlation follows this legend:

- .00 to .19: "very weak"
- .20 to .39: "weak"
- .40 to .59: "moderate"
- .60 to .79: "strong"
- .80 to 1.0: "very strong"

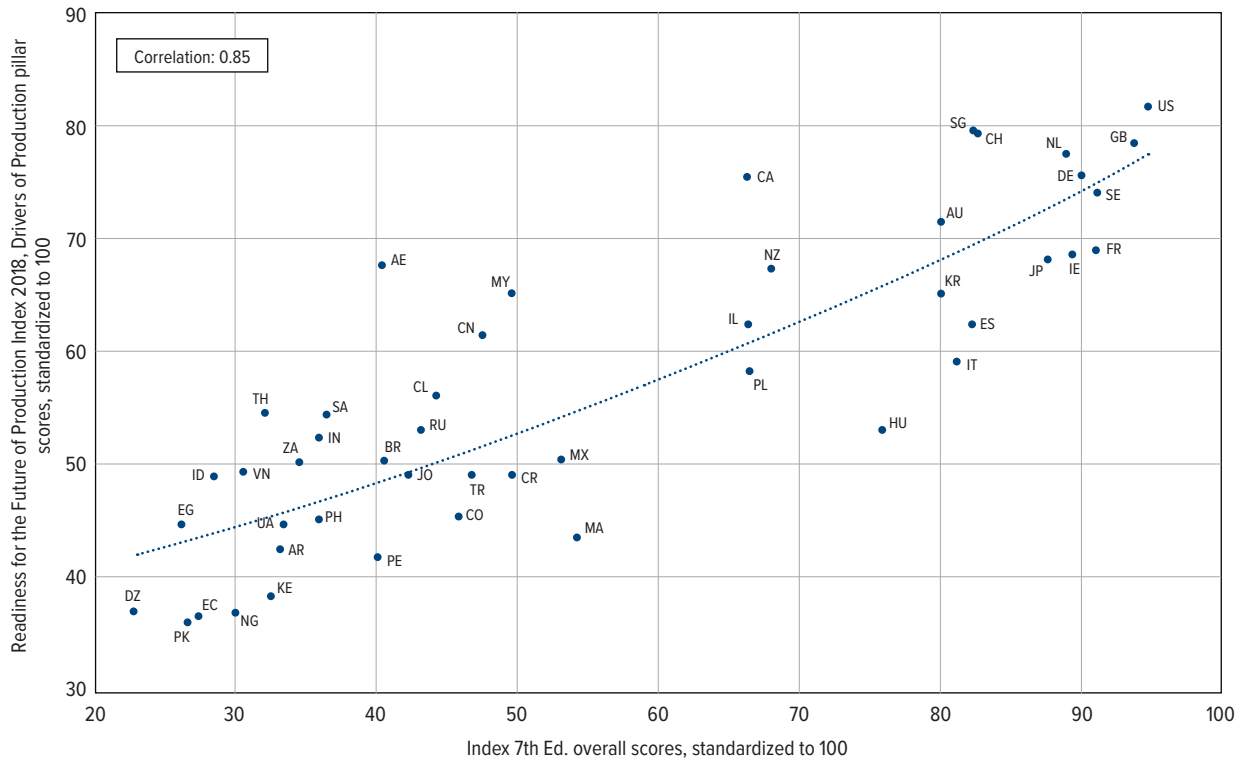
Each individual test of the correlation between two variables was performed under a confidence level of .95, which means that if this procedure was repeated on multiple samples, the calculated confidence interval (i.e., a range estimation that is calculated from the observation, and therefore would be different for each sample) would encompass the true parameter 95% of the time. In other words, the confidence interval represents values for the parameter, for which the difference between the parameter and the observed estimate is not statistically significant at the 5% level.

However, it is important to note that correlation—a statistical test of the existence of a linear relationship between two variables—does not imply causation (i.e., the fact that two variables are very strongly correlated does not mean that one has caused the other). That said, a strong to very strong correlation does imply that a linear relationship exists between the two variables, the nature of which depends on the variables.

READINESS FOR THE FOURTH INDUSTRIAL REVOLUTION

Economies with Robust IP Environments Are Significantly Better Positioned to Capitalize on the Fourth Industrial Revolution

Association between the Index scores and the Readiness for the Future of Production Assessment, Drivers of Production pillar scores[3]



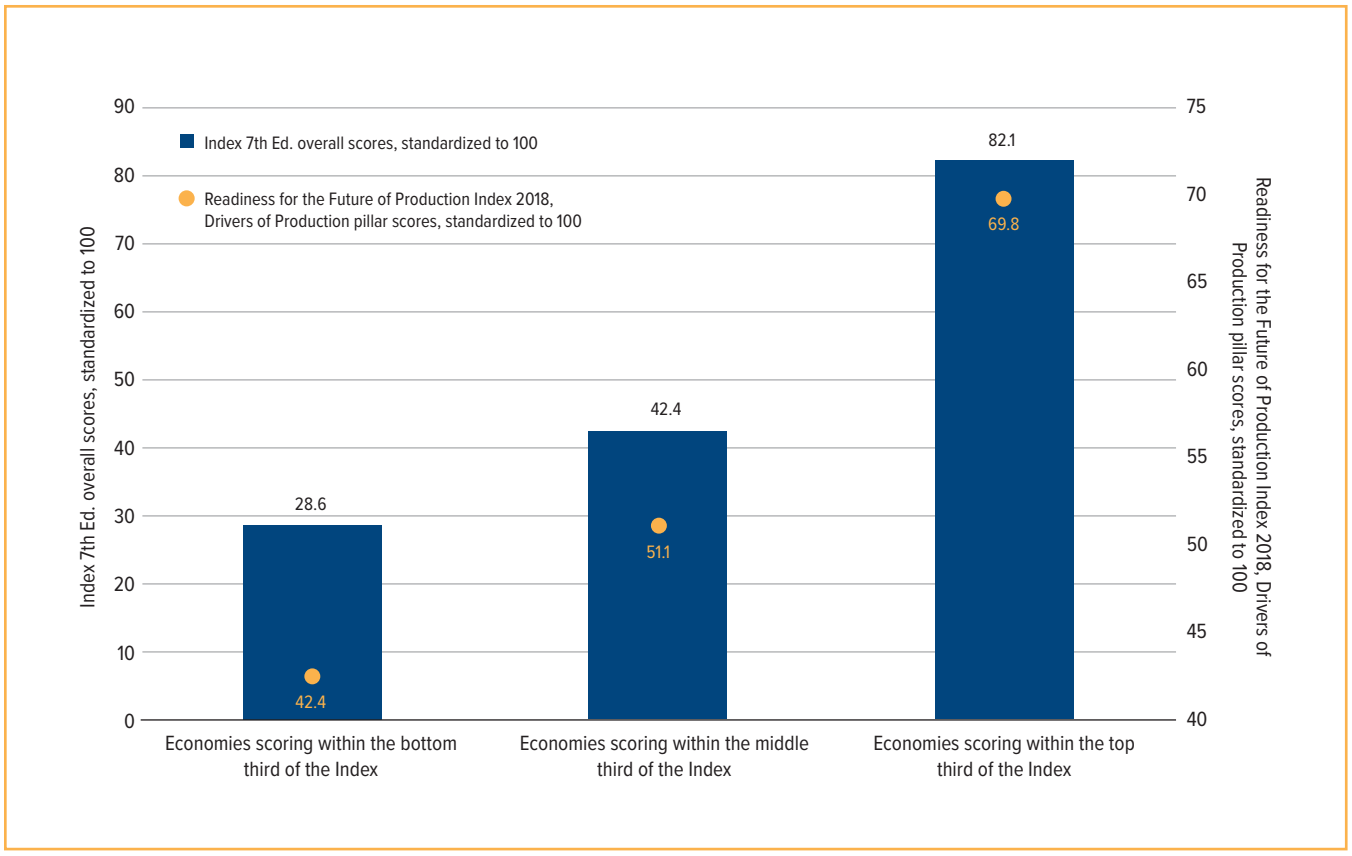
Source: World Economic Forum (2018); GIPC (2019)
Note: Data are not available for Brunei, Taiwan, and Venezuela.

- The Readiness for the Future of Production Assessment's Drivers of Production pillar scores, which gauge economies' performance in key sectors and themes that enable economies to capitalize on emerging technologies to compete in future production systems, display a very strong association with the Index scores.

- This relationship adds to the strength of the overall findings of the Statistical Annex to date—namely, that robust IP protection is a critical component of a 21st century knowledge-based economy.

- In fact, a positive stepwise improvement can be seen across both measures: Economies with robust IP environments (scoring in the top third of the Index) are on average 37% more likely to secure new growth opportunities compared with economies whose IP environments require improvement (scoring in the middle third of the Index), which in turn are 20% more competitive and better positioned to take advantage of technological shifts compared with economies scoring in the bottom third of the Index.

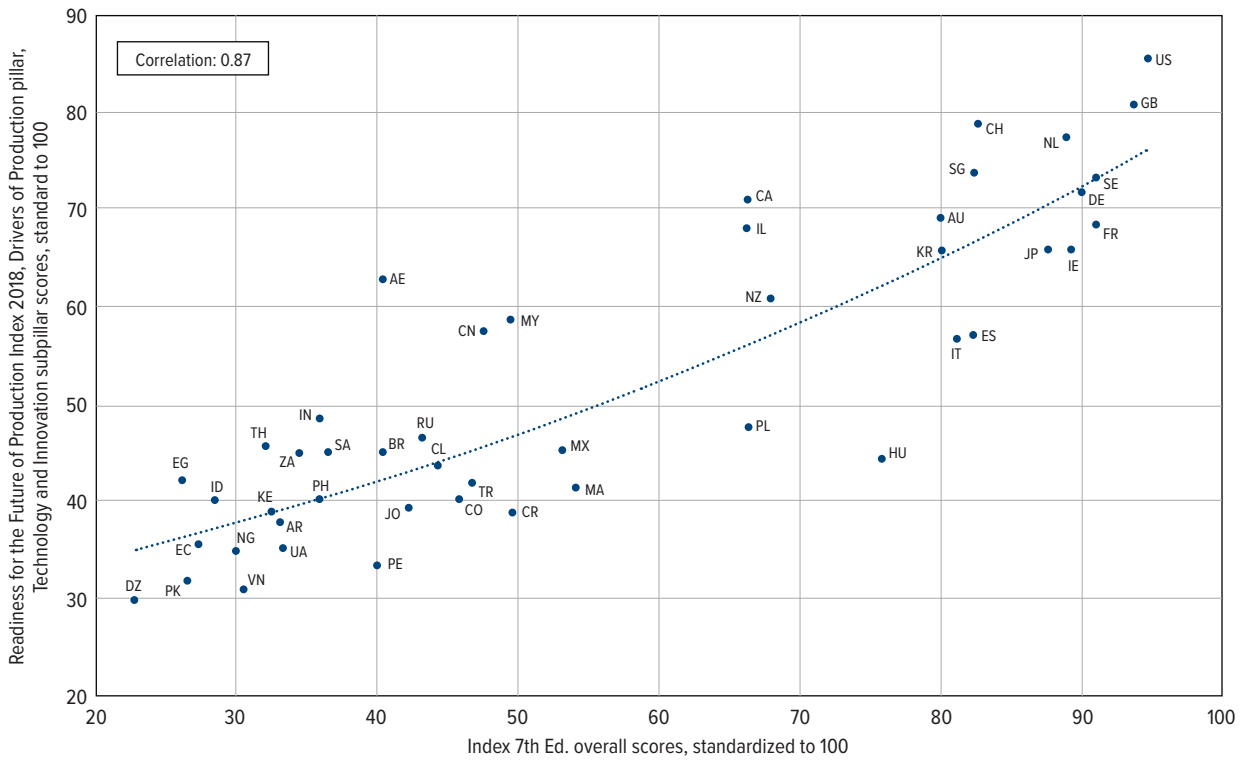
Association between the Index scores and the Readiness for the Future of Production Assessment 2018, Driver of Production pillar scores: Division by thirds in Index scores, average scores per third



Source: World Economic Forum (2018); GIPC (2019)

A Strong IP Framework = Greater Capacity for Innovation and Technological Absorptive Capacity

Association between the Index scores and the Readiness for the Future of Production Report, Drivers of Production pillar, Technology & Innovation subpillar scores[4]

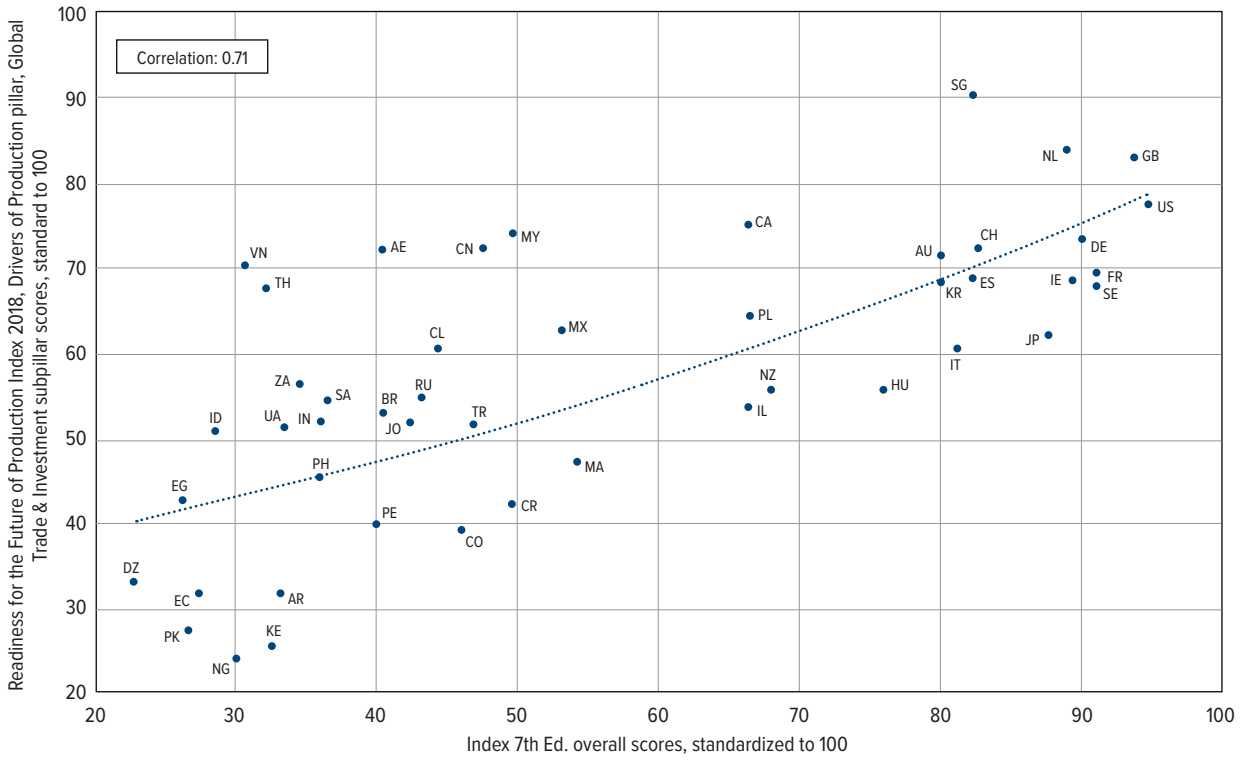


Source: World Economic Forum (2018); GIPC (2019)
Note: Data are not available for Brunei, Taiwan, and Venezuela.

- The Readiness for the Future of Production Assessment's Technology & Innovation subpillar measures how advanced, digitally secure, and globally connected and interoperable the economic production system is—a critical element for economies' ability to foster and commercialize new and innovative technologies.
- The Index exhibits a very strong correlation of 0.87 to the Technology & Innovation subpillar scores. In fact, countries with strong IP systems are 55% more likely to be able to transform their economies using sophisticated, state-of-the-art technologies compared with economies whose IP systems require improvement.

Favorable IP Regimes Promote Trade Openness and Attractiveness to Foreign Investments

Association between the Index scores and the Readiness for the Future of Production Assessment, Global Trade & Investment subpillar scores[5]



Source: World Economic Forum (2018); GIPC (2019)
Note: Data are not available for Brunei, Taiwan, and Venezuela.

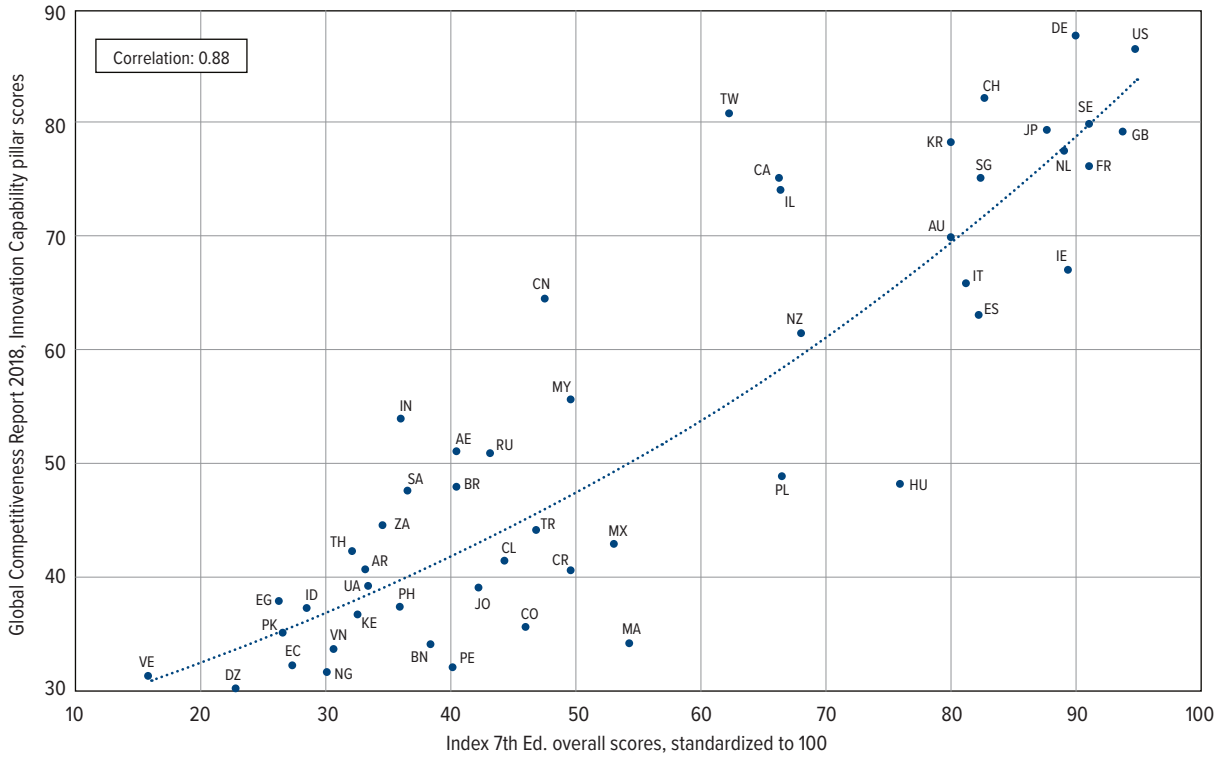
- The Readiness for the Future of Production Assessment's Global Trade & Investment subpillar measures economies' levels of openness to international trade and the availability of capital directed to production-related development. There is a strong relationship (at a correlation strength of 0.71) to the Index scores, suggesting that the strength of a national IP environment is a contributing factor to economies' ability to bolster knowledge and skill attainment, increase technology transfer, and boost productivity and competitiveness.

- Economies with fair to strong IP environments are on average 39% more open for business and attractive to foreign investments in their production systems compared with weaker economies.

RESOURCES TO INNOVATE

Robust IP Protection Is a Key Component in Developing a Strong Innovation Capability

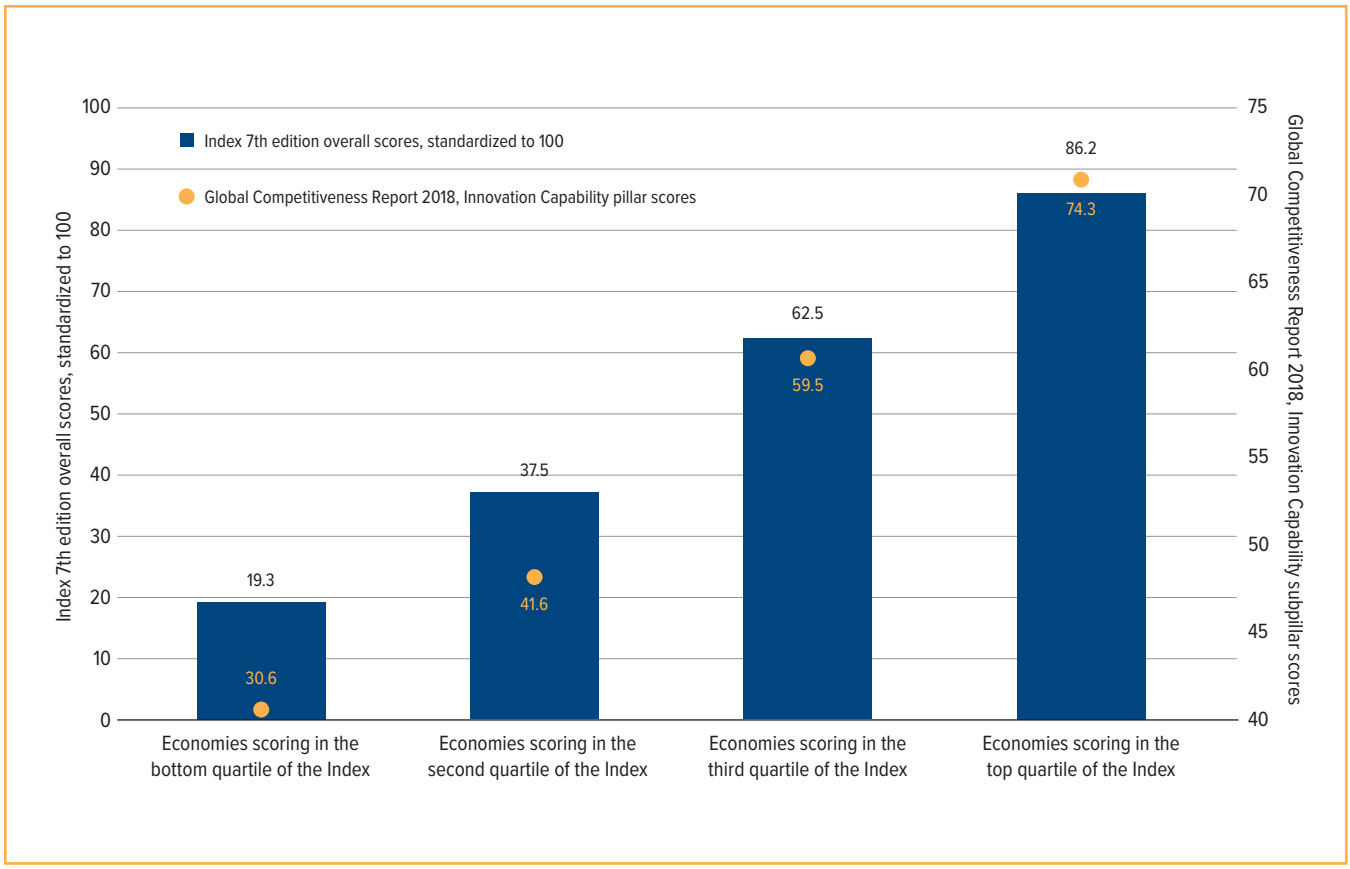
Association between the Index scores and the *Global Competitiveness Report 2018*, Innovation Capability pillar scores[6]



Source: World Economic Forum (2018); GIPC (2019)

- A very strong relationship (a correlation of 0.88) was found between the Index scores and the *Global Competitiveness Report*'s Innovation Capability pillar scores.
- Economies with fair to strong IP regimes are on average 70% more likely to maintain an environment capable of producing innovative outputs compared with weaker economies.
- The link between the two variables is particularly strong when looking at group averages by quartiles of Index scores: Economies that score within the third quartile of the Index are on average 43% more capable of innovating and benefiting from local innovation activities compared with economies that score within the second quartile of the Index.

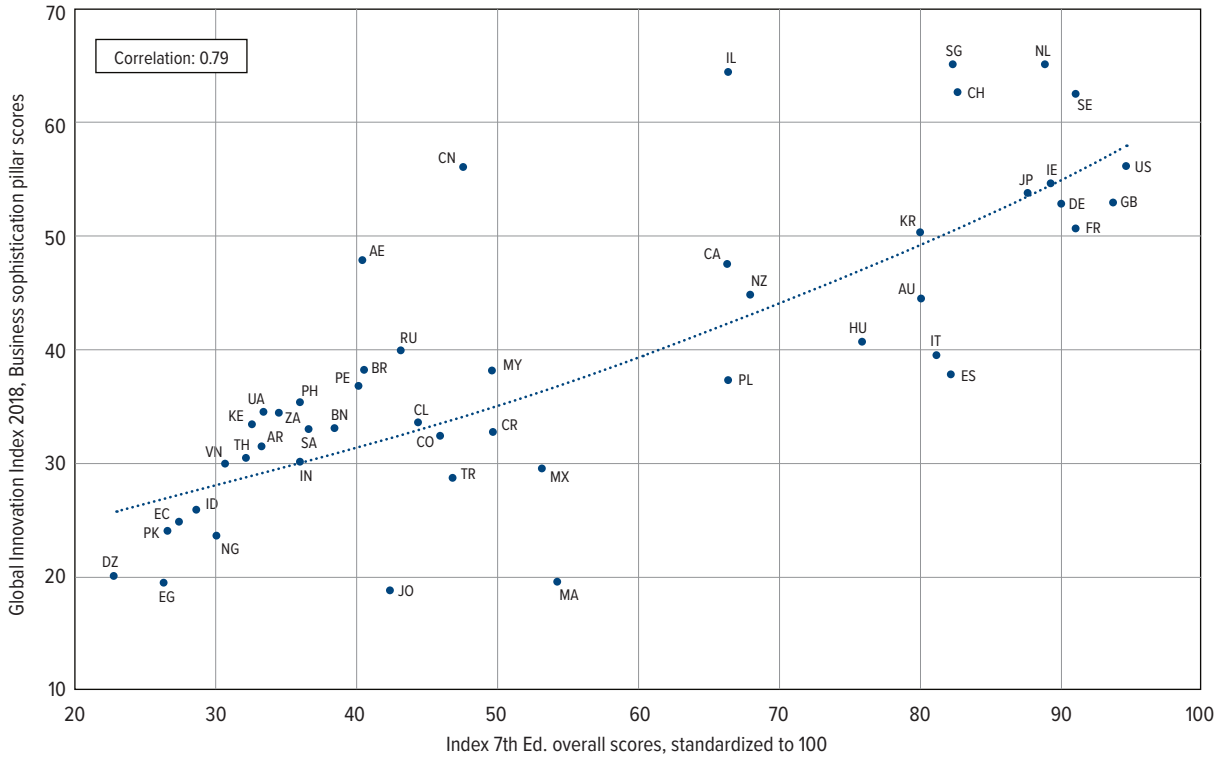
Association between the Index scores and the *Global Competitiveness Report 2018*, Innovation Capability pillar scores: Division by quartiles in Index scores, average scores per quartile



Source: World Economic Forum (2018); GIPC (2019)

Supportive IP Regimes Are Essential for Creating Environments That Are Conducive to Innovation

Association between the Index scores and the Global Innovation Index 2018, Business Sophistication pillar scores[7]

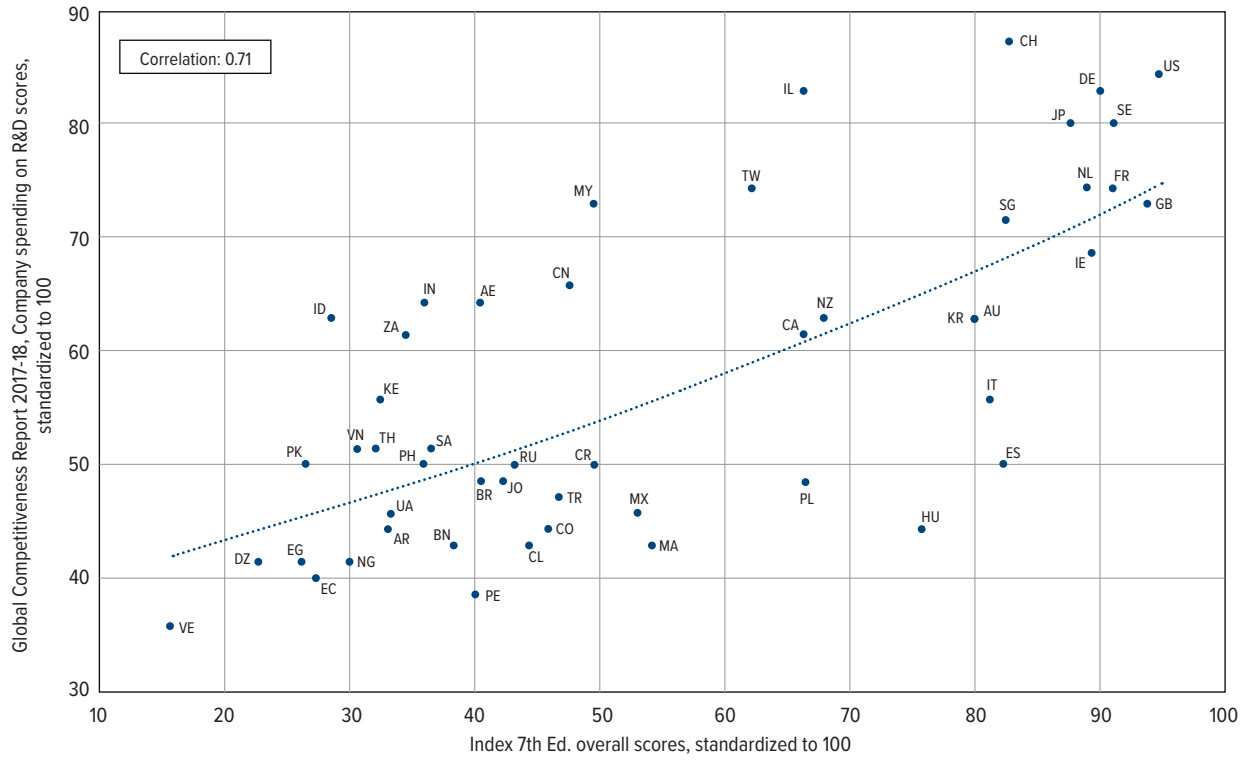


Source: World Economic Forum (2018); GIPC (2019)
Note: Data are not available for Taiwan and Venezuela.

- The Global Innovation Index's Business Sophistication pillar measures the availability of competent talent, levels of innovation linkages and infrastructure, and levels of foreign direct investment (FDI) and reliance on high-tech imports. There is a strong correlation of 0.79 to the Index scores.
- As a result, economies with strong IP protection are 53% more likely to experience the benefits of an innovation-driven economy, ranging from more high-skilled and high-paid workers to increased R&D activity.

Companies Are More Likely to Spend on R&D in Favorable IP Environments

Association between Index scores and the *Global Competitiveness Report 2017–18*, company spending on R&D scores[8]

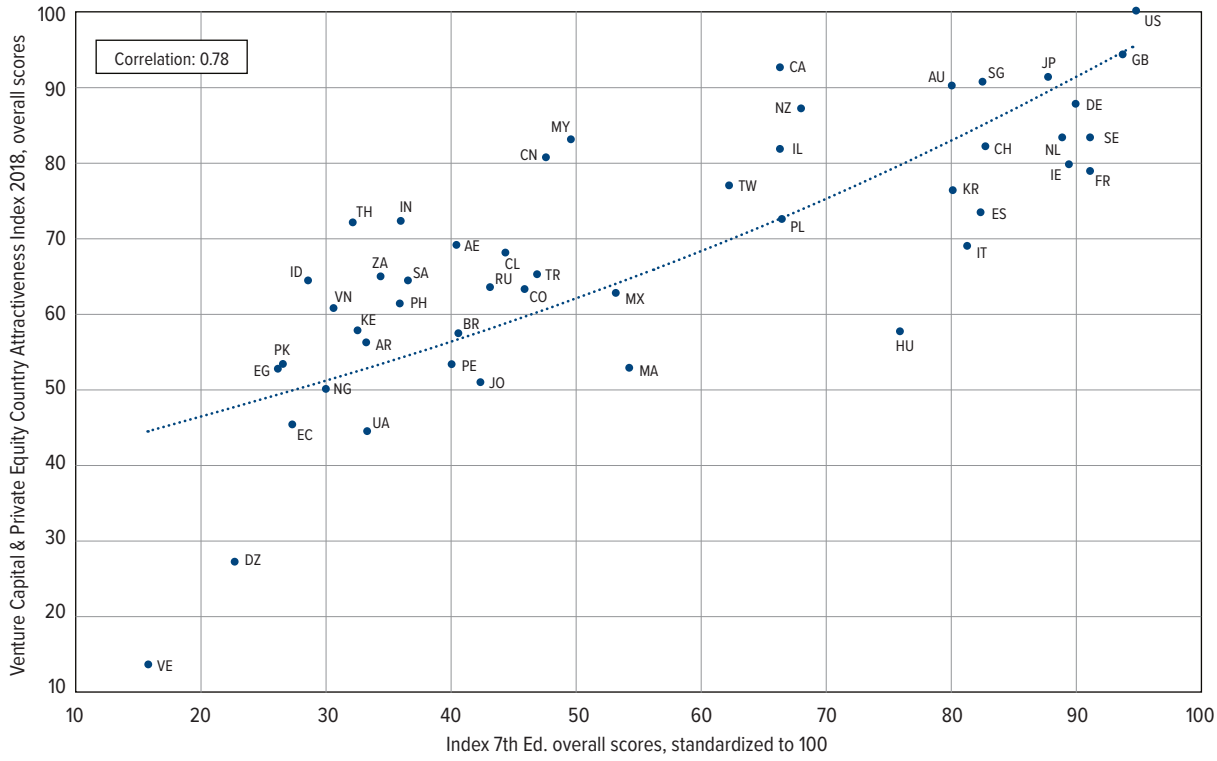


Source: World Economic Forum (2018); GIPC (2019)

- A strong correlation of 0.71 exists between the Index scores and private-sector propensity to spend on R&D.
- Companies in economies that provide robust IP environments (scoring in the top half of the Index) are 33% more likely to see private-sector investment in R&D activities compared with companies in economies with less supportive IP environments (scoring in the bottom half of the Index).

Economies with Robust IP Regimes Are More Attractive to Investors

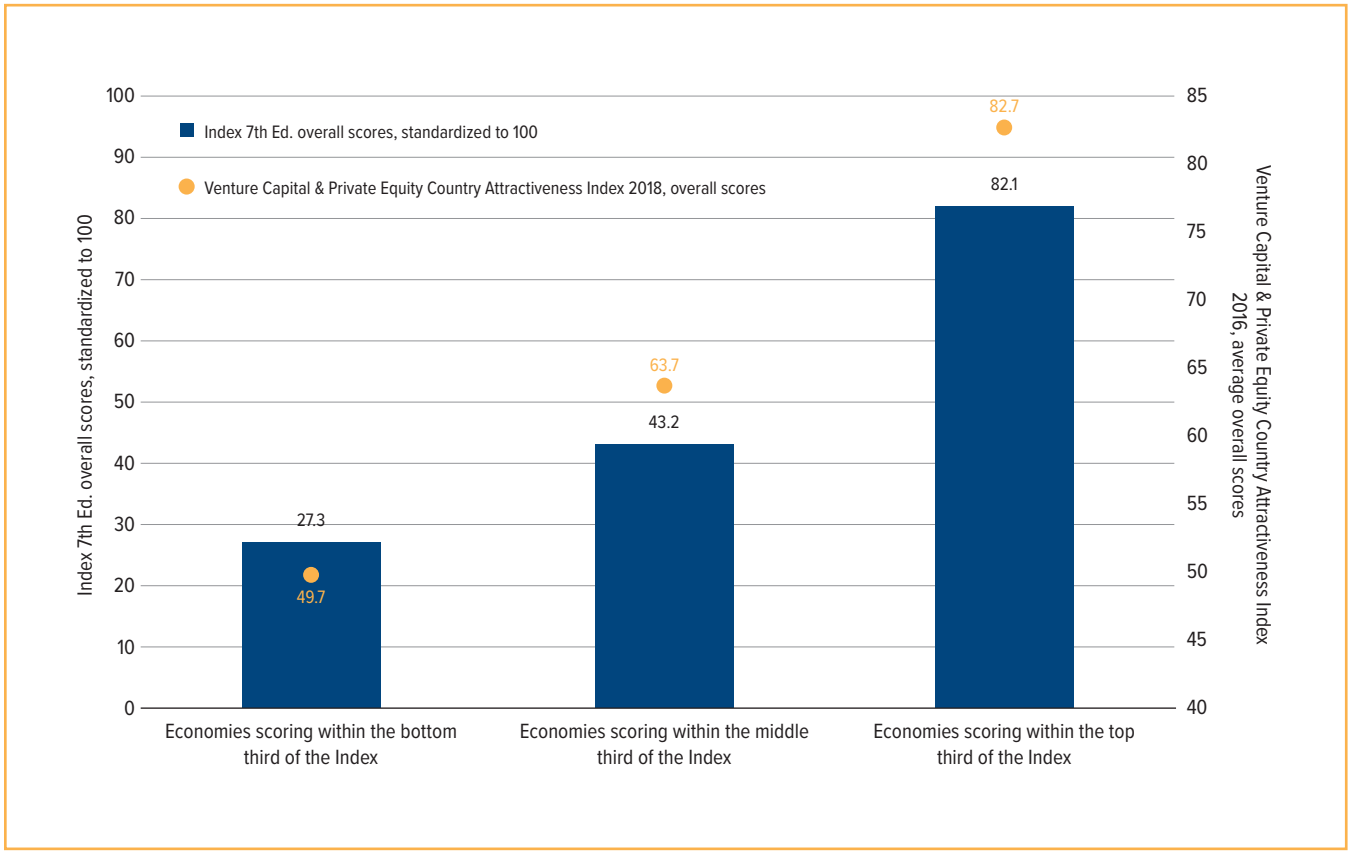
Association between the Index scores and the Venture Capital & Private Equity Country Attractiveness Index 2018 scores[9]



Source: IESE Business School and EMLYON Business School (2018); GIPC (2019)
Note: Data are not available for Brunei and Costa Rica.

- There is a strong correlation of 0.78 to the IESE and EMLYON Business Schools' Venture Capital & Private Equity Attractiveness Index scores.
- Innovators and companies in economies that score in the top third of the Index are on average 30% more likely to attract venture capital and private equity funds compared with innovators and companies in economies that score in the middle third of the Index, which in turn display a 28% higher likelihood for attracting venture capital and private equity funds compared with innovators and companies in economies that score in the bottom third of the Index.

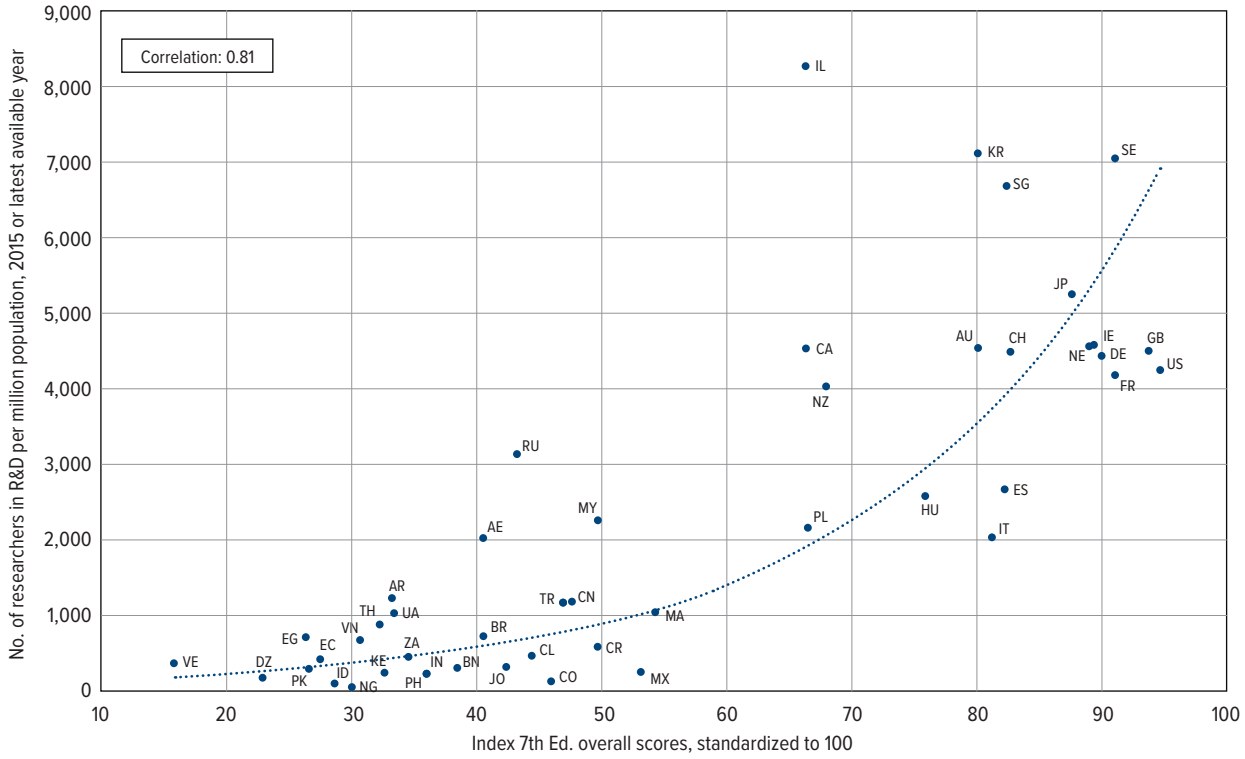
Association between the Index scores and the Venture Capital & Private Equity Country Attractiveness Index 2018 scores: Division by thirds in Index scores, average scores per third



Source: IESE Business School and EMLYON Business School (2018); GIPC (2019)
Note: Data are not available for Brunei and Costa Rica.

Strong IP Environments Encourage the Development of Human Capital

Association between Index scores and the number of researchers in R&D per million population

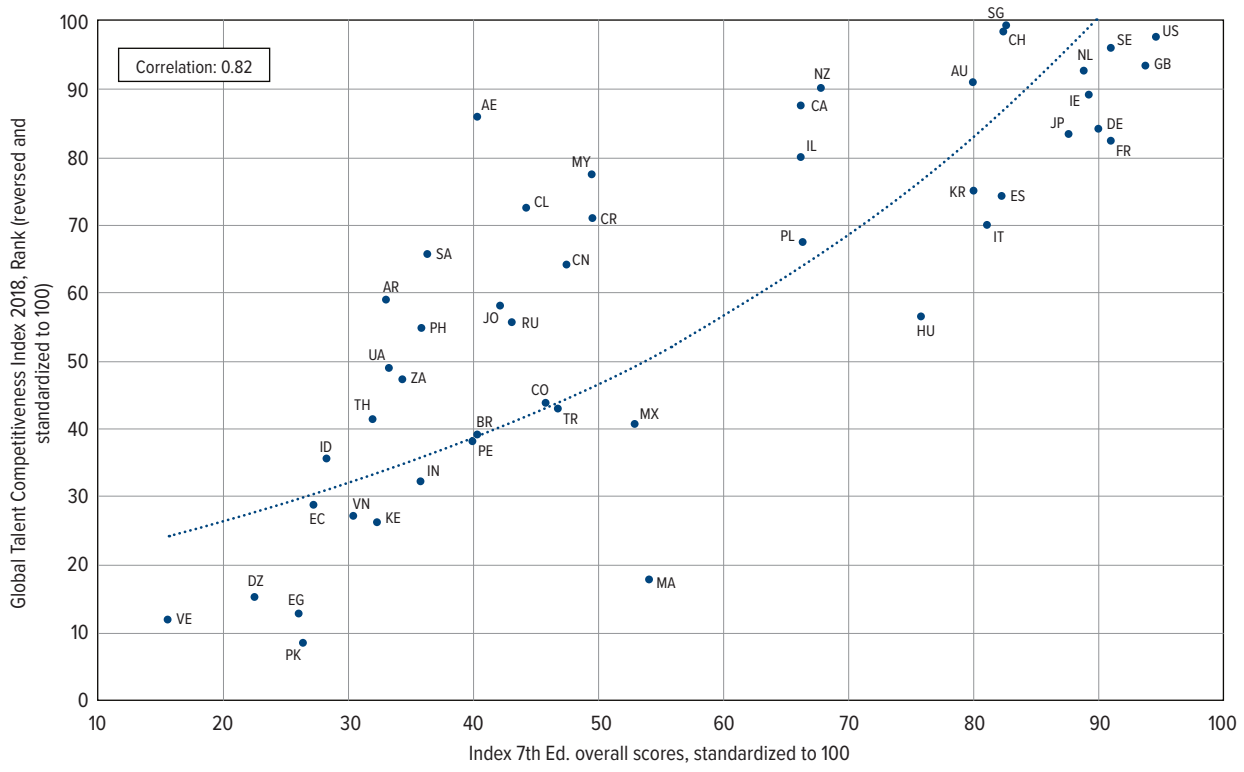


Source: The World Bank (2018); GIPC (2019)
Note: Data are not available for Peru, Saudi Arabia, and Taiwan.

- Highly skilled scientists and researchers are a critical resource for creating technological advancements in any sector and any economy at large. The relationship between the Index scores and levels of human capital has remained very strong (a correlation strength of 0.81 and above) over the past four editions of the Annex.
- Economies with favorable IP regimes, on average, have nearly six times more R&D-focused personnel than economies whose IP environments require improvement.

Favorable IP Environments Are Better Positioned to Compete in the Global Innovation Arena

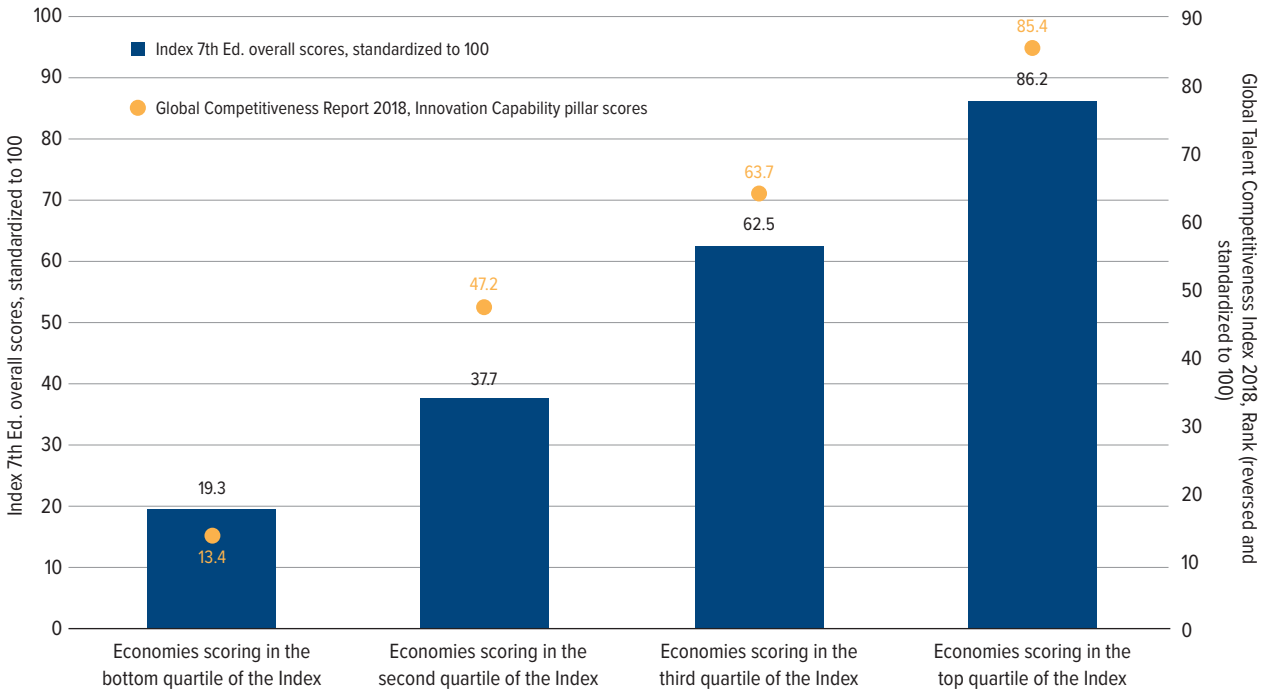
Association between the Index scores and the Global Talent Competitiveness Index 2018 rankings[10]



Source: INSEAD Business School (2018); GIPC (2019)
Note: Data are not available for Brunei, Nigeria, and Taiwan.

- IP protection displays a very strong relationship—at a correlation strength of 0.82—with economies' performance on the Global Talent Competitiveness Index. The latter benchmarks economies' ability to develop, attract, and empower human capital, measuring both inputs—such as enabling landscape, market openness, quality of learning, and sustainability—and outputs—such as mid- and high-level skills and overall talent impact.
- Economies with higher Index scores are, on average, 78% more competitive on the Global Talent Competitiveness Index than weaker economies are.
- When dividing the Index scores into quartiles, a corresponding stepwise increase is revealed in economies' talent competitiveness, suggesting that the overall strength of economies' IP protection goes hand-in-hand with the development of a strong and competitive workforce.

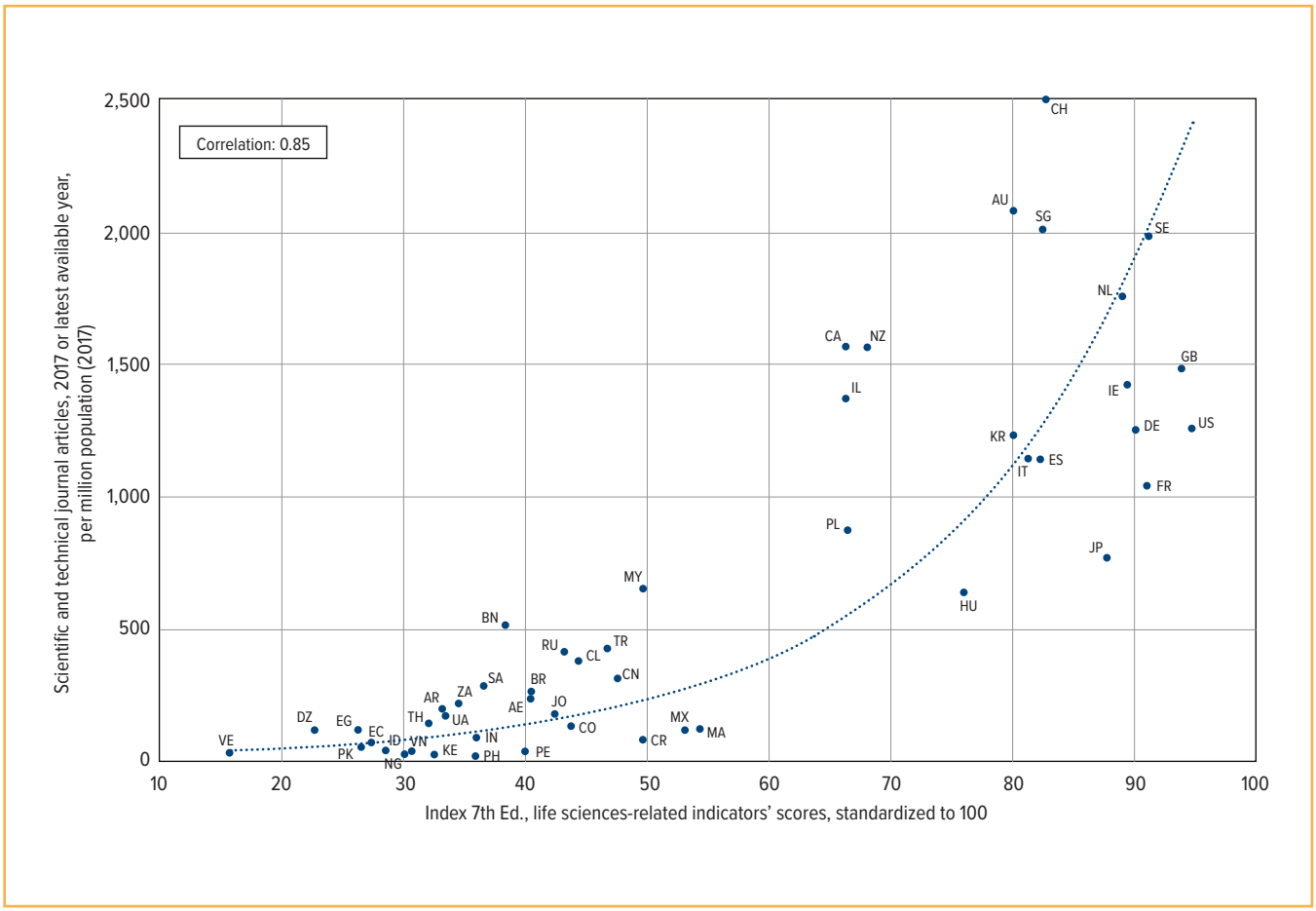
Association between the Index scores and the *Global Talent Competitiveness Index 2018* rankings: Division by quartiles in Index scores, average scores per quartile



Source: INSEAD Business School (2018); GIPC (2019)

Supportive IP Frameworks and Science and Technology Knowledge Production

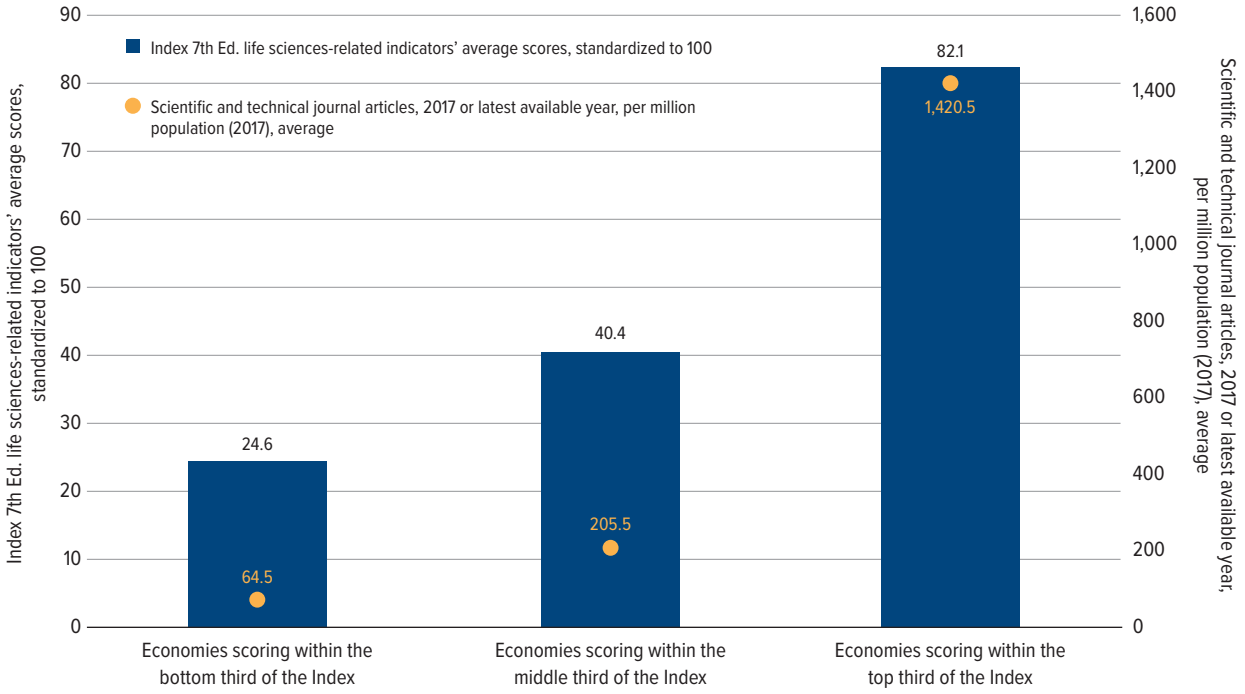
Association between the Index scores and the number of scientific and technical journal articles per million population (2017)[11]



Source: The World Bank (2018); GIPC (2019)
Note: Data are not available for Taiwan.

- The population-adjusted rate of scientific and technical journal articles—a robust measure for the quality and productivity of human capital in the fields of life sciences, technology, and engineering—displays a very strong correlation (0.85) with the Index overall scores.
- Economies with robust IP systems, as measured by the Index, are more likely to have over 7 times more knowledge output in terms of scientific and technical journal articles.

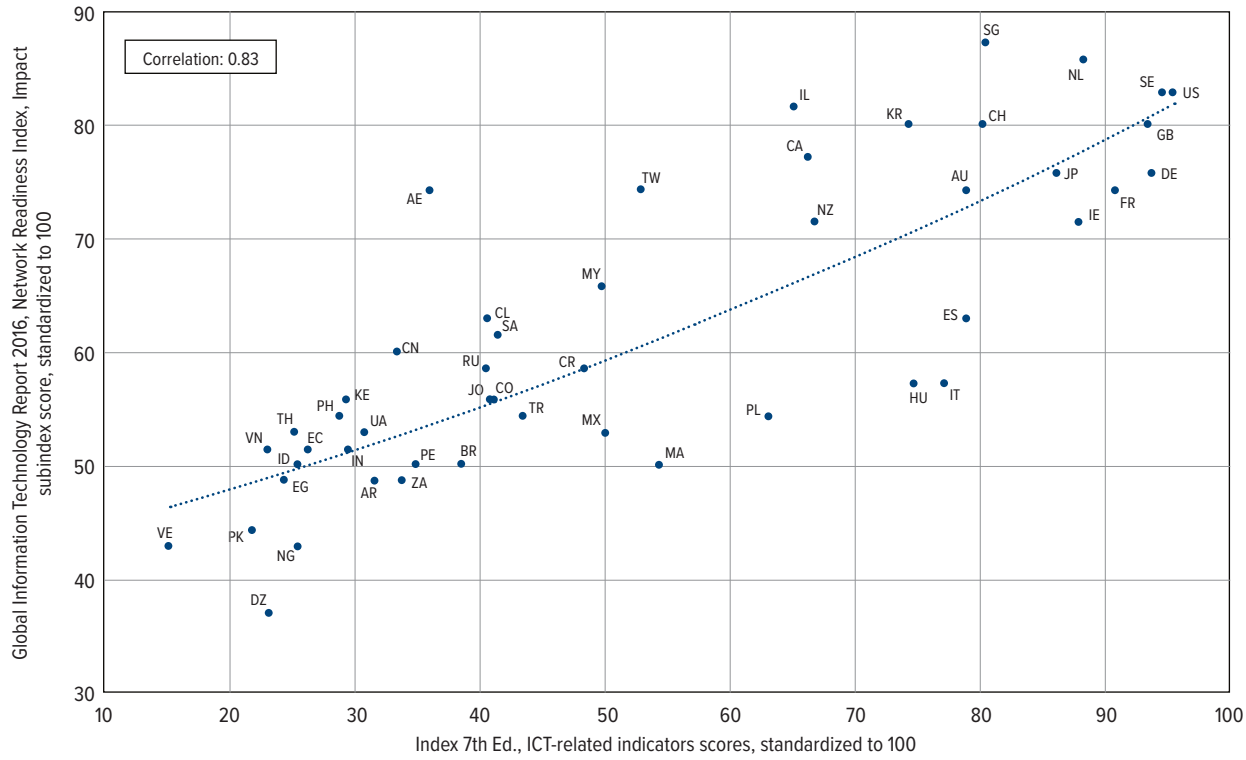
Association between the Index scores and the number of scientific and technical journal articles per million population (2017): Division by thirds in Index scores, average scores per third



Source: The World Bank (2018); GIPC (2019)

IP Protection Contributes to the Growth of the ICT Sector and Knowledge-Based Economies

Association between the Index ICT-related indicators scores and the *Global Information Technology Report 2016*, Network Readiness Impact scores[12]

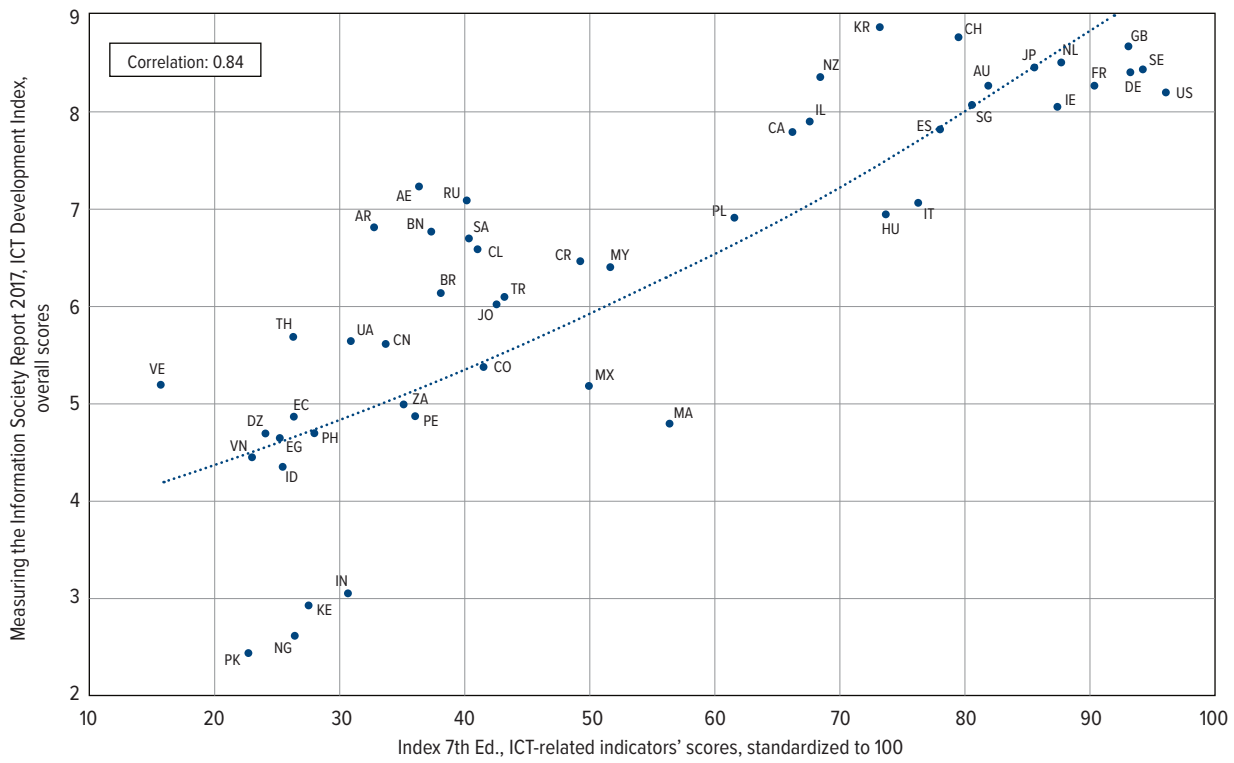


Source: World Economic Forum, INSEAD, Cornell (2016); GIPC (2019)
Note: Data are not available for Brunei.

- There is a strong correlation (0.83) between the ICT-related indicators of the Index and the extent to which an economy leverages ICT and benefits from its economic and societal impact, as measured by the *Global Information Technology Report*'s Network Readiness Index.
- On average, economies with stronger Index scores are 35% more likely to fully leverage ICTs for increased productivity and technology development.

IP Protection Contributes to the Growth of the ICT Sector and Knowledge-Based Economies

Association between the Index ICT-related indicators scores and the *Measuring the Information Society Report 2017* ICT Development Index[13]



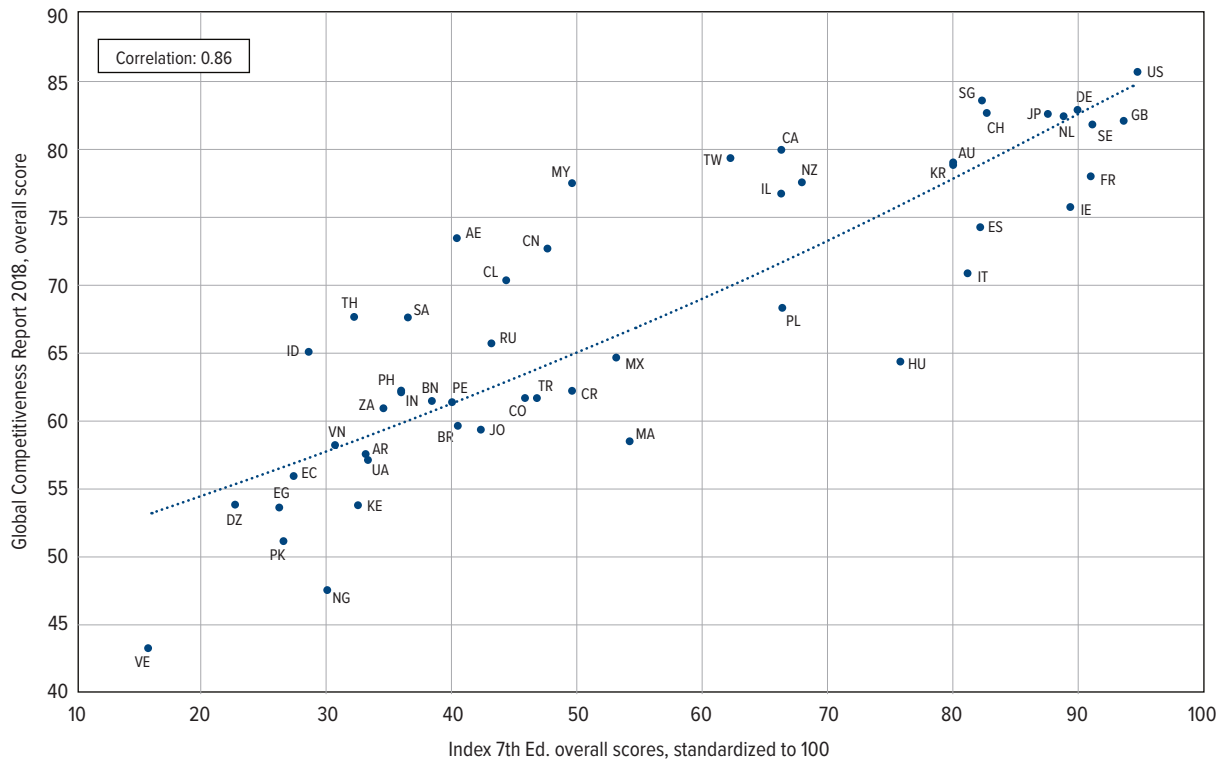
Source: International Telecommunication Union (2017); GIPC (2019)
Note: Data are not available for Taiwan.

- The Index's ICT-related indicators scores display a very strong correlation of 0.84 with the ICT Development Index.
- Economies with favorable IP environments are 47% more likely to support a dynamic ICT sector and experience the socioeconomic benefits this generates.

OUTPUTS OF A COMPETITIVE KNOWLEDGE-BASED ECONOMY

Economies with Favorable IP Environments Are More Globally Competitive

Association between the Index scores and the *Global Competitiveness Report 2018* overall scores[14]

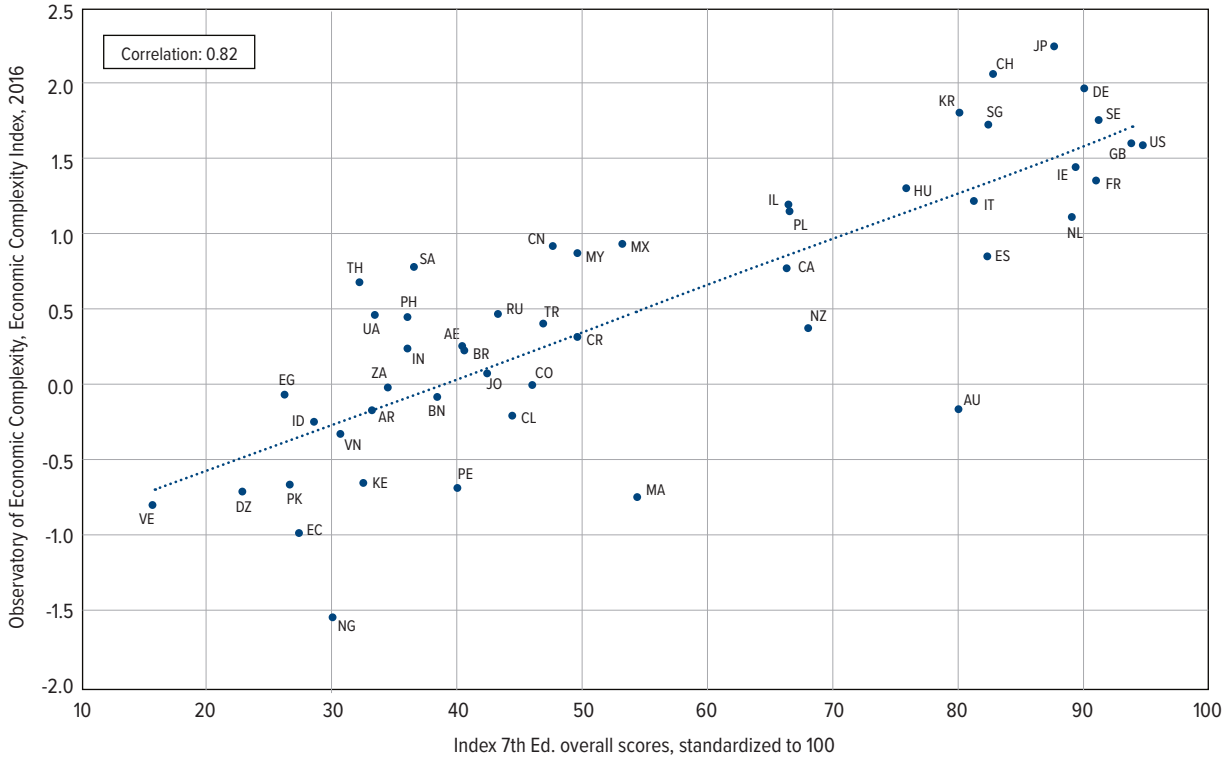


Source: World Economic Forum (2018); GIPC (2019)

- The Global Competitiveness Index is a comprehensive benchmark of the set of institutions, policies, and factors that determine economies' productivity and competitiveness. There is a very strong relationship (at a correlation strength of 0.86) with the Index scores.
- On average, economies with stronger Index scores are 26% more competitive than economies that score below 50%.

Robust IP Protection and Economic Complexity

Association between the Index scores and the Observatory of Economic Complexity's Economic Complexity Index, 2016[15]

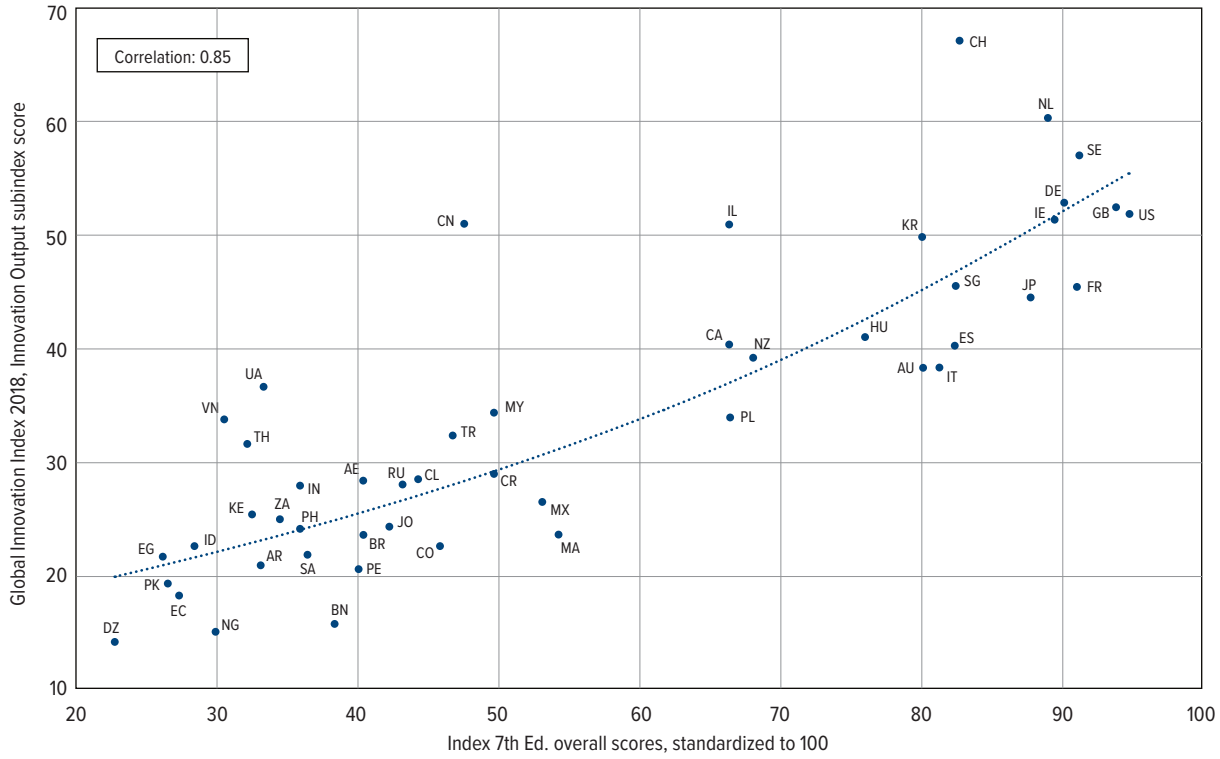


Source: Observatory of Economic Complexity (2018); GIPC (2019)

- The Observatory of Economic Complexity's Economic Complexity Index measures the multiplicity and complexity levels of the knowledge required to produce a given product and the level of its exports. There is a very strong correlation of 0.82 with the Index scores.
- Economies that score above 50% on the Index are on average twice as likely to produce and export complex, knowledge-intensive products and reap the associated social and economic benefits compared with economies that score below 50%.

Strong IP Environments Have Higher Levels of Innovative Output

Association between Index scores and the Global Innovation Index 2018, Innovation Output subindex scores[16]

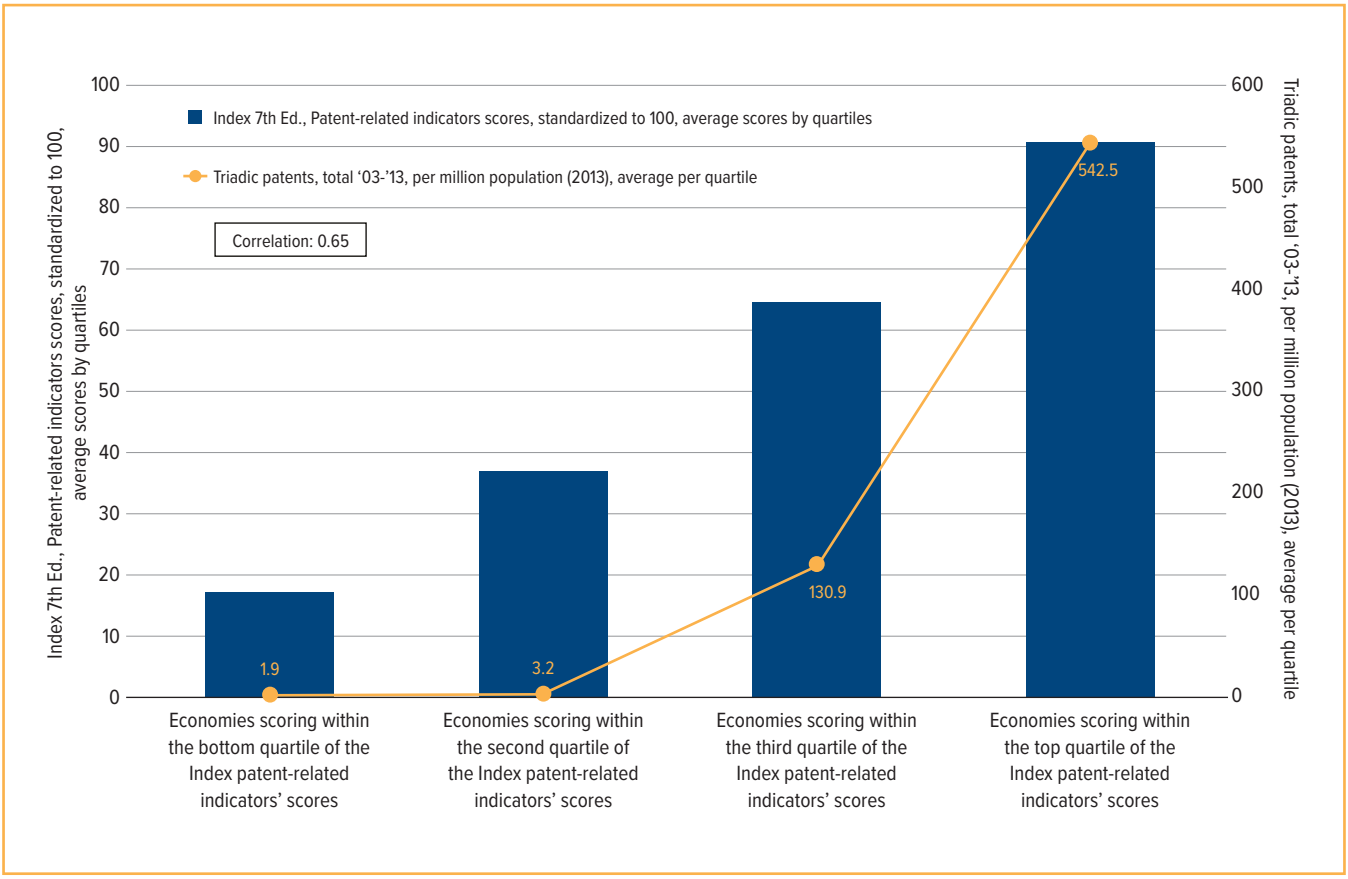


Source: Cornell/INSEAD/WIPO (2018); GIPC (2019)
Note: Data are not available for Brunei and Taiwan.

- The Global Innovation Index's Innovation Output subindex is an aggregate measure that looks at a wide variety of indicators that reflect knowledge creation and development, including intangible assets, research publications, and high-tech production. When compared with the Index, there is a very strong correlation of 0.85 to the Index scores.
- Economies with robust IP regimes experience 76% more knowledge-based, technological, and creative outputs than economies whose IP regimes trail behind.

Inventive Intensity Depends on Strong Patent Protection

Association between Index patent-related indicators scores and triadic patents (total, 2003–13) per million population, by quartiles in Index scores, average per quartile[17]

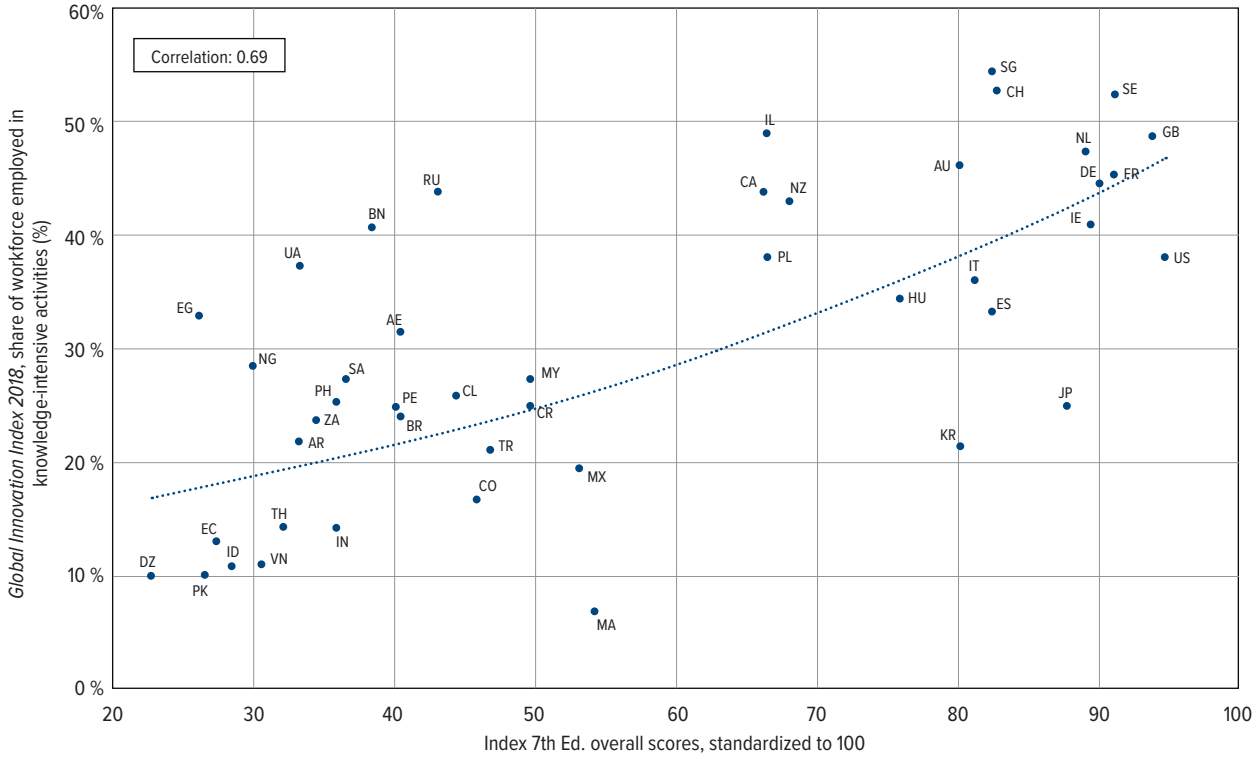


Source: OECDstat (2018); World Bank (2018); GIPC (2019)

- Triadic patenting rates are a measure of patent protection granted by the three biggest patent offices (U.S., EU, and Japan) and serve as a good indicator of the development of high-value innovations with significant commercial potential.
- The Index patent-related indicators scores display a strong relationship (a correlation of 0.65) with triadic patenting rates standardized by population. Strong IP environments generate more triadic patenting, while the opposite makes it virtually nonexistent.
- Economies in the top Index quartile generate more than 4 times the number of high-value innovations than economies in the third quartile. Additionally, economies with the strongest IP frameworks have over 500 more high-value inventions patented per million population than economies in the lowest quartile.
- Economies in the lower two quartiles see rates of triadic patenting activity in the low single digits per million population.

A Robust IP Regime Promotes the Growth of Knowledge-Intensive Sectors

Association between the Index scores and *Global Innovation Index 2018*, share of workforce employed in knowledge-intensive services[18]

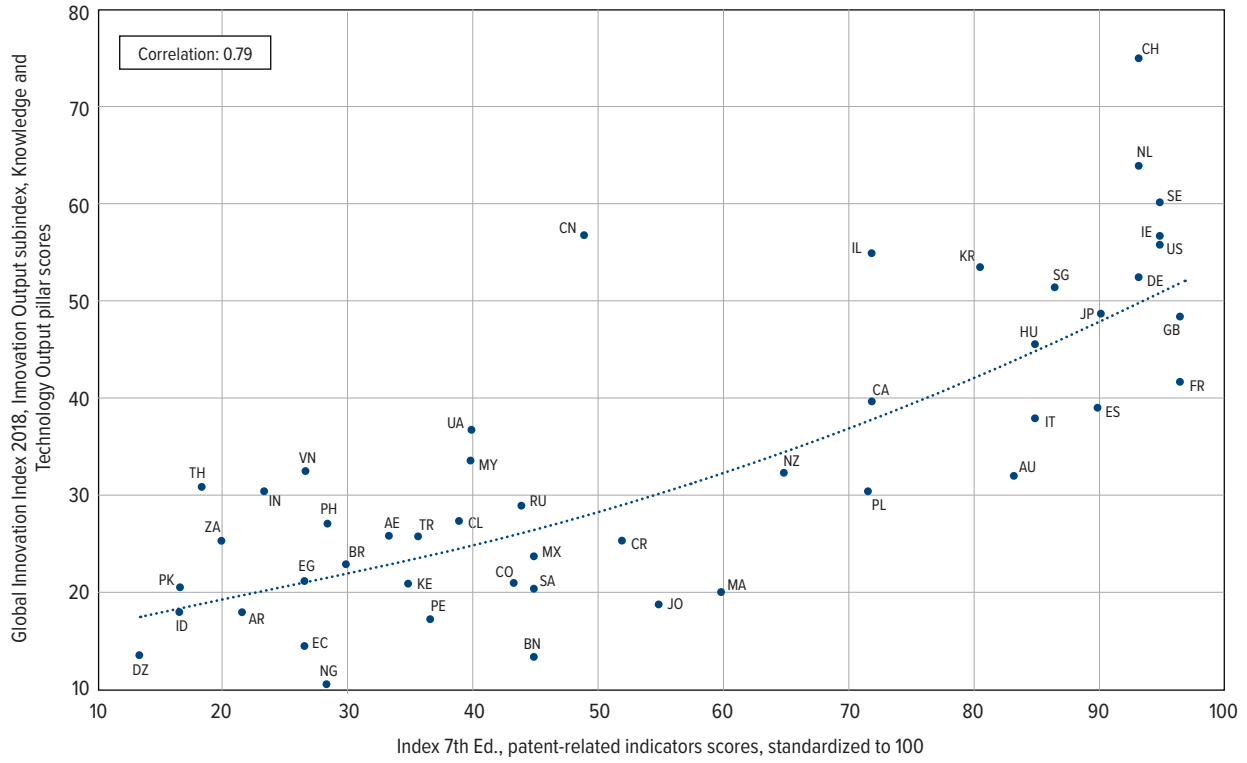


Source: Cornell/INSEAD/WIPO (2018); GIPC (2019)
Note: Data are not available for Taiwan and Venezuela.

- There is a strong correlation (0.69) between Index scores and the share of the workforce employed in knowledge-intensive activities, as measured by the *Global Innovation Index 2018*.
- The share of the workforce concentrated in knowledge-intensive sectors in economies with robust IP environments (those scoring in the top third of the Index) is 67% higher than it is in economies that trail in terms of IP protection (those scoring in the bottom third of the Index).

Patent Protection Is Linked to the Growth of High-Tech Sectors

Association between Index patent-related indicators scores and the Global Innovation Index 2018, Innovation Output subindex, Knowledge and Technology Output pillar scores[19]

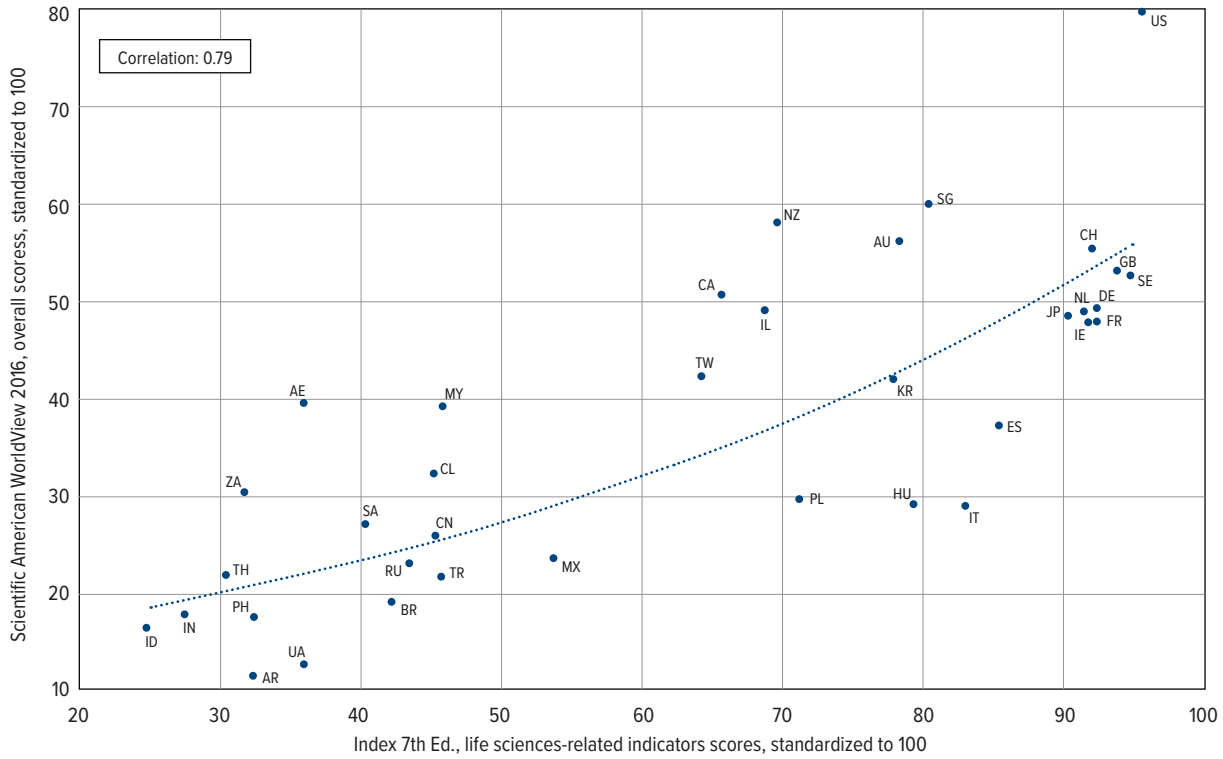


Source: Cornell/INSEAD/WIPO (2018); GIPC (2019)
Note: Data are not available for Taiwan and Venezuela.

- The Index's patent-related indicators exhibit a strong correlation of 0.79 with knowledge and technology outputs (as measured by the Global Innovation Index's Innovation Output subindex)
- Economies with strong patent environments, scoring above 50% on the Index, produce up to 80% more knowledge and technology outputs than do economies whose patent environments trail behind.

Biotechnological Innovation Depends on Protecting IP

Association between the Index's life sciences–related indicators scores and the Scientific American WorldView scores[20]

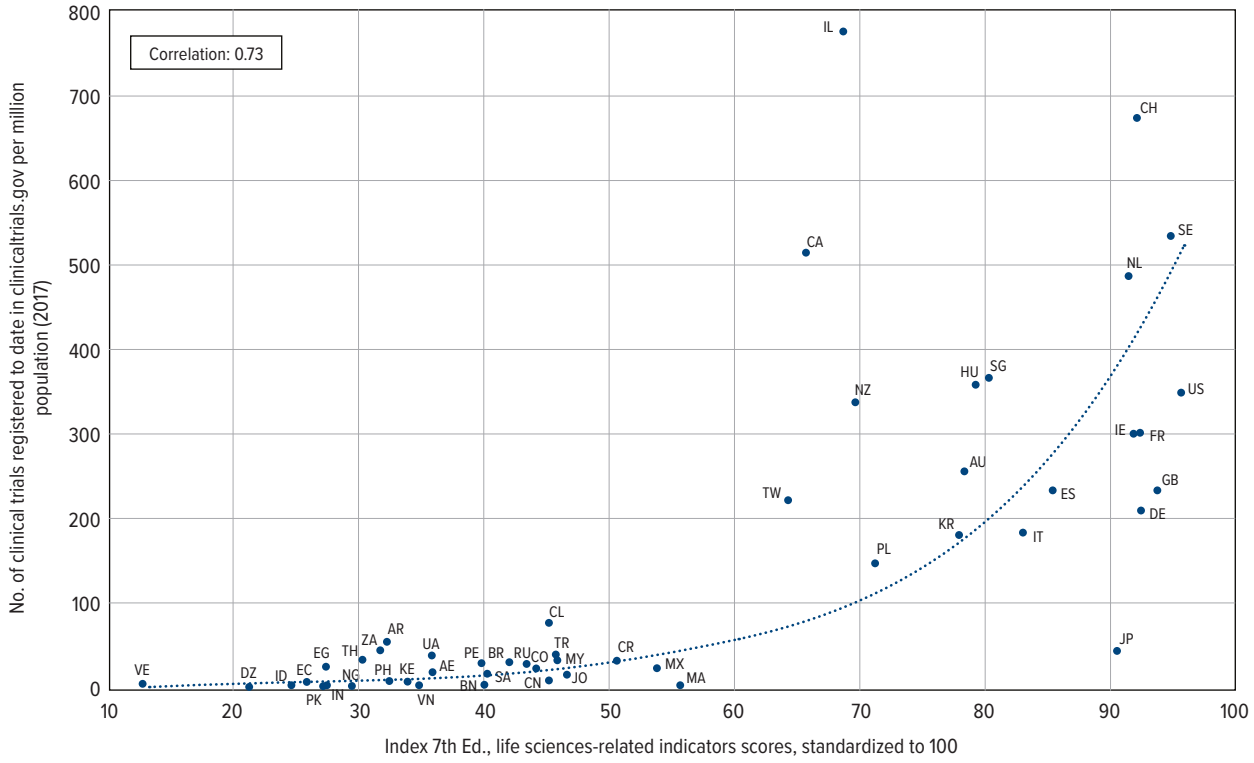


Source: Scientific American (2016); GIPC (2019)
Note: Data are not available for Algeria, Brunei, Colombia, Costa Rica, Ecuador, Egypt, Jordan, Kenya, Nigeria, Pakistan, Peru, Venezuela, and Vietnam.

- Protecting IP rights related to the life sciences, such as patents, regulatory data protection, and patent term restoration, has a very clear and direct correlation with an environment in which biotechnology innovation can thrive.
- The Index scores on life sciences–related indicators correlate strongly—at 0.79—with the Scientific American WorldView overall scores (as a measure of biotech innovation).
- Economies that score in the top half of the Index are twice as likely to provide environments that are conducive to biotech innovation compared with economies that score in the bottom half of the Index.

IP Rights Lead to Biomedical Foreign Direct Investment

Association between Index life sciences–related indicators scores and the number of clinical trials per million population

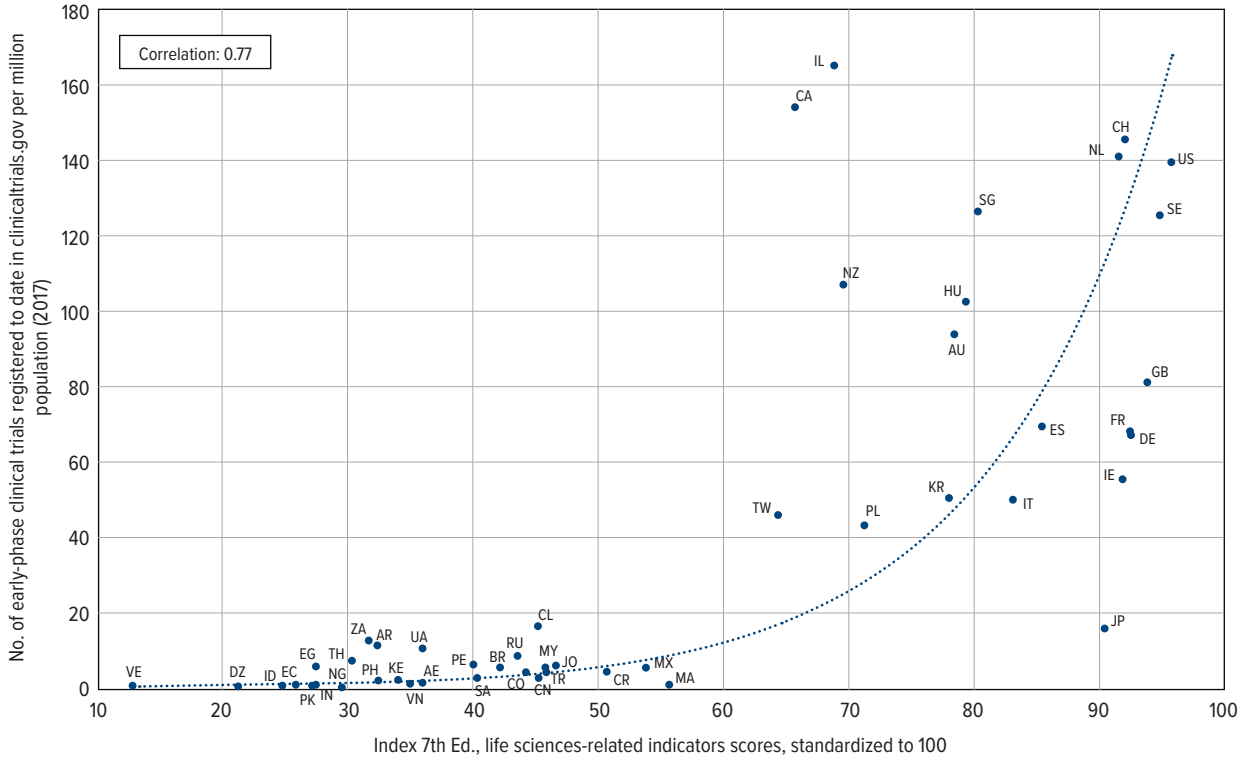


Source: clinicaltrials.gov (2018); World Bank (2018); GIPC (2019)

- Economies' clinical trial intensity, serving as a proxy for life sciences FDI, displays a strong association—a correlation of 0.73—with biomedical IP rights, as measured by the Index's scores on life sciences–related indicators.
- On average, top-scoring economies on the Index's life sciences–related indicator host almost 14 times more clinical trials than low-scoring economies do.

IP Protection Is Critical to Greater Investment in Cutting-Edge Clinical Research

Association between Index life sciences–related indicators scores and the number of early-phase (I+II) clinical trials per million population

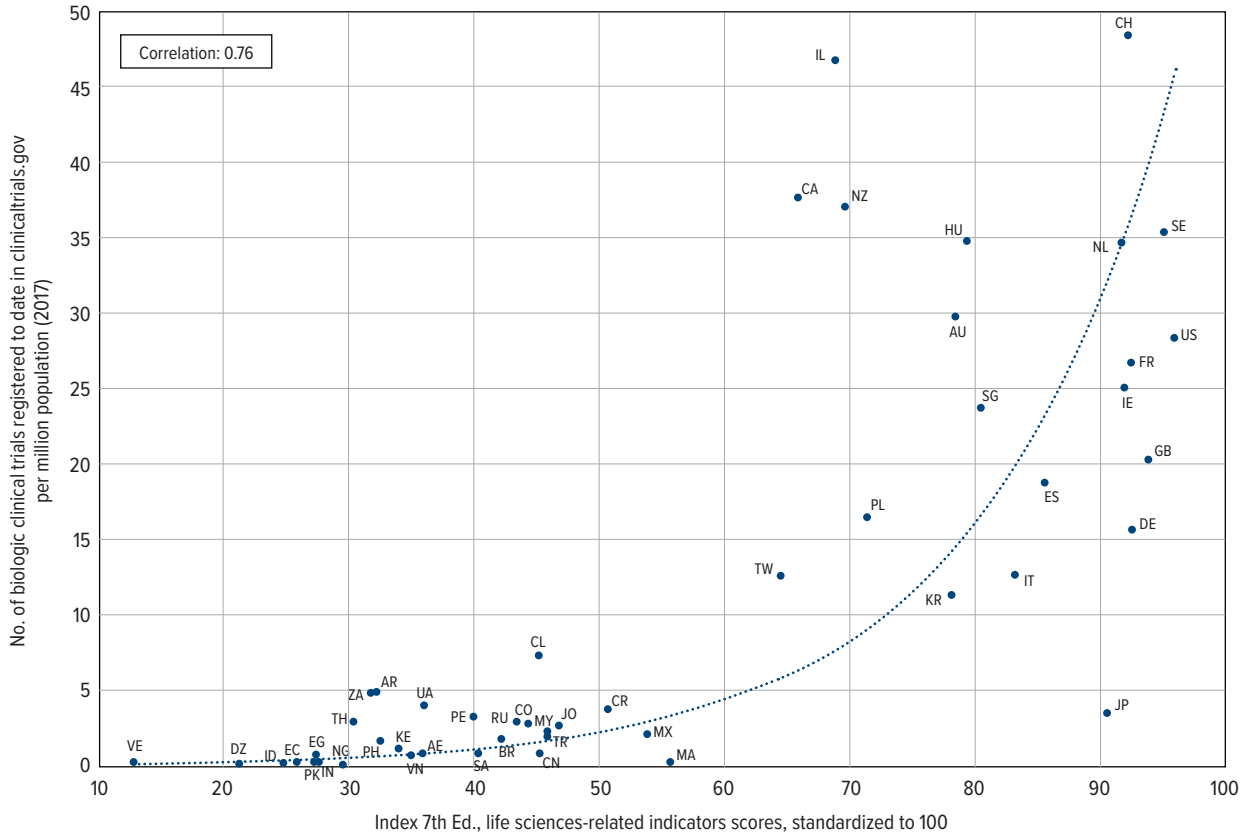


Source: clinicaltrials.gov (2018); World Bank (2018); GIPC (2019)

- The Index scores for life sciences–related indicators exhibit a strong correlation of 0.77 with rates of early-stage (phase I and II) clinical trial activity.
- Economies that maintain robust IP environments tend to see about 19 times more early-phase clinical trials on average compared with economies whose life sciences–related IP environments trail behind.

Development of Biological Therapies Is Closely Linked to IP Protection

Association between Index life sciences–related indicators scores and the number of biologic clinical trials per million population



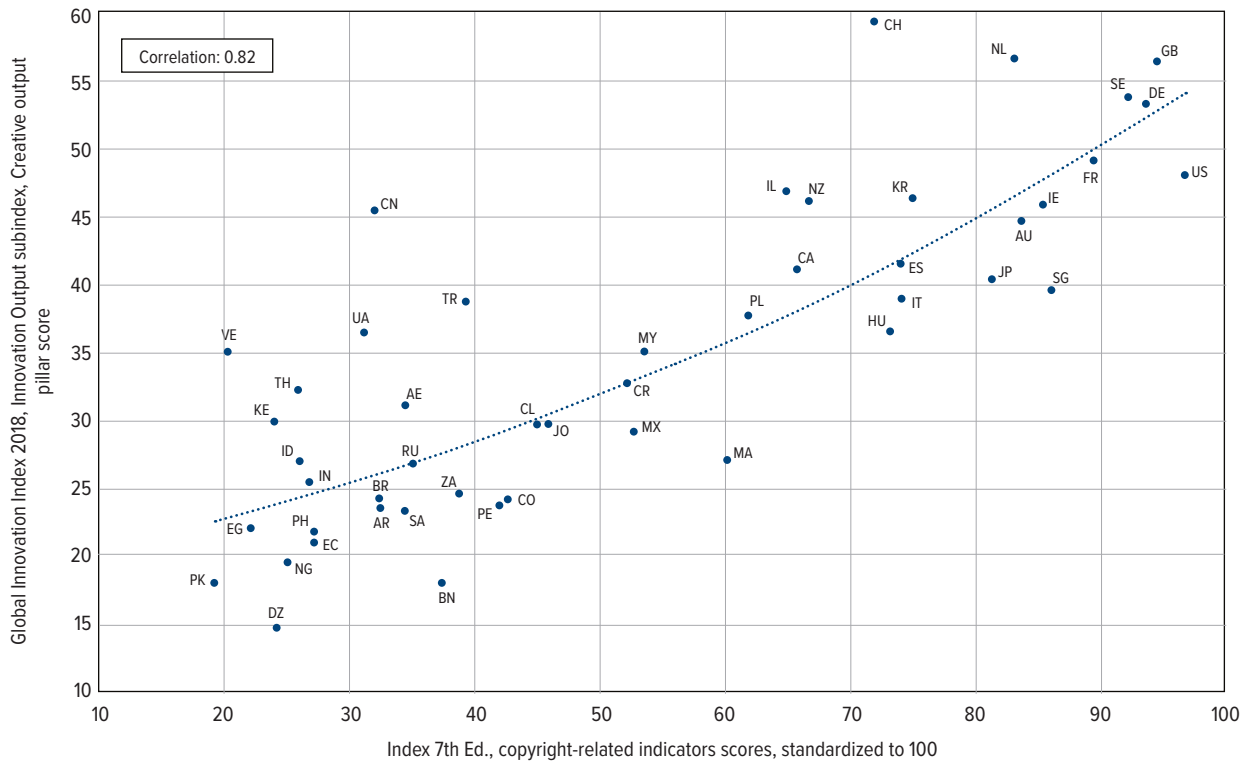
Source: clinicaltrials.gov (2018); World Bank (2018); GIPC (2019)

- Biological medicines—gene-, cellular-, or protein-based therapies produced from living organisms—are at the forefront of medical research. The trials involved in developing these biologics are highly complex and require high levels of skill and technical infrastructure; this is the high end of the value chain in clinical research.
- There is a strong correlation of 0.76 between the population-adjusted number of clinical trials of biologic drugs and the Index scores for life sciences–related indicators.
- Economies with strong to robust IP frameworks for the life sciences host on average 12 times more clinical trials on innovative biologic drugs than do economies with a weaker environment.

VALUE ADDED AND CREATIVITY

Robust Copyright Protection Encourages Creative Activity

Association between Index copyright-related indicators scores and the Global Innovation Index 2018, Innovation Output subindex, Creative Output pillar scores[21]

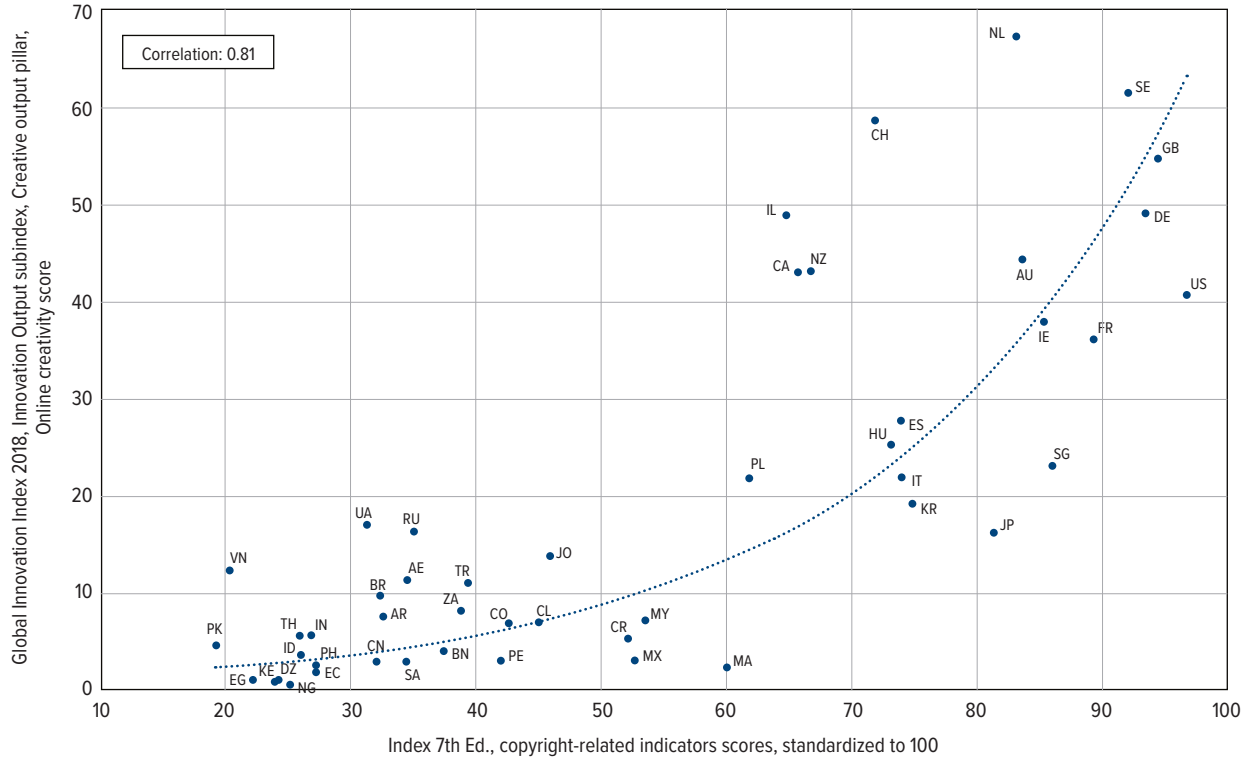


Source: Cornell/INSEAD/WIPO (2018); GIPC (2019)
Note: Data are not available for Taiwan and Venezuela.

- Copyright protection, measured by the Index's copyright-related indicators, displays a very strong correlation of 0.82 to the creative outputs pillar within the Global Innovation Index.
- Economies that score above 50% on the Index's copyright-related indicators are 64% more likely to benefit from growth in both the volume and the value of the dynamic content and media sectors than are economies that score in the bottom half of the Index.

Robust Copyright Protection Encourages Online Creativity

Association between Index copyright-related indicators' scores and the Global Innovation Index 2018, Innovation Output subindex, Creative Output pillar, Online Creativity scores[22]

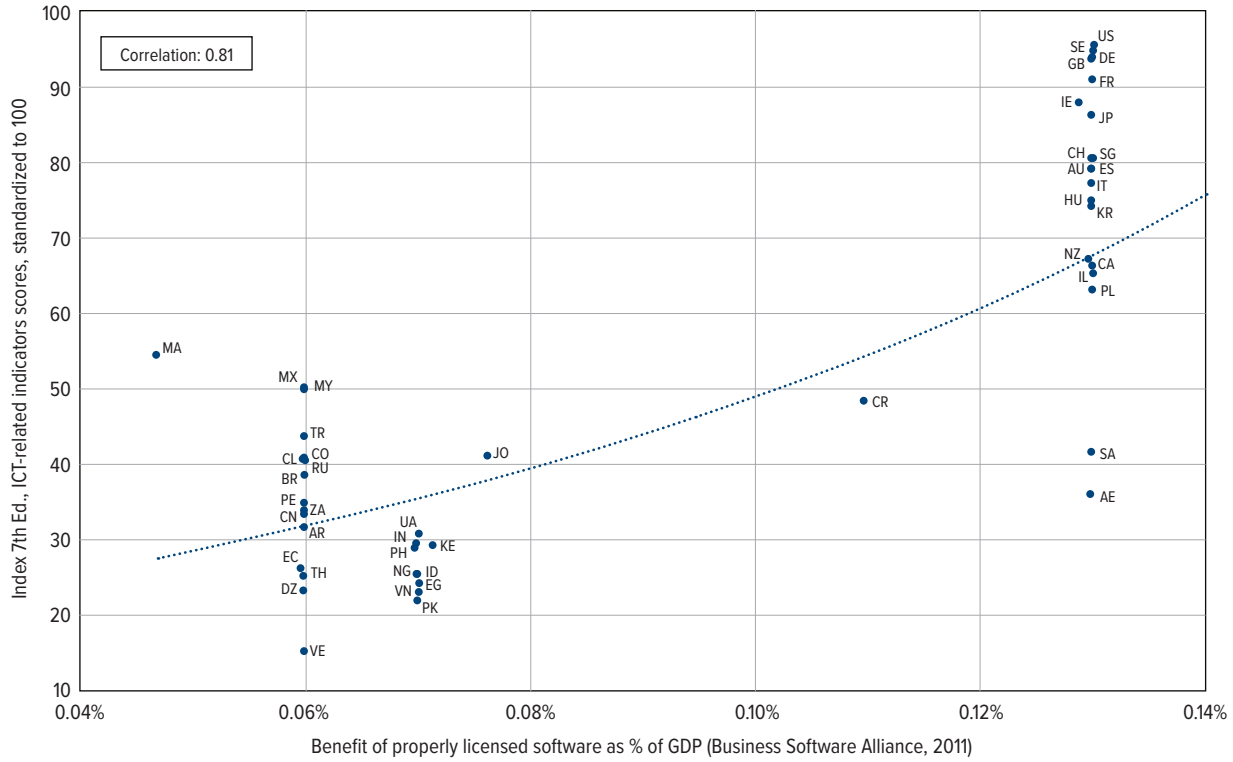


Source: Cornell/INSEAD/WIPO (2018); GIPC (2019)
Note: Data are not available for Brunei and Taiwan.

- The Index's copyright-related indicators' scores display a very strong relationship (at a correlation strength of 0.81) with online creativity as measured by the Global Innovation Index.
- Economies that provide and enforce strong copyright protection, including for digital and online works, generate over 4 times more online and mobile content, such as websites, applications, and audiovisual media than do economies with weak copyright protection.

IP Rights = Greater Added Value of Properly Licensed Software

Association between the Index scores on ICT-related indicators and the GDP benefit from a 1% increase in software use[23]

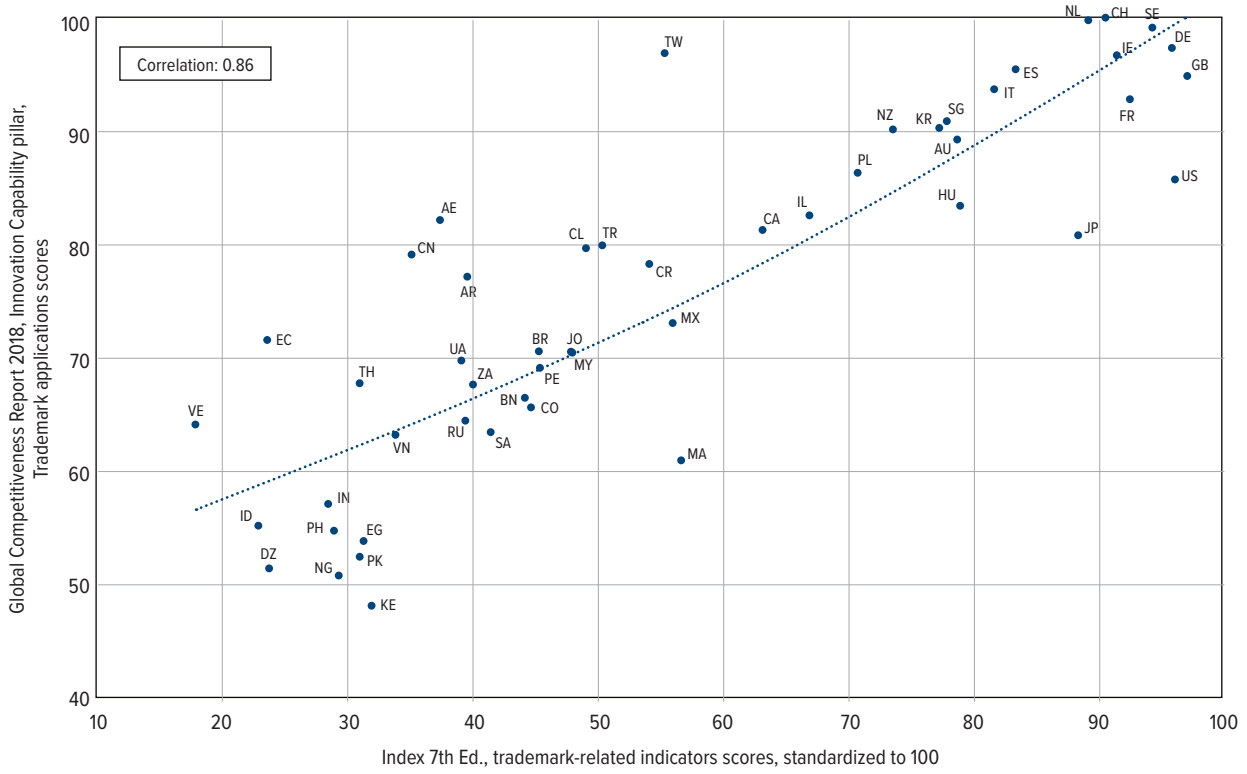


Source: Business Software Alliance/INSEAD (2013); GIPC (2019)

- The Index's ICT-related indicators scores are very strongly related to the benefits of properly licensed software as a percentage of GDP (a correlation strength of 0.81) as measured by BSA (Business Software Alliance) and INSEAD.

Strong IP Environments Promote International Brand Use

Association between the Index trademark-related indicators' scores and the *Global Competitiveness Report 2018*, Innovation Capabilities pillar, Trademark Applications scores[24]

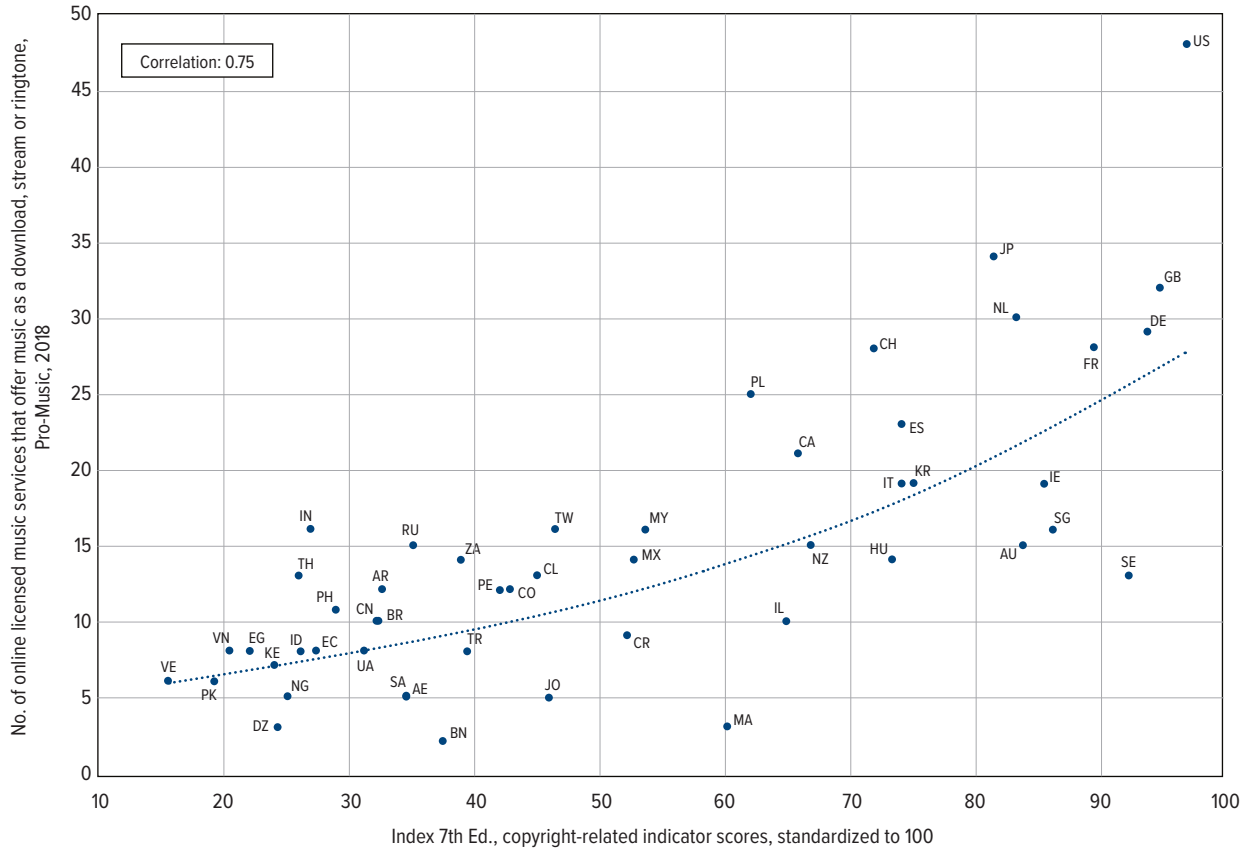


Source: World Economic Forum (2018); GIPC (2019)

- Obtaining international trademark protection and enforcing it across multiple jurisdictions requires significant financial resources; a high rate of international trademark applications provides a good indication of the quality and value of companies and products within a given economy. In other words, high rates of international trademark applications suggest high rates of international competitiveness linked with a given economy.
- The Global Competitiveness Index's Trademark Applications indicator—which offers a population-adjusted, standardized measure of international trademark applications—exhibits a very strong relationship (at a correlation strength of 0.86) with the Index's trademark-related indicators' scores.
- Economies with effective IP systems have significantly higher levels of international trademark applications than those whose IP regimes lag behind.

Strong Copyright Protection Encourages Increased Availability of Legitimate Online Music Outlets

Association between the Index copyright-related indicators scores and volume of licensed online music services[25]

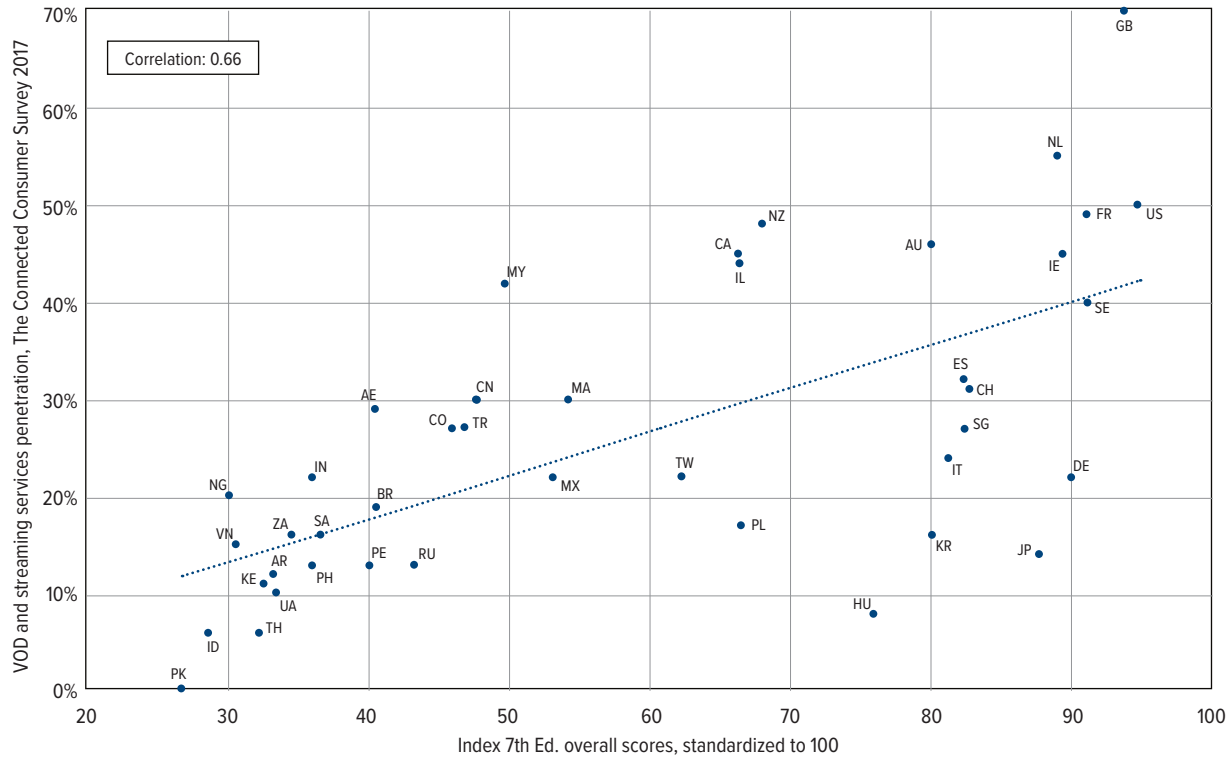


Source: Pro-Music.org (2018); GIPC (2019)

- There is a strong correlation of 0.75 between the Index's copyright-related indicators scores and the number of online licensed music services as measured by Pro-Music.org.[26]
- Economies that maintain robust copyright environments enjoy on average two to three times wider access to new music through legitimate and secure platforms.

Mature IP Environments Experience Wider and More Convenient Access to Video Content

Association between Index scores and video-on-demand (VOD) and streaming services penetration[27]

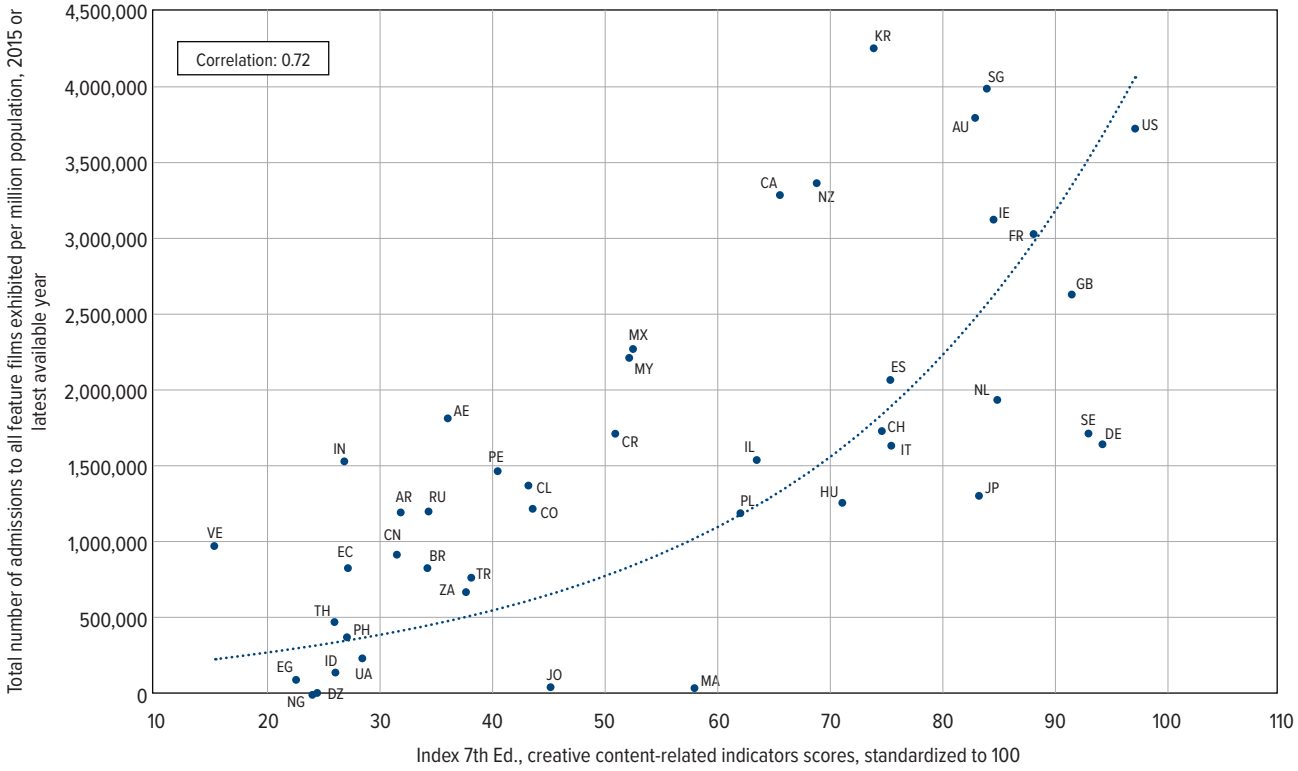


Source: Think with Google, The Connected Consumer Survey (2017); GIPC (2019)
Note: Data are not available for Algeria, Brunei, Chile, Costa Rica, Ecuador, Egypt, Jordan, and Venezuela.

- The Index scores present a strong association between rates of VOD and television streaming services penetration, as measured by The Connected Consumer Survey, with a correlation of 0.66.
- In economies that score above 50% on the Index, advanced and easy-access delivery of home entertainment tends to be available to 34% of the population, compared with only 17% in economies whose IP regimes require greater improvement.
- On average, nearly half of the population in the Index's top 5 economies benefit from access to exclusive global and national programming via advanced services such as VOD and streaming, as opposed to only 9% of the population in the Index's bottom 5 economies.

IP Protection Supports Wider Access to Audiovisual Content

Association between Index content–related indicators scores and the number of admissions to all feature films exhibited per million population[28]



Source: UNESCO Institute for Statistics (2018); GIPC (2019)
Note: Data are not available for Brunei, Kenya, Pakistan, Saudi Arabia, Taiwan, and Vietnam.

- Index scores on content-related indicators are strongly correlated with the quantity of theater admissions for feature films, with a correlation of 0.72.
- Top IP performers are likely to see 2.5 times more theater screenings of feature films—and generate more tax revenue from ticket sales—than countries with average or below-average Index scores.

ENDNOTES

1 K Schwab (December 12, 2015), "The Fourth Industrial Revolution: What It Means and How to Respond," *Foreign Affairs*, https://www.foreignaffairs.com/articles/2015-12-12/fourth-industrial-revolution

2 World Economic Forum, AT Kearney, *Readiness for the Future of Production Report 2018*, pp. 1–3.

3 The Driver of Production pillar within the Readiness for the Future of Production Index consists of 59 indicators within 11 subpillars nested under 6 key drivers: Technology & Innovation, Human Capital, Global Trade & Investment, Institutional Framework, Sustainable Resources, and Demand Environment. See World Economic Forum, *Readiness for the Future of Production Report 2018*, pp. 5–9.

4 The Technology & Innovation subpillar within the Readiness for the Future of Production Index measures economies' capacity to innovate and utilize new technologies in the value chains by gauging ICT availability and usage, digital security levels, R&D spending, and innovative outputs as well as the availability of venture capital and FDI in innovation. See World Economic Forum, *Readiness for the Future of Production Report 2018*, p. 21.

5 The Global Trade & Investment subpillar within the Readiness for the Future of Production Index measures economies' trade balance and infrastructure, logistic performance, availability of financial resources for the private sector, and volume of investments. See World Economic Forum, *Readiness for the Future of Production Report 2018*, pp. 46–47.

6 The Innovation Capability pillar in the World Economic Forum's *Global Competitiveness Report 2018* measures a wide array of indicators that influence economies' ability to generate innovative outputs, including R&D spending, multistakeholder collaboration in research, dispersion of specialized clusters, inventive activity, and buyer sophistication. See World Economic Forum, *The Global Competitiveness Report 2018*, pp. 641–642.

7 The Global Innovation Index Business Sophistication pillar is comprised of three subpillars: Knowledge Workers—measuring both inputs and outputs for human capital in the public and private sector; Innovation Linkages—measuring the levels of collaborative R&D activities; and Knowledge Absorption—measuring innovation capacity as well as attractiveness to foreign direct investments. See Cornell University, INSEAD, and WIPO (2018), *The Global Innovation Index 2018: Energizing the World with Innovation*.

8 The company R&D spending score is based on responses to the question, "In your country, to what extent do companies spend on research and development?" where 1 = do not spend on R&D and 7 = spend heavily on R&D (standardized to 100), in the World Economic Forum's *Global Competitiveness Report 2017–18*. Because this variable is no longer measured in the latest edition of the *Global Competitiveness Report* series, this edition of the Annex continues to use the data from the 2017–18 edition.

8 The IESE and EMYLON Business Schools' Venture Capital and Private Equity Country Attractiveness Index measures economies' attractiveness to venture capital and private equity funding by examining a range of factors, including the capital market, taxation environment, investor protection, entrepreneurial culture, and deal opportunities. See A Groh, H Liechtenstein, K Lieser, & M Biesinger, (2018), *The Venture Capital and Private Equity Country Attractiveness Index: 2018 Annual*. IESE Business School and EMYLON Business School.

19 The *Global Talent Competitiveness Index 2018*, by INSEAD Business School, the Adecco Group, and Tata Communications, is an international benchmark of 119 economies based on the policies and practices that enable an economy to develop, attract, and empower human capital, measuring both inputs—such as enabling landscape, market openness, quality of learning, and sustainability—and outputs—such as mid- and high-level skills and overall talent impact. See B Lanvin & P Evans, (Eds.), *The Global Talent Competitiveness Index 2018*. Fontainebleau, France: INSEAD, the Adecco Group, and Tata Communications,.

11 Scientific and technical journal articles refer to the number of scientific and engineering articles published in the fields of physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences in 2017 or the latest available year, adjusted per million population for 2017. Source: The World Bank. Life sciences–related indicators consist of indicators that fall under the Patent category of the GIPC Index (excluding patentability of computer-implemented inventions), as well as indicators in Trademarks and Trade Secrets, Market Access, Commercialization of IP Assets, Enforcement, Systematic Efficiency, and International Treaties categories that are relevant to life sciences (specifically 1–2, 4–8, 16–21, 22–24, 25–29, 31, 33–37, 38–39, and 43–45).

12 The Impact subindex of the Network Readiness Index measures economic and social impacts of ICT, including value added, employment, and access to public and private services. Source: World Economic Forum, INSEAD, *Global Information Technology Report and Network Readiness Index 2016*. ICT-related indicators consist of indicators that fall under the Patent, Copyright, Trademarks, and Trade Secrets categories, as well as relevant indicators in Enforcement and International Treaties (specifically 3, 8, 9–15, 20–21, 22–23, 25–28, 31–37, 42, and 44–45).

13 The ICT Development Index measures the level of ICT development across 176 economies by examining the availability of ICT infrastructure and access, level of ICT usage, and capability to use ICTs effectively, derived from relevant skills. Economies are benchmarked based on their ICT frameworks' readiness, usage, and impact on the economy. Source: International Telecommunications Union. ICT-related indicators consist of indicators that fall under the Patent, Copyright, Trademarks, and Trade Secrets categories, as well as relevant indicators in Enforcement and International Treaties (specifically 3, 8, 9–15, 20–21, 22–23, 25–28, 31–37, 42, and 44–45).

14 The recent edition of the Global Competitiveness Index—named GCI 4.0—has seen extensive revamping from its predecessor (*Global Competitiveness Report 2017–18*), with the addition of new concepts, benchmarks, and calculation methods. The overall score is based on 12 equally weighted pillars that reflect the extent and complexity of the drivers of productivity and competitiveness, including Institutions; Infrastructure; ICT Adoption; Macroeconomic Stability; Health; Skills; Product Market; Labor Market; Financial System; Market Size; Business Dynamism; and Innovation Capability. Source: World Economic Forum, 2018.

15 The Economic Complexity Index measures the multiplicity and complexity levels of the knowledge required to produce a given product and the level of its exports. A higher economic complexity coefficient entails higher capabilities to produce knowledge-intensive products as well as higher levels of productive outputs. See Observatory for Economic Complexity, Methodology, https://atlas.media.mit.edu/en/resources/methodology/

16 Innovative output is measured by the Global Innovation Index Innovation Output subindex score. The Innovative Output subindex accounts for knowledge and technology outputs; knowledge impact, including labor productivity and high-tech outputs; and the diffusion of knowledge, including high-tech and ICT exports as well as licensing fees and FDI outflows.

17 Triadic patenting (patents filed with the three major patent offices in the world—the USPTO, EPO, and JPO-- is generally considered to be the best indicator of the perceived overall value and quality of a patent. The patent application is filed in those three separate locations and filing costs are high. In this edition of the Statistical Annex, the triadic patent rates are calculated as the sum of triadic patents over a 10-year period from 2003 to 2013, adjusted per million population to get a standardized rate of triadic patenting intensity. Source: OECDStat, Patents by technology, Triadic patent families, Total patents, Inventor country of residence, Priority date, 2003 to 2013 inclusive; World Bank (Population). Patent-related indicators consist of indicators that fall under the Patent category of the Index, as well as those indicators in Trade Secrets, Commercialization of IP Assets, Enforcement, and International Treaties categories that are relevant to patents (specifically 1–8, 24, 25–26, 33, 35, and 44–45).

18 The share of a workforce employed in knowledge-intensive activities is measured by the sum of employees in categories 1 to 3 according to the International Standard Classification of Occupations as a percentage of total employed. Categories 1 to 3 in this classification include managers, professionals and associate professionals, legislators and senior officials, administrative and managerial workers, and clerical and related workers. Source: WIPO/INSEAD/Cornell, Global Innovation Index 2018.

19 Knowledge creation, impact, and diffusion is measured by the Global Innovation Index, Innovation Output subindex, Knowledge and Technology Outputs pillar score. This score comprises variables such as patenting activity, growth of high-tech businesses, and knowledge-based exports. Source: Global Innovation Index 2017.

20 Overall scores of Scientific American WorldView are based on performance in seven categories: Productivity, Intellectual Property Protection, Enterprise Support, Intensity, Education/Workforce, Foundations, and Policy and Stability. Source: Scientific American WorldView (2016). Life sciences–related indicators consist of indicators that fall under the Patent category of the GIPC Index (excluding patentability of computer-implemented inventions), as well as indicators in Trademarks and Trade Secrets, Market Access, Commercialization of IP Assets, Enforcement, Systematic Efficiency, and International Treaties categories that are relevant to life sciences (specifically 1–2, 4–8, 16–21, 22–24, 25–29, 31, 33–37, 38–39, and 43–45).

21 Creative output is measured by the score of the Creative Outputs pillar of the Global Innovation Index, Innovative Output subindex, which captures outputs such as exports of creative services, entertainment, media and ICT spending, and local creation of webpages and audiovisual content. Source: WIPO/INSEAD/Cornell, Global Innovation Index 2017. Copyright-related indicators consist of indicators that fall under the Copyright category of the GIPC Index, as well as those indicators in Commercialization of IP Assets, Enforcement, and International Treaties categories that are relevant to copyrights (specifically 9–15, 25, 27–28, 31–37, 42, and 45).

22 Online creativity is measured by the score of the Online Creativity subpillar of the Creative Outputs pillar under the Innovative Output subindex of the Global Innovation Index, which captures local creation of webpages and online audiovisual content. Source: WIPO/INSEAD/Cornell, Global Innovation Index 2017.

23 BSA/INSEAD (2013), *Competitive Advantage: The Economic Impact of Properly Licensed Software*.

24 The Global Competitiveness Index's Trademark Applications indicators measure the number of international trademark applications by country of origin, adjusted per million population and standardized by log transformation to a score of 0–100. See World Economic Forum, *The Global Competitiveness Report 2018*, p. 642. The Index's trademark-related indicators consist of indicators that fall under the Trademark category of the GIPC Index, as well as indicators in Commercialization of IP Assets, Enforcement, and International Treaties categories that are relevant to trademarks (specifically 16–21, 25, 27–28, 31, 33–37, 43, and 45).

25 The availability of licensed online music services is measured by the number of online licensed music services per country that offer music as a download, stream, or ringtone, based on information from local industry groups that is compiled by the International Federation of the Phonographic Industry. Source: Pro-Music.org (2017).

26 The Pro-Music organization divides digital music services into three types: "download stores," which enable online purchase and direct download of individual tracks or full albums (e.g., iTunes); "subscription services," which provide access to online libraries of music using paid subscriptions (e.g., Spotify, Deezer); and "advertising-supported services," which enable free listening of music and viewing of videos while the performers and copyright holders receive royalties through advertisements; see http://pro-music.org/digitalmusic-services.php

27 VOD and streaming services penetration is gauged by responses to the question, "Thinking about the last month, have you watched TV programs using VOD and streaming services?" in The Connected Consumer Survey 2017. Source: Google Consumer Barometer (2017).

28 Creative content–related indicators consist of indicators that fall under the Copyright category, as well as relevant indicators in Trade Secrets, Commercialization of IP Assets, Enforcement, and International Treaties (specifically 9–14, 22–23, 25, 27–28, 31, 33–37, 42, and 45).

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