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Content

Analysis of competitiveness of the postal services industry in Mongolia	1
Enebish Jambal, Oyuntungalag Yadamsuren, Oyuntungalag Buyantur, Sumjidmaa Tumurchudur, Tsolmon Jambal	
The development of e-commerce turnover in the Czech Republic during economic crises: a case study	16
Kristína Korená, Petra Pártlová, David Vyšín	
Rules for Expert Institutes' Work Procedures Ensuring Proper Performance of Expert Activities	37
Petr Ševčík	
Assessing factors Affecting Tax Compliance Intention	48
Galmandakh Urlee, Sumjidmaa Tumurchudur, Oyuntungalag Buyantur	
Effectiveness measurement for cleaning services	61
Ekaterina Chytilová, Petra Palmová	
Assessing Global Innovation Index: A Comprehensive Analysis of its Metrics, Methodology, and Implications	74
Gjergji Tafa, Besarta Tafa	
Multicultural Training as a Tool Increasing the Work and Management Efficiency in an International Environment: Qualitative Survey of Czech Businesses Experience	93
Jan Urban, Zdeněk Čaha, Michal Ruschak, Mario Bogdanović	

Assessing Global Innovation Index: A Comprehensive Analysis of its Metrics, Methodology, and Implications

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Abstract

The Global Innovation Index (GII) is a crucial instrument for evaluating and tracking innovation performance on a worldwide scale. This research article comprehensively

reviews the GII's metrics, methods, and implications. The study objective is to increase our knowledge of the GII and how it supports innovation-driven economic development.

The paper's introductory paragraphs explain the key components of the GII, including the inputs and outputs that support the innovation ecosystem. It looks at the many indicators used to gauge innovation, such as human capital, expenditure, infrastructure, and market sophistication. The benefits and drawbacks of the GII metrics are examined in this study.

Furthermore, the research delves into the methodology employed in constructing the GII, exploring the data collection process, weighting scheme, and aggregation techniques. This analysis provides insights into the index's reliability, validity, and comparability across countries and regions.

The implications of the GII are then discussed, focusing on its significance for policymakers, businesses, and researchers. The paper explores how the GII can serve as a diagnostic tool, helping governments identify strengths, weaknesses, and areas of improvement in their national innovation systems. Additionally, it examines how the GII can inform strategic decision-making for businesses seeking to invest in innovation-intensive sectors or expand their global reach.

Finally, the research paper concludes by highlighting potential avenues for future research, including the refinement of the GII metrics, the inclusion of emerging technologies, and the examination of the index's relationship with economic outcomes. By providing a comprehensive analysis of the GII, this research paper aims to contribute to the ongoing discourse on innovation measurement and policy

formulation, ultimately fostering an environment conducive to sustainable economic growth and prosperity.

Keywords: Global Innovation Index, economic development, policymakers, emerging technologies.

Introduction

In today's fast-paced global landscape, understanding innovation's role in economic development is crucial (Strakova et al., 2021a; Khyareh & Rostami, 2022). Central to this understanding is the Global Innovation Index (GII), a comprehensive tool for assessing global innovation performance. This research delves into the GII's metrics, methodologies, and real-world implications, aiming to illuminate its significance for policymakers, businesses, and researchers. The GII encompasses diverse metrics, from human capital investment to market infrastructure sophistication, providing a nuanced view of innovation ecosystems worldwide. However, it's not without limitations, which we'll carefully examine. We'll also dissect the GII's methodologies, analyzing data collection, weighting, and aggregation techniques to gauge its reliability and cross-country comparability. The GII's impact extends beyond rankings, influencing policy decisions and business strategies. Governments use it to pinpoint areas for development, while businesses leverage it to identify investment opportunities and navigate global markets effectively.

The Global Innovation Index (GII) is a tool that offers an in-depth view of countries' innovation performance and provides an understanding of the complex factors that influence this performance (Stojanović et al., 2022; Yu et al., 2021). To ensure its reliability and relevance, a GII assessment methodology that includes key processes such as data collection, indicator weighting, and aggregation is important (Talir et al., 2023; Alqararah, 2023). Regarding data collection, Huarng & Yu (2022) mention that data is collected from a variety of sources, including national statistical offices, international databases, and surveys conducted among enterprises, which ensures a comprehensive overview of the innovation environment in each country. The weighting of indicators reflects their relative importance to innovation performance, and the final aggregation of the weighted scores provides an index that allows for international comparison (Brás, 2023; Sicakyüz, 2023).

In the context of global comparisons, research by Oturakci (2023) has shown, based on statistical methods, that countries with high scores in the GII typically exhibit more robust economic growth. This fact was also confirmed by Bate et al. (2023) to identify key determinants of a country's innovation performance. Multi-stage and multi-modal analyses, including multiple linear regressions, hierarchical regression, and analysis of variance (ANOVA), were conducted to explore variations in innovation performance and

identify key determinants for each country category. The results showed that human capital, research, infrastructure, and entrepreneurial sophistication are the key pillars determining countries' innovation performance. They found that investment in key areas such as education, technological infrastructure, and R&D stimulates innovative activity, leading to the development of new technologies and productivity gains. In GII, authors Queirós et al. (2019) and Nasir & Zhang (2024) add that this relationship between innovation and economic growth is critical for policymakers seeking effective ways to boost economic dynamism in their countries.

For policymakers, the GII acts as an important analytical tool to identify the strengths and weaknesses of national innovation systems (Bakhtiar et al., 2022; Costa Cavalcante, 2024). Based on this analysis, they can design targeted policies that promote innovation in key sectors and facilitate the development of technology clusters (Pertas et al., 2022; Erdin & Çağlar, 2023). According to Auboin et al. (2021), through measures such as tax breaks, R&D subsidies, and support for start-ups, governments can effectively shape the domestic innovation environment, which has a direct impact on economic development. Moreover, the multi-criteria analysis of Aytekin et al. (2022) showed that an integrated approach to innovation policy that includes investments in education and research infrastructures can significantly improve a country's overall competitiveness. These investments not only promote the creation of new technologies but also increase the ability of the economy to absorb and commercialise innovations created elsewhere, contributing to more sustainable and diversified economic growth (Strakova et al., 2021b; Scaliza et al., 2022).

Emerging technologies that are considered a key element of the GII assessment, such as artificial intelligence, biotechnology, and renewable energy, represent dynamic fields that are transforming industries and opening up new opportunities for economic development (Abbasov, 2022; Ma et al., 2023). The authors, Dempere et al. (2023), used data from the Global Innovation Index (GII) and its components to show that countries successfully implementing these technologies typically achieve significant improvements in their global competitiveness. Novillo-Villegas et al. (2022) added that countries that actively promote collaborative projects between universities, industry, and government institutions achieve higher rates of technology transfer and faster commercialization of research outputs, further strengthening their economies.

Investments in human capital play a crucial role in GII and are considered to be the cornerstones of countries' ability to generate innovation. Creative and well-educated individuals are the engine for generating new ideas and technological innovation (Talir & Strakova, 2023; Borshch et al., 2023). Research conducted by Hung et al. (2021) shows that integrating international experts into national R&D teams can significantly increase innovation outputs and the commercialization of new technologies. This study highlights the importance of diversity and cross-cultural collaboration in innovation processes, which helps countries create sustainable competitive advantages on a global scale.

The advantages of these indicators lie in their ability to provide quantitative, measurable, and internationally comparable information that allows the identification of key strengths and weaknesses of national innovation systems (Alqararah & Alnafrah, 2024). However, these indicators also introduce some complexities, such as the challenges associated with interpreting data within different economic and cultural contexts, which can affect the way innovation activities are conducted and reported (Alidrisi, 2021; Fleacă et al., 2023). de Miranda et al. (2021) highlight the potential limitations arising from the use of secondary data and methods that can be a source of bias. This means that the interpretation of results, especially those related to the impact of GII on economic and market aspects, should be done with caution.

In conclusion, this paper highlights the GII's pivotal role in shaping innovation policy and fostering economic growth. By understanding its intricacies and implications, we pave the way for future research aimed at refining the index and enhancing its relevance in a rapidly evolving world.

Methods and Data

The Global Innovation Index is an annual ranking of countries by their capacity for, and success in, innovation, published by the World Intellectual Property Organization (WIPO). Many indicators affect the index like Innovation Input, Innovation Output, Institutions, Human capital and research, Infrastructure, Market sophistication, Business sophistication, Knowledge and technology outputs, and Creative outputs. For the purpose of this research study, we will take into consideration only three of them.

For technological development, the index “Knowledge and technology outputs”. For administration, and governmental development there will be used the index “Institutions” and for financial development, there will be used the index “Market sophistication”. Data available for all of these indicators are found in the report provided by the World Intellectual Property Organization (WIPO). This research intends to make a deep analysis of these data to see the relationship among the indicators and their effect on overall global development.

Each of the three indexes taken in the analysis is composed of many other subcategories which provide the overall evaluation of the main category of the index, as follows:

Knowledge and technology outputs

a. Knowledge creation

The Knowledge Index or KI is an economic indicator prepared by the World Bank Institute to measure a country's ability to generate, adopt and diffuse knowledge.

b. Patents by origin/bn PPP\$ GDP

c. PCT patents by origin/bn PPP\$ GDP

d. Utility models by origin/bn PPP\$ GDP

- e. Scientific and technical articles/bn PPP\$ GDP
- f. Citable documents H-index

Initially employed for a single scientist or scholar, the h-index is an author-level indicator that assesses the output and citation effect of the articles. The h-index is correlated with outward signs of achievement including receiving the Nobel Prize, getting chosen for research grants, and holding leadership positions at prestigious universities. The index is constructed using a combination of the scientist's most frequently referenced articles and the number of times those papers have been mentioned in other works. In more recent years, the index has been used to measure the output and influence of scholarly journals as well as a group of scientists, such as a department, university, or nation. Jorge E. Hirsch, a physicist at UC San Diego, proposed the index as a tool for evaluating the relative excellence of theoretical physicists and is referred to as the Hirsch index.

- g. Knowledge impact
- h. Labour productivity growth, %

Labour productivity represents the total volume of output (measured in terms of Gross Domestic Product, GDP) produced per unit of labour (measured in terms of the number of employed persons or hours worked) during a given time reference period.

- i. New businesses/the pop.
- j. Software spending, % GDP
- k. ISO 9001 quality certificates/bn PPP\$ GDP

The only family standard that outlines the specifications for a quality management system that can be certified to (although certification is not required) is ISO 9001. Every firm, no matter how big or little, regardless of their sector, may employ it. Over a million companies and organizations in more than 170 countries have obtained ISO 9001 accreditation.

Several quality management principles, including a clear customer focus, top management engagement and motivation, the process method, and continuous improvement, serve as the foundation for this standard. These concepts are explained in further detail by the quality management principles of ISO. Using ISO 9001 helps to ensure that customers obtain trustworthy, high-quality products and services, which has a number of advantageous impacts for organizations.

- l. High-tech manufacturing, %
- m. Knowledge diffusion

When knowledge or information is disseminated, it is made known to a large group of individuals or over a large geographic region. When an agent broadcasts his knowledge to the other agents with whom he is directly associated, knowledge dispersion occurs. When agents acquire new information and mix it with their already existing knowledge

stockpiles, knowledge generation occurs. As a result, network dependence is a need for both formation and spread.

n. Intellectual property receipts, % total trade

Charges for the use of intellectual property are payments and receipts made between residents and non-residents for the licensed use of proprietary rights (such as patents, trademarks, copyrights, industrial processes and designs, trade secrets, and franchises), as well as for the authorized use of these rights.

o. Production and export complexity

The Economic Complexity Index (ECI) is a powerful dimensionality reduction technique used to predict and explain future economic growth, income inequality, and greenhouse gas emissions.

p. High-tech exports, % total trade

q. ICT services exports, % total trade

Information and Communication Technology service” refers to forms of technology that are used to transmit, process, store, create, display, share or exchange information by electronic means.

Institutions

a. Political environment

The stability of the local administration is a crucial aspect to evaluate while analysing the political climate. Examine the nation's business-friendly policies as well, paying particular attention to things like taxation, anti-trust and competition legislation, union sway, and consumer protection rules.

b. Political and operational stability

Measures of perceived possibility of political instability and/or politically motivated violence, including terrorism, include Political Stability and Absence of Violence/Terrorism.

c. Government effectiveness

Perceptions of the calibre of public services, the calibre of the civil service and the extent of its independence from political constraints, the calibre of policy development and implementation, and the credibility of the government's commitment to such policies are all included in the category of government effectiveness. It is determined by the civil service's proficiency, the government's ability to carry out decisions effectively, the public sector's susceptibility to political pressure, and its capacity to deal with political changes without significantly altering existing policies or interrupting the provision of public services.

d. Regulatory environment

That area of the company's external marketing environment where political and legal pressures influence laws that have an impact on marketing efforts; changes to regulations may bring opportunities or dangers. The "command and control," performance-based, and management-based modes of regulation are the three primary types.

e. Regulatory quality

This indicator assesses the government's capacity to create and carry out sensible laws and regulations that support and encourage the growth of the private sector.

f. Rule of law

The political tenet of the rule of law is that all individuals and institutions within a nation, state, or community, including legislators and authorities, are subject to the same laws.

g. Cost of redundancy dismissal

Costs incurred when a position is eliminated or is no longer necessary, known as redundancy. After redundancy, the position/job leaves the organization. This might be due to corporate downsizing, closure, or just a lack of demand for the work

h. Business environment

i. Policies for doing business

j. Entrepreneurship policies and culture

Market sophistication

a. Credit

b. Finance for startups and scale-ups

c. Domestic credit to the private sector, % GDP

d. Loans from microfinance institutions, % GDP

e. Investment

f. Market capitalization, % GDP

The word "market capitalization" describes a company's value as decided by the stock market. The entire market value of all outstanding shares is how it is described. Investors can use it to determine how big a firm is in comparison to another. Because it represents the price investors are prepared to pay for a company's shares, market capitalization assesses a company's value on the open market as well as the market's opinion of its future prospects.

g. Venture capital investors, deals/bn PPP\$ GDP

Investors who join limited partnerships to combine investment funds are known as venture capitalists. They invest that money in fledgling businesses in exchange for ownership holdings in such businesses. Instead of investing early on, VCs often do so

once a firm has begun to generate income. New businesses that may not have access to stock markets or sufficient cash flow to incur loans, are those which receive the support of venture capital. Because both parties gain stock in prospective firms and businesses obtain the capital they need to get started, this arrangement may benefit both sides.

h. Venture capital received, value, % GDP

i. Trade, diversification, and market scale

The scale of the market is the proportion of customers who are appropriate for you and your service(s). You might have to guess, or guesstimate, certain statistics while thinking about the size of your market. This is OK, and as you advance, you may strive for better precision.

j. Applied tariff rate, weighted avg., %

The weighted average of the effective applied rates for all items subject to tariffs determined for all traded goods is known as the simple mean applied tariff. The Harmonized System of Trade is used to classify data at the six- or eight-digit level.

k. Domestic industry diversification

Economic diversification is characterized as a change toward a more diverse structure of domestic production and commerce to raise productivity, create employment, and laying the groundwork for long-term poverty reduction growth.

l. Domestic market scale, bn PPP\$

Results

In the report provided by the World Intellectual Property Organization (WIPO), this study takes into analysis 135 countries out of 195 in total in the world. Some of them are excluded due to the very low values of the indicators taken into analysis, and some others due to the inconsistency in providing timely information.

The analysis is done on a time frame of 10 years, starting from 2013 to 2020. The relevance of this analysis is thought to be valuable as this period includes the most important world event lately, as the pandemic of COVID 19. Moreover, given the rapid development especially referring to technology, ten years are considered relevant enough to drive some conclusions on the overall development and the predicted future challenges.

The first part consists on the analysis of top ten countries regarding the value of the Global Innovation index. It describes how this ranking has changed during the period of ten years, which of the countries have kept their position, have upgraded or downgraded accordingly, as well as any surprisingly derivating variable that might have been shown. (Tab. 1; Tab. 2; Tab. 3; Tab. 4; Tab. 5)

Tab. 1: Comparison of the global innovation index for the period 2013-2014

Year	2014	Year	2013
Indicator	Global Innovation Index	Indicator	Global Innovation Index
Switzerland	64.8	Switzerland	66.6
United Kingdom	62.4	Sweden	61.4
Sweden	62.3	United Kingdom	61.2
Finland	60.7	Netherlands	61.1
Netherlands	60,6	United States of America	60,3
United States of America	60.1	Finland	59.5
Singapore	59.2	Hong Kong	59.4
Denmark	57.5	Singapore	59.4
Luxemburg	56.9	Denmark	58.3
Hong Kong	56.8	Ireland	57.9

Source: Own.

Tab. 2: Comparison of the global innovation index for the period 2015-2016

Year	2016	Year	2015
Indicator	Global Innovation Index	Indicator	Global Innovation Index
Switzerland	66.3	Switzerland	68.3
Sweden	63.6	Sweden	62.4
United Kingdom	61.9	United Kingdom	62.4
United States of America	61.4	Netherlands	61.6
Finland	59.9	United States of America	60.1
Singapore	59.2	Finland	60
Ireland	59	Singapore	59.4
Denmark	58.5	Ireland	59.1
Netherlands	58.3	Luxembourg	59
Germany	57.9	Denmark	57.7

Source: Own.

Tab. 3: Comparison of the global innovation index for the period 2017-2018

Year	2018	Year	2017
Indicator	Global Innovation Index	Indicator	Global Innovation Index
Switzerland	68.4	Switzerland	67.7
Netherlands	63.3	Sweden	63.8
Sweden	63.1	Netherlands	63.4
United Kingdom	60.1	United States of America	61.4
Singapore	59.8	United Kingdom	60.9
United States of America	59.8	Denmark	58.7
Finland	59.6	Singapore	58.7
Denmark	58.4	Finland	58.5
Germany	58	Germany	58.4
Ireland	57.2	Denmark	58.1

Source: Own.

Tab. 4: Comparison of the global innovation index for the period 2019-2020

Year	2020	Year	2019
Indicator	Global Innovation Index	Indicator	Global Innovation Index
Switzerland	66.1	Switzerland	67.2
Sweden	62.5	Sweden	63.7
United States of America	60.6	United States of America	61.7
United Kingdom	59.8	Netherlands	61.4
Netherlands	58.8	United Kingdom	61.3
Denmark	57.5	Finland	59.8
Finland	57	Denmark	58.4
Singapore	56.6	Singapore	58.4
Germany	56.5	Germany	58.2
Republic Korea	56.1	Israel	57.4

Source: Own.

Tab. 5: Comparison of the global innovation index for the period 2021-2022

Year	2022	Year	2021
Indicator	Global Innovation Index	Indicator	Global Innovation Index
Switzerland	64.6	Switzerland	65.5
United States of America	61.8	Sweden	63.1
Sweden	61.6	United States of America	61.3
United Kingdom	59.7	United Kingdom	59.8
Netherlands	58	Republic of Korea	59.3
Republic of Korea	57.8	New Zealand	58.6
Singapore	57.3	France	58.4
Germany	57.2	Singapore	57.8
Finland	56.9	Dominican Republic	57.3
Denmark	55.9	Ghana	57.3

Source: Own.

Switzerland

As shown in the tables, Switzerland has always ranked the first in top ten countries for the value of the Global Innovation Index. It is the most innovative country and it has ranked as such for the twelfth time in a row, i.e. in the last twelve years. Switzerland will once again be the world's most inventive economy in 2022. This is the outcome of the World Intellectual Property Organization's (WIPO) annual Global Innovation Index (GII), which was released on September 29. This is the 15th year that it has been published, with the United States coming in second, followed by Sweden, the United Kingdom, and the Netherlands. Germany moved up two spots from last year to seventh place.

The index assesses innovation through factors such as institutes, people resources and research, infrastructure, investments, knowledge adaption and distribution, and creative performance. Switzerland's GDP performance is above forecasts, according to the country report. The balance is also beneficial in terms of the translation of innovation investments into innovation output.

According to Fobes (Konovalov, 2024), some of the primary factors that contribute to Switzerland being the most inventive country in the world are as follows:

1. The educational system: Zurich alone has over 22,000 students from more than 120 countries.
2. A political structure that "guarantees productive stability and allows the Swiss economy to thrive," according to Seedstars.
3. Investments: Total venture capital invested in businesses in 2021 will be €3.1 billion, up 44% from 2020.
4. R&D, world-class research institutes: Switzerland invested \$25.5 billion in R&D in 2019.
5. One of the country's benefits has been its geographical location.
6. Highly skilled overseas workers: According to the IMD 2021 World Talent Ranking 2021, Switzerland ranks first among the top ten economies.
7. Values such as creativity, uniqueness, and equality. Despite its achievements, the Swiss technology industry has space for improvement. Looking at how the world's most inventive countries may grow and progress can provide lessons for technology leaders and entrepreneurs all across the world.

United States of America

Recently the USA has ranked third on the Global Innovation Index, but prior it used to be in the fourth or fifth rank, preceded by the United Kingdom and sometimes the Netherlands. The main decline in the values of the index was observed in 2018 because of the rapid upgrade of the Netherlands and Singapore.

Immediately after this, the values of the Global Innovation Index show a huge increase and this is merely due to the measures taken by the government in the development of the technology of the country. The Bureau of Economic and Business Affairs started hosting regular Innovation Roundtables with the American corporate sector in 2018. To further American economic interests, this series examines the difficulties and chances presented by developing technology and the Information and Communication Technology (ICT) industry. The United States government is better able to comprehend cutting-edge technology when it is used more broadly thanks to increased participation and cooperation with the American private sector. Hearing directly from technology businesses' viewpoints during diplomatic discussions aids decision-makers in

formulating effective policy that preserves and expands the technical lead enjoyed by the United States.

There was a slight decrease in the index in 2020 due to the pandemic and after this, the index continued to increase recently. Nowadays the American economy leads the world in innovation. Global innovation and the creation of cutting-edge and new technology are driven by American businesses. The State Department is dedicated to breaking down obstacles abroad, safeguarding intellectual property, and keeping the United States on the cutting edge of technology. Giving academics, technical specialists, and business executives the tools, they need to take advantage of the enormous prospects in the digital economy is more crucial than ever. The Bureau of Economic and Business Affairs advocates for a level playing field so that American entrepreneurs and high-tech businesses can prosper in international markets. America has always been at the forefront of innovation worldwide and will keep empowering the American private sector to uphold that position. (Evaluation of Innovation Performances Using the Entropy Based Gray Relational Analysis Method: G7 Group Countries Example, 2020).

United Kingdom

The UK was also a country with a very high value on the Global Innovation Index. Ranking between third and fourth place, sometimes overrun by the USA and some other times by the Netherlands, it has shown to be one of the main drivers of innovation in the world. This position comes mostly as a reflection of the governmental measures to promote innovation and technology. Let's not forget also the role of education which is a big driver of tremendous developments worldwide.

What is surprising in the UK is that except for a slight increase in the year 2019, after the pandemic, the index showed a decline and it continued with the trend till the recent years. This pattern is the same as in Switzerland and Sweden. Is it possible that now the innovation is in the hands of the USA or probably there might be other new countries that are showing up their willingness and adaptability to innovation? This is yet to be seen and analyzed by scholars.

The credits of the United Kingdom as a runner of the innovation are directed but not limited to the following:

A global innovation centers

The United Kingdom is one of the most inventive nations in the world, ranking within the top five in the Global Innovation Index 2019. Many of the world's largest and most dynamic corporations, such as Google, Facebook, Amazon, and Coca-Cola, have chosen the United Kingdom as their European headquarters. In 2017, over 590,000 new businesses were established in the United Kingdom. According to Forbes, this reflects the UK's inventive spirit, enterprising workforce, and business-friendly atmosphere--the most business-friendly environment of Europe's major economies.

As a standard, excellence centers

The United Kingdom is home to four of the world's top 10 universities: Oxford, Cambridge, University College London, and Imperial College London, and is ranked second in the world for university excellence on the Global Talent Competitiveness Index (GTCI). What is the significance of this? The cutting-edge technology and knowledge accessible at these university and research centers attract innovative firms. According to the World Economic Forum, cooperation between academics and industry is the most successful of Europe's main economies since it is encouraged by the public sector. Universities not only produce the critical thinking required to improve company performance, but they also contain innovative R&D centers focused on commercializing innovations. The UK Government established the Global Entrepreneur Programme (GEP) to encourage ambitious entrepreneurs to extend their businesses from the UK in an effort to accelerate the rate of innovation.

Tax benefits for entrepreneurs

Foreign-owned enterprises account for more than half of all R&D company expenditure in the UK. This is due in part to the UK's significant financial and tax incentives for innovation. Small and medium-sized enterprises can benefit from venture capital programs, which provide large tax breaks for investors and contribute to the UK being the finest environment in Europe to start, fund, and build a firm. The R&D expenditure tax credit provides enterprises engaging in UK R&D projects with attractive incentives of up to 230%.

Keep your thoughts safe

Apart from the United States, the United Kingdom boasts a world-class intellectual property framework that has produced 78 Nobel Prize winners in scientific fields. This intellectual property regime safeguards innovators' names, ideas, products, designs, and written words. The UK Patent Box also provides corporations with a corporation tax rate of 10% on income from ideas patented in the UK, as opposed to the existing rate of 19%. If you have an invention or idea and are contemplating investing in the UK, our UK Investment Support Directory will help you identify a legal IP specialist.

Government assistance for your business

Innovate UK, the UK government's innovation agency assists businesses in developing new ideas and commercializing them. It can assist you with obtaining funding, connecting with researchers and other collaborators locate prospective clients and foreign partners to collaborate on innovations. Innovate UK has helped a lot of firms expand and is a fantastic source of support for business innovation.

Create world-class infrastructure by innovating.

The UK's digital infrastructure network supports a software and technology industry greater than the rest of Europe combined, with the finest superfast internet service of any major European country. The United Kingdom ranks first in the World Economic Forum's Networked Readiness Index 2016, which assesses a country's ability to employ information and communication technologies to enhance economic and social well-

being. Furthermore, the UK invests £6 billion per year in research councils and universities, while a network of Catapult Centers assists emerging technologies in becoming commercially viable. (Innovation's Performance: A Transnational Analysis Based on the Global Innovation Index, 2024).

The Netherlands

The trend of the Global Innovation Index of the Netherlands has been the same as the three above-mentioned countries. It reached its peak in 2017 and could rank second in 2018 but it is surprisingly downgraded in 2021. This year ranks better than the Netherlands, which continues to upgrade. The other five positions are interchanged through the years among the Republic of Korea Finland, Denmark, Singapore, and Germany.

Dutch advantages

The Netherlands, in particular, performs well in terms of business sophistication, placing first in this area. Other areas where the country excels include knowledge and technology outputs and creative outputs, where it ranks second and third, respectively. In addition to the three highly ranked pillars, the logistics performance indicator and the sub-pillars of information and communication technology and business environment show strength. The Netherlands also outperforms the top 25 GII economies in the sub-pillars of education, knowledge absorption, online creativity, and knowledge dissemination, among other things.

Weaknesses in the Netherlands

In terms of shortcomings, in the Netherlands, they tend to be reserved for specific indicators, such as the ease of obtaining credit and the cost of redundancy dismissal, wage weeks. The exception is the postsecondary education sub-pillar, which is regarded as a weakness.

Republic of Korea

Korea's Clean Energy Technology Roadmap identifies milestones for clean energy technology development to attain a low-carbon society, and it aids in the realization of the Korean government's energy policy objectives. To refocus Korea's energy R&D on clean energy, the Clean Energy Technology Development Strategy was established by 7 government ministries, including the Ministry of Trade, Industry, and Energy and the Ministry of Science, ICT, and Future Planning, as well as approximately 200 experts from industry, academia, and research institutes. The program envisions "converting the new climate regime crisis into an opportunity for economic growth through clean energy technology innovation." The roadmap's objectives are as follows: 1) reacting to climate change through reducing greenhouse gas emissions 2) generating new energy firms, and 3) propelling global technological innovation.

Strategies:

Utilize innovative technologies and technological convergence to enter the new market.

They intend to disrupt the existing market by introducing breakthrough technologies that increase performance, reduce costs, and hasten commercialization. Furthermore, by collaborating with the humanities and social sciences, we will increase social acceptance, allowing energy research and development to enter the market. The confluence of energy technology and other technologies will overcome the "Valley of Death" and the "Darwinian Sea," i.e. market penetration failure.

Implement new regulations from the government about the energy sector.

The Korean government is trying to launch a new energy industry. To achieve Korea's goal of lowering greenhouse gas emissions and developing a future development engine based on energy prosumers, low-carbon generation, electric cars, and eco-friendly processes, the "2030 Strategy for Boosting New Energy Industry" was established in November 2015. A new investment plan in the energy industry has also been developed by KEPCO (Korea Electric Power Corporation) which includes smart meters, frequency-controlling ESS, electric vehicle charging stations, and energy big data. The plan will be carried out by these rules.

Reduce time to commercialization with demonstrations abroad

The development of certification standards and demonstration programs will start at the R&D stage to speed up the time it takes for new technologies to reach the market. Enhancements will be made to international demonstrations depending on local and regional settings. For instance, we will carry out our customized power system demonstration, which conforms with local legislation, policies, markets, and power grids, through smart-city demonstration, which represents the varied urban features of each city.

Establish a renewable energy business ecosystem with people from diverse areas.

For distributed energy transactions, we require an energy platform that considers users, power capacity, and energy suppliers. The involvement of numerous industry participants, including electronics manufacturers, solution providers, and IT firms, will result in the expansion of the clean energy sector's ecosystem. Additionally, we will require established businesses to participate in materials technology for the new energy industries.

Conclusion

The comprehensive analysis of the Global Innovation Index (GII) presented in this paper sheds light on its metrics, methodology, and implications for innovation-driven economic development. Through an exploration of the GII's components, including inputs and outputs, various indicators used for evaluation, and the methodology behind its construction, this research provides valuable insights into the index's reliability, validity, and utility for cross-country comparisons.

One of the key takeaways from this analysis is the significant role of the GII in informing policy decisions, guiding strategic investments, and fostering innovation ecosystems worldwide. Governments utilize the index as a diagnostic tool to identify strengths and weaknesses in their national innovation systems, while businesses leverage it to identify investment opportunities and navigate global markets effectively.

The study also highlights the limitations of the GII, acknowledging areas for improvement such as the inclusion of emerging technologies and the refinement of metrics to better capture innovation dynamics. Moreover, it underscores the importance of ongoing research to enhance the relevance and applicability of the index in a rapidly evolving global landscape.

Looking ahead, the paper identifies potential avenues for future research, emphasizing the need for continued refinement of GII metrics, exploration of the index's relationship with economic outcomes, and consideration of emerging trends in innovation. By contributing to the ongoing discourse on innovation measurement and policy formulation, this research aims to foster an environment conducive to sustainable economic growth and prosperity.

In conclusion, the comprehensive analysis presented in this paper underscores the pivotal role of the Global Innovation Index in shaping innovation policy and driving economic development. By understanding its intricacies and implications, policymakers, businesses, and researchers can work together to harness the power of innovation for the benefit of society as a whole.

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