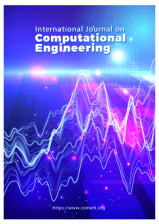
International Journal on Computational Engineering

Journal Homepage www.comien.org/index.php/comien



Global Innovation Index for Different Country Groups: Opportunities and Challenges

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***Abstract*—Innovation and the introduction of technological changes allow countries to transform the production of goods and the provision of various services, both in the private sector of the economy and in the sphere of governmental services. Innovative technologies and artificial intelligence are becoming the main factors of competition between countries. While production processes are gradually being rebuilt to a new technological mode, there is already a significant increase in the digitalization of business processes and services, which leads to the emergence of new business models and types of economic activity. The objective of this study is to analyze the disparities in innovation development across countries based on GII 2023 data and assess the challenges and opportunities for Armenia and its neighboring countries in enhancing their innovation potential. The research is conducted using a comparative analysis methodology, relying on data from the WIPO 2023 report. It involves statistical comparisons and the calculation of averaged indicators for different country groups to identify key trends and patterns. The findings of GII 2023 highlights significant disparities in innovation development, with top-performing countries excelling in institutional stability, human capital, and technological progress, while Armenia, its neighboring countries, and the EAEU/CIS region exhibit comparatively low scores, indicating slower scientific and technological advancement. This underscores the need for targeted policies to foster innovation and bridge the growing gap in global competitiveness.**

***Keywords*—Economic competitiveness; Global Innovation Index (GII); human capital; technological infrastructure; promotion of innovations; economic growth.**

Manuscript received 6 Jan. 2025; revised 17 Jul. 2025; accepted 24 Sep. 2025. Date of publication 31 Dec. 2025.

I. Introduction

Innovation is considered one of the key factors ensuring economic growth and competitiveness in the modern world. Promoting technological progress, research and development (R&D), and adopting of new technologies enables countries to improve economic growth, living standarts of population and obtain competitive advantages. Global Innovation Index (GII) is widely used tool for assessing and comparing innovation policies, technological potential, and economic development levels across different countries. It also provide the certain methodology of calculation of the index.

The results of GII 2023 indicate significant disparities in countries' innovation capabilities. Switzerland, Sweden, and the United States remain among the leading nations, where institutional stability, R&D expenditures, and technological innovations drive economic growth. At the same time, developing countries, particularly some nations in the Commonwealth of Independent States (CIS), the Eurasian Economic Union (EAEU), and parts of Africa, face considerable challenges in developing innovation infrastructure, navigating market complexities, and fostering knowledge and technological advancements.

The primary objective of this study is to conduct a comparative analysis of the average GII 2023 indicators to identify regional differences in innovation and evaluate their impact on economic performance. The analysis is based on key indicators such as existing institutions, human capital, market infrastructure, implementation of technology, development of knowledge and creative thinking.

This study highlights that innovation is not only a measure of technological progress but also a crucial driver of economic and social reforms. Therefore, governments must actively invest in R&D, technological infrastructure, and the development of education systems to ensure competitiveness and sustainable economic growth.

II. Material and Methods

Innovation is one of the most essential components of modern economies, driving economic growth, competitiveness, and technological progress [1]. It plays a particularly important role for post-Soviet countries, which have transitioned from a centrally planned economy to a market-based model but still face systemic challenges.

The development of theory of innovation began with Schumpeter, who defined innovation as "creative destruction". He claimed that economic growth mainly depends on technological changes occurring in the country. [1]. Later, Freeman [2], Lundvall [3], and Nelson [4] introduced the National Innovation Systems (NIS) theory, which suggests that a country's innovation progress depends on the interaction between research institutions, the education system, and the business environment.

In former Soviet Union countries, innovation policies are largely dependent on state support and international cooperation, reflecting the unique characteristics of transition economies [5].

Various indicators are used to measure innovation. The Global Innovation Index (hereafter - GII) is the widespread method which examines both the composition and calculation methods of indicator. This complex indicator combines both - innovation inputs (education, governance, market and business environment) and innovation outputs (knowledge production, technological development, and creative results) [6].

Other assessment methods include the European Innovation Scoreboard (EIS), which focuses on comparing EU countries, and the Bloomberg Innovation Index, which highlights the role of high-tech industries.

Estonia, Latvia, and Lithuania are the innovation leaders in the region. Estonia serves as a global example of a digital economy, where digital governance and e-government services play a significant role [7]. Lithuania and Latvia are developing their technological ecosystems by promoting startups and implementing educational reforms [8]. Ukraine, formerly one of the technological hubs of the USSR, is currently facing challenges caused by the war, which impact its research and development (R&D) potential [9].

Armenia and Georgia are fostering technological entrepreneurship; however, issues related to education and financing still persist [10]. Azerbaijan, Kazakhstan, and Uzbekistan are investing in the technology sector, but complexities in the market and investment environment limit their development [11].

According to international studies, the main challenges in the region include:

- **Lack of investment**: According to the World Bank [12], R&D funding in post-Soviet countries is below the global average.
- **Weak governance**: Complex administrative structures in state institutions hinder the promotion of innovation [5].
- **Brain drain**: Many specialists migrate to more competitive markets, affecting the scientific potential of the region [13].

GII 2023 evaluates the level of innovation in 132 countries using two main groups of indicators:

Innovation Inputs – These include the internal conditions of the economy that foster innovation (e.g., institutions, human capital, market, and business environment).

Innovation Outputs – These reflect the outcomes of knowledge and technology creation, as well as the development of creative industries.

This methodology enables the comparison of countries across various criteria, not only in terms of economic strength but also in terms of the effectiveness of innovation policies.

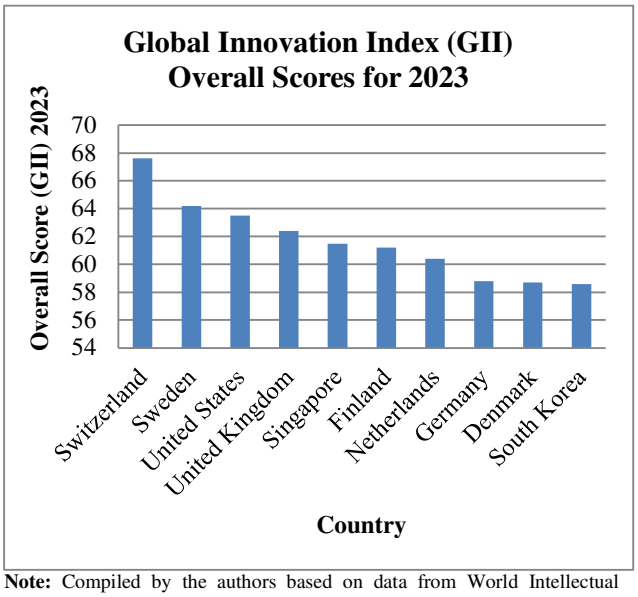
GII 2023 is calculated based on seven main subcategories, which are divided into the two primary groups: Innovation Inputs and Innovation Outputs.

The final score of GII is computed using the following formula, which consider country's conditions for innovations and results obtained:

$$GII = \frac{(Innovation\ Input\ Sub-Index + Innovation\ Output\ Sub-Index)}{2}$$

III. Result and Discussion

According to the 2023 edition of the Global Innovation Index (GII), Switzerland continues to hold the title of the most innovative country in the world (see Figure 1), maintaining this position for 13 consecutive years. The country is particularly strong in the field of research and development (R&D), ranking third globally and achieving high positions in innovation outputs such as intellectual property rights and new technologies. More than two-thirds of Switzerland's R&D expenditures come from the private sector, which significantly contributes to its leadership in innovation.



Note: Compiled by the authors based on data from World Intellectual Property Organization [14]. Global Innovation Index 2023: Innovation in the Face of Uncertainty. Geneva: WIPO. Available at: https://www.wipo.int/global_innovation_index/en/

Fig. 1 Top 10 Most Innovative Countries According to GII 2023

In the 2023 Global Innovation Index (GII), the lowest-ranking countries (10 least innovative countries in the world include Angola, Niger, Burundi, Mali, Guinea, Mauritania, Mozambique, Ethiopia, Burkina Faso, Cameroon) share common challenges, including weak educational systems,

low levels of research and development (R&D) activity, lack of technological infrastructure, and an unstable investment environment.

Table 1 presents the innovation development rankings of the former Soviet Union countries according to GII 2023.

TABLE I
INNOVATION DEVELOPMENT RANKINGS OF FORMER SOVIET UNION COUNTRIES ACCORDING TO GII 2023

Country	Overall Score (GII) 2023	Institutions Ranking (GII) 2023	Human Capital & Research Ranking (GII) 2023	Infrastructure Ranking (GII) 2023	Market Sophistication Ranking (GII) 2023	Business Sophistication Ranking (GII) 2023	Knowledge & Technology Outputs Ranking (GII) 2023	Creative Outputs Ranking (GII) 2023
Estonia	53.4	11	34	5	5	25	20	15
Lithuania	42	19	42	43	34	35	29	41
Latvia	39.7	39	43	33	61	37	49	31
Russia	33.3	110	26	72	56	44	54	53
Ukraine	32.8	100	47	77	104	48	45	37
Georgia	29.9	25	69	80	77	58	72	81
Armenia	28	69	92	79	89	94	67	61
Belarus	26.8	128	37	71	99	74	47	88
Kazakhstan	26.7	61	59	59	87	75	83	90
Uzbekistan	26.2	55	89	73	69	78	78	93
Azerbaijan	23.3	42	87	95	85	64	114	100
Kyrgyzstan	20.2	122	49	92	71	114	96	116
Tajikistan	18.3	90	99	122	94	110	85	123

Note: Data for Turkmenistan and Moldova are unavailable.
Source: Compiled by the authors based on Global Innovation Index 2023 [14].

According to the 2023 Global Innovation Index (GII), the former Soviet Union countries exhibit significant differences in terms of innovation. These countries can be categorized into three main groups: leaders, moderately developed countries, and laggards.

Estonia (53.4 points) is the clear innovation leader in the region. The country has successfully implemented digital governance, developed high-tech industries, and established efficient infrastructure. Lithuania (42.0) and Latvia (39.7) also hold strong positions, though they lag behind Estonia in certain areas.

These countries have managed to build a stable economic environment, develop their education systems, and attract investments in the technology sector.

Russia (33.3) and Ukraine (32.8) possess strong scientific and technological potential but face challenges in governance, investments, and infrastructure. Georgia (29.9) and Armenia (28.0) show some potential for innovation development but require improvements in the education system and investment environment.

The main barriers to innovation in these countries are limited funding opportunities, insufficient support for research and development (R&D), and challenges in the business environment.

The lowest-ranked countries in the region are Belarus (26.8), Kazakhstan (26.7), Uzbekistan (26.2), Azerbaijan (23.3), Kyrgyzstan (20.2), and Tajikistan (18.3). These countries have underdeveloped education systems, low R&D investments, and restricted business and technological progress.

Tajikistan and Kyrgyzstan rank at the bottom, primarily due to poor infrastructure and weak development in knowledge and technology outputs.

The analysis of GII 2023 indicates that innovation development is highly uneven worldwide. Leading countries (Switzerland, Sweden, the United States) have a stable institutional environment, a well-developed research base, and high-tech and creative outputs. OECD and EU countries also maintain innovation competitiveness. Meanwhile, the EAEU, CIS, and countries with the lowest innovation levels lag significantly behind in the path of innovation development (Table 2).

TABLE II
COMPARATIVE ANALYSIS OF THE INNOVATION ENVIRONMENT OF WORLD COUNTRIES AND VARIOUS GROUPS BASED ON AVERAGE INDICATORS (GII 2023)

Country	Overall Score (GII) 2023	Institutions Ranking (GII) 2023	Human Capital & Research Ranking (GII) 2023	Infrastructure Ranking (GII) 2023	Market Sophistication Ranking (GII) 2023	Business Sophistication Ranking (GII) 2023	Knowledge & Technology Outputs Ranking (GII) 2023	Creative Outputs Ranking (GII) 2023
Top 10	61.69	12.90	6.30	9.70	11.20	7.30	6.70	8.80
OECD (38)	48.64	33.03	26.79	26.95	35.13	25.63	25.45	27.24
Central & Southern Europe (17)	48.39	35.24	25.35	27.12	42.47	25.59	23.65	23.41
EU (27)	47.47	35.56	30.07	25.26	41.85	27.22	24.33	26.11
World (131 countries)	32.51	66.27	66.50	66.44	66.43	66.24	66.55	76.13
Former Soviet Union (13)	30.82	67.00	59.46	69.31	71.62	65.85	64.54	71.46
Armenia & Neighboring Countries (5)	29.98	74.40	69.80	80.20	61.20	75.80	70.40	62.40
EAEU (5)	27.00	98.00	52.60	74.60	80.40	80.20	69.40	81.60
CIS (8)	25.35	84.63	67.25	82.88	81.25	81.63	78.00	90.50
10 least innovative countries	13.26	105.00	119.60	124.50	123.90	119.40	117.90	124.60

Source: Calculated by the authors based on Global Innovation Index 2023 data [14].

For Armenia and neighboring countries, key challenges remain the creation of knowledge, the improvement of markets, and infrastructure development. EAEU countries have a lower innovation environment, which hinders regional progress. The results of GII 2023 can serve as an important guideline for policy development and the implementation of innovation reforms, especially in countries that significantly lag behind the global average indicators.

The average GII 2023 score of the top 10 countries is 61.69, which significantly exceeds the OECD average of 48.64. The top 10 outperform OECD countries in all categories, particularly in institutions (12.90), human capital (6.30), and knowledge and technology outputs (6.70). While OECD countries have a sufficiently developed institutional environment and infrastructure, they lag significantly behind the global leaders in technological outputs.

The average score of the 27 EU countries is 47.47, which is close to the indicators of Central and Southern Europe (48.39) and OECD countries (48.64). These regions have a relatively stable economic environment, well-developed human capital (30.07 for the EU), and market sophistication (41.85 for the EU, 42.47 for Central and Southern Europe). However, their technological output scores (24.33 for the EU, 23.65 for Central and Southern Europe) are lower than the 6.70 score of the top 10, indicating a more modest pace of technological progress. The global average GII 2023 score is 32.51, which is significantly lower than that of OECD, EU, and Central and Southern European countries. The world lags significantly behind in institutions (66.27), human capital (66.50), and technological progress (66.55). This indicates that most developing countries still face serious obstacles to innovation growth.

The former Soviet Union (FSU) countries have an average GII score of 30.82, which is slightly below the global average. These countries show relatively high scores in market sophistication (71.62) and business sophistication (65.85), but their rankings in human capital (59.46) and infrastructure (69.31) are lower. This indicates that despite economic reforms, the FSU countries still lag significantly in technological advancement and the development of innovation infrastructure.

The average GII score for Armenia and neighboring countries is 29.98, slightly below the global average but higher than that of the EAEU or CIS. In this region, market sophistication (61.20) is higher than in the FSU, but infrastructure (80.20) and human capital (69.80) scores are lower, highlighting challenges in knowledge creation and dissemination.

The EAEU countries have an average score of 27.0, which is relatively low compared to other regions. Their business sophistication (80.20) and market sophistication (80.40) scores are low, indicating significant economic barriers in these countries.

The CIS countries have an average GII score of 25.35, one of the lowest among all regions. Their institutional (84.63), infrastructure (82.88), and technological output (78.00) scores

are weak, suggesting that greater investment is needed to foster innovation development. The bottom 10 countries have an average GII 2023 score of just 13.26. These nations rank at the lowest level of innovation development, with extremely weak institutions (105.0), human capital (119.6), and technological progress (117.9).

IV. Conclusion

The analysis of GII 2023 reveals significant disparities in innovation development among countries. The top 10 and OECD countries outperform all other groups, particularly in institutional stability, human capital, and technological advancement. The EU and Central and Southern European countries are at a relatively high level but still lag behind the top 10. The average GII scores of Armenia and its neighboring countries, as well as those of the EAEU and CIS, remain comparatively low, indicating a slow pace of scientific and technological development in the region. The scores of the bottom 10 countries suggest that innovation development is nearly absent in certain nations, leading to serious economic and social challenges.

The results of GII 2023 serve as an essential guideline for shaping innovation policies, particularly in countries that significantly lag behind the global average indicators.

The analysis highlights that innovation plays a crucial role in driving economic growth, competitiveness, and sustainable development. However, the differences in innovation potential among countries are substantial and influenced by various factors. The main factors are institutional stability, quality of human capital, quality of market regulations and infrastructure development, and ability of adoption of new technologies. GII 2023 underscores the growing innovation gap between countries. Those investing in research and development, high-tech advancements, and human capital growth achieve better economic outcomes. Meanwhile, countries that fail to establish a stable institutional environment and support science and technology development fall behind in global competition.

For Armenia and other countries in the region, accelerating innovation development could serve as a key driver of economic progress, ensuring long-term economic growth and global market competitiveness.

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