ÜƏMT QLOBAL İNNOVASIYA İNDEKSİNİN İNNOVASİYA GÖSTƏRİCİSİ KİMİ EFFEKTİVLİYİ: CƏNUBİ QAFQAZ VƏ SEÇİLMİŞ LATIN AMERİKASI ÖLKƏLƏRİNİN Qİİ MƏLUMATLARININ TƏHLİLİ

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Xülasə

Tədqiqat işi 2013–2023-cü illər ərzində Cənubi Qafqaz və Latın Amerikası ölkələrinin seçilmiş qrupuna aid Qlobal İnnovasiya İndeksi (Qİİ) məlumatlarının hərtərəfli və sistemli təhlilini təqdim edir. Müxtəlif innovasiya sistemləri üzrə nəticələrin müqayisəliliyini təmin etmək və məlumatların normallaşdırılmasına şərait yaratmaq məqsədilə geniş ölkə seçimi aparılmışdır. Tədqiqat milli innovasiya ekosistemlərinin güclü və zəif tərəflərini araşdırır və vahid ölkələrarası müqayisələrin çətinliklərini Qİİ-nin standartlaşdırılmış və beynəlxalq səviyyədə tanınmış çərçivəsindən istifadə etməklə aradan qaldırır. Avropa Komissiyasının *Avropa İnnovasiya Cəvəli* metodologiyasına uyğunlaşdırılmış qabaqcıl statistik üsullara əsaslanaraq, seçilmiş ölkələrin göstəriciləri qiymətləndirilmiş, onlar innovasiya kateqoriyalarına təsnifləşdirilmiş və siyasət inkişafı üçün elmi əsaslara söykənən nəticələr əldə edilmişdir. Bu tədqiqatın fərqləndirici cəhəti iki coğrafi və iqtisadi baxımdan müxtəlif regionun müqayisəli araşdırılmasında cəmləşməsi və bununla da innovasiya yönümlü inkişaf üçün yeni və praktik siyasət tövsiyələri irəli sürməsidir. Təhlil Qİİ-nin əsas komponentlərini parçalayaraq onların həm güclü, həm də zəif tərəflərini üzə çıxarır və kontekstə uyğun tövsiyələr təqdim edir. Tədqiqat seçilmiş ölkələrin sıralanması ilə tamamlanır və milli, həmçinin regional innovasiya siyasətinin formalaşdırılması üçün dəyərli töhfə verir. Müəlliflərin məlumatına görə, bu, Cənubi Qafqaz ölkələrinin innovasiya göstəricilərini Latın Amerikası ölkələrinin nəticələri ilə sistemli və aydın şəkildə müqayisə edən ilk elmi araşdırmadır.

***Açar sözlər:** Qİİ, innovasiya, Latın Amerikası, Qafqaz, innovasiya performansı*

THE EFFECTIVENESS OF THE WIPO GLOBAL INNOVATION INDEX AS AN INNOVATION INDICATOR: ANALYSIS OF GII DATA FOR SOUTH CAUCASUS AND SELECTED LATIN AMERICAN ECONOMIES

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Abstract

This study presents a comprehensive and systematic analysis of the Global Innovation Index (GII) data for selected countries in the South Caucasus and Latin America over the period 2013–2023. A broad set of countries was included to allow for data normalization and ensure comparability of results across different innovation systems. The research examines the strengths and weaknesses of national innovation ecosystems and addresses the challenges of uniform cross-country comparisons by employing the GII as a standardized and internationally recognized framework. Drawing on advanced statistical techniques adapted from the European Commission's *European Innovation Scoreboard* methodology, the study evaluates the performance of the selected countries, classifies them into innovation categories, and provides rigorous evidence-based insights for policy development. A distinctive contribution of this research lies in its comparative focus on two geographically and economically diverse regions, thereby generating novel and actionable policy implications for innovation-driven growth. The analysis further disaggregates the main components of the GII to reveal both their enabling factors and inherent limitations, and formulates context-specific recommendations. The study concludes by ranking the selected countries, offering valuable input for national and regional innovation policy design. To the best of the authors' knowledge, this is the first study to systematically and explicitly compare the innovation performance of South Caucasus economies with that of Latin American countries.

Keywords: *GII, innovation, Latin America, Caucasus, innovation performance*

ЭФФЕКТИВНОСТЬ ГЛОБАЛЬНОГО ИННОВАЦИОННОГО ИНДЕКСА ВОИС КАК ПОКАЗАТЕЛЯ ИННОВАЦИОННОЙ АКТИВНОСТИ: АНАЛИЗ ДАННЫХ ГИИ ДЛЯ ЮЖНОГО КАВКАЗА И ВЫБРАННЫХ СТРАН ЛАТИНСКОЙ АМЕРИКИ

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Резюме

Данное исследование представляет собой всесторонний и системный анализ данных Глобального Индекса Инноваций (ГИИ) для выбранных стран Южного Кавказа и Латинской Америки за период 2013–2023 гг. Широкий набор стран был включён в выборку для обеспечения нормализации данных и сопоставимости результатов между различными инновационными системами. В работе рассматриваются сильные и слабые стороны национальных инновационных экосистем, а также преодолеваются трудности унифицированного межстранового сравнения посредством использования ГИИ как стандартизированной и международно признанной методологической основы. Опираясь на усовершенствованные статистические методы, адаптированные из методологии *Европейского Инновационного Табло* Европейской комиссии, исследование оценивает результаты выбранных стран, классифицирует их по инновационным категориям и формирует научно обоснованные рекомендации для разработки политики. Отличительной особенностью исследования является его сравнительный акцент на двух географически и экономически различных регионах, что позволяет выработать новые и практико-ориентированные политические рекомендации для инновационно-ориентированного роста. Дополнительно проведён детальный анализ основных компонентов ГИИ, выявлены как их стимулирующие, так и ограничивающие факторы, а также предложены контекстно-специфические рекомендации. Исследование завершается ранжированием выбранных стран, что предоставляет ценные ориентиры для формирования национальной и региональной инновационной политики. Насколько известно авторам, это первое исследование, которое системно и чётко сопоставляет инновационную результативность стран Южного Кавказа с показателями государств Латинской Америки.

Ключевые слова: *ГИИ, инновации, Латинская Америка, Кавказ, инновационная эффективность*

1. INTRODUCTION

The Global Innovation Index (GII) is a comprehensive benchmarking tool that measures and ranks the innovation performance of countries worldwide. It is co-published by Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO). The essence of the GII lies in its ability to provide a detailed look at the multifaceted nature of innovation by evaluating various dimensions and offering insights that help policymakers, business leaders, and other stakeholders foster innovation ecosystems.

We have replicated the method of European Innovation Scoreboard and calculated their innovation performance scores. Thus, we have used their framework to categorize performance of respective countries.

There are many ways to measure innovation potential performance. According to World Intellectual Property Organizations (WIPO), (2023) one of the ways to measure innovation is using Global Innovation Index (GII) scores. At first sight, it is not obvious why one should analyze South Caucasus and some Latin American countries in one context. The research interest of the paper is to compare selected countries through various metrics based on the data of GII report by revealing their weekneses and strengths. We have used the WIPO methodology to compute GII scores. Our interest has fallen to investigate performances of South Caucasus countries and some countries from Latin America. We chose theese countries because they have similar ranking according to GII report. This enables us to come up with considerate scores. But when it comes to the economic development trend there are many points in common. Basically, the countries in the world are divided to developed and developing countries. Ideally, developed countries should not be compared with developing countries. But it is normal to compare developing countries with developing countries. Because of this, we have chosen two groups of countries that are apparently developing countries. Also, because there are more than 20 countries analyzed statistically it is fine to go over the calculation process of Performance Score production. In the background we have used averages, minimum and maximum values and many other statistical concepts in our analysis.

The remainder of the paper is organized as follows. There are theoretical framework, methodology and findings, conclusion.

The paper starts with theoretical framework. The framework has analyzed many papers and divided the innovation and innovation performance determinants into three categories. Further into the framework, we have analyzed individual papers and tried to uncover what is behind innovation performance of companies and countries. Although, companies and countries have differences in essence they are groups of people coming together either to stand as a group or to achieve some goal. The framework finds three determinants of innovation performance.

The next part of the paper is methodology and findings. Here we have used many data sources and analyzed and calculated many intermediate results and final results as GII scores of select countries. The methodology is adopted from European Comission Innovation Scoreboard in our analysis. We have used GII report variables in our analysis. The paper started with the WIPO`s GII report variables and went on to calculate statistical variables like minimum and maximum values, ranges, skewness of the distribution of individual variables and calculated scaled scores. From scaled scores we have done some statistical and mathematical calculations to reach the final GII scores. The last subsection of the methodology and findings lists our findings from the analysis.

The last part of the paper is conclusion. Here we have come up with several ideas for the countries. It is very good that more and more countries are using GII scores to evaluate and monitor innovation landscape. We suggest to enhance the usage of GII scores with additional reforms in primary and secondary education systems. It should be noted that countries should focus on one industry at a time. Creative thinking should

be encouraged over rote learning among students of all levels. STEM education should be encouraged on national level in countries. Research and education in English should be encouraged in countries for broader recognition and interaction internationally. Generally, the economies should not focus solely on boosting their GII ranks, but also different metrics.

2. THEORETICAL FRAMEWORK

We have analyzed several papers on innovation performance. The literature has used either country or company levels as the method of analysis in their papers.
We will go over some papers to identify the determinants of innovation and innovation performance. What are the factors of innovation performance? What leads to the change in innovation performance? The literature suggests many linkages in this respect. Let's move on to what is behind innovation and innovation performance.

2.1. The determinants of innovation and innovation performance

2.1.1. Personal/individual and/or group related

First, Let's go over the individual determinants of innovation performance. There is a need to analyze the personal and individual characteristics. In order to carry out any activity, there needs to be some motivator, demand or some idea. In this respect, educational and motivational issues are important factors. Coutinho, E. M. O., & Au-Yong-Oliveira, M. (2024) maintains that Education, R&D investments, innovation partnerships, ecological sustainability and knowledge absorption will lead to innovation performance. The author emphasizes the importance of education and knowledge prevalence. Logically, the size and physical power of individual or a group does not lead to innovation by virtue. Laursen, K., & Salter, A. (2006) shows that Company size cannot be a determinant of innovative performance. There are many examples that prove this idea. Individual capabilities do suggest success or failure in many situations. Of course, we need to consider the time individual or company as a group is involved in the task. Hurtado-Palomino, A., et al. (2022) shows that increase in innovation capability and potential absorptive capacity will increase innovation performance. It is true that person will achieve higher performance provided he/she have increased his/her capability and/or capacity.
Motivation is an important factor in life. Jiang, S., et al. (2023) shows that individual motivation leads to intermediary innovative behavior and process ends with innovation performance. It is true that yesterday's mood, work has an impact on today's performance. Ali, M. A., et al. (2021) shows that increase in innovation performance is correlated and leads to increase in intellectual capital. There will be some improvement provided, that there is a clear foresight into the future. Andrijauskiene, M., et al. (2021) shows that country should design future innovation policies to achieve the improvement in innovation performance.

2.1.2. Leader and/or organization related

Second, we will mention company specific factors. Not everybody is equal in emotional strength. Because of this, some people are put or appointed to the positions that makes them responsible for the results of others. Such people are called managers. There is a big debate that your boss should help you grow. The managers that help you grow are called leaders. It is obvious that not all of the managers are leaders. But there is a very big literature on leadership and leaders. We are going to talk about the case where leadership

can do favor to the innovation and performance of countries or companies. Cui, F., et al. (2022) Transformational and transactional leadership will lead to organizational learning and innovation performance. Organizational learning is also a very interesting topic but our aim is not to go further here. It is enough to mention that organizations should cultivate the culture of learning to stay afloat in the modern business world. Cui, F., et al. (2022) shows that Organizational learning and leadership style has a positive impact on enterprise innovation performance. So, good leadership is an important ingredient for Organizational learning and, organizational learning is an important factor for the innovation performance of the enterprise. As the organizations grow and make innovations, they grow the information about business. de Silva, M., et al. (2018) shows Innovation intermediaries make internal value. So, the companies that professionally help others innovate do accumulate valuable information on innovation. These companies are operating on the business sector. So, it is important to commercialize the information. Marule, N. P. (2022) shows Commercialization in innovation value chain is important factor.

2.1.3. Country related

Third, we will mention country specific factors of innovation performance. There are more than 190 countries in the world. The countries are establishing geographical and political groups to keep and grow their importance in the world. Some of the papers mentioned in Table 1 have considered country as their units of measurement. One example is the paper by Akhmadi, S., & Tsakalerou, M. (2023) that shows perception of innovation does not change between wider regions particularly in the EU but, there is a vast amount of data that it holds in every country groups. There is a big debate about political stability. Some countries favor stability over openness. Mohamed, M. M. A., et al. (2022) shows that Political stability together with foreign direct investment leads to economic growth. If there is a foreign direct investment into the country in addition to the political stability, there will be an economic growth in the country. The other issue is sustainability. It basically means that humanity needs to consider ecology as the most important factor in every decision from pollution to production. Jovovic, R., et al. (2017) shows that Sustainable development is the driver of innovation. Coutinho, E. M. O., & Au-Yong-Oliveira, M. (2023) have analyzed Portugal and showed that for her human capital and R&D investments are also important factors. Economics divides countries in terms of many characteristics. The most understandable and clear division is in terms of Gross Domestic Product (GDP). Basically, GDP is the total amount of money created by the citizens and the companies established by these citizens. According to one view there are Developed and Developing countries. Developed countries have higher GDP. According to another view there are lower-income, middle-income and, higher-income countries. Bate, A. F., et al. (2023) shows that Middle-income countries should focus on human capital, higher-income countries should focus on innovation linkage. Countries use funds to direct the economies. Costa, J., & Moreira, A. C. (2022) shows that public funds may increase performance improvements under certain conditions. Governments keep track of several indicators of economy. They are forming macroeconomic environment. Kirikkaleli, D., & Ozun, A. (2019) shows Macroeconomic environment and business sophistication are important factors of innovation capacity. So, the countries that have many means to direct funds and industries, also, have many number of products produced internally have more chance to innovate. There are many ways and measures to somehow calculate innovation. Ponta, L., et al. (2021) shows that Innovation patent index is the best measure of innovation performance.

3. METHODOLOGY AND FINDINGS

Now it is time to mention the method of our study. We have adopted the methodology of European Comission Innovation Scoreboard (European Comission, 2022) in this paper. We have chosen the author because the paper proposes a coherent and clear methodology in the paper.

3.1. Trends in the GII of South Caucasus and Selected Latin American Countries

The Global Innovation Index (GII) serves as a critical benchmark for evaluating and comparing the innovation capabilities of countries worldwide. Analyzing the GII scores from 2013 to 2023 for the Caucasus region and selected Latin American countries reveals intriguing trends and patterns in innovation performance across these regions.

Table 1. Global Innovation Indices of South Caucasus and Some Latin American Countries

Country	Global Innovation Index										
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Caucasus Region											
Azerbaijan	105	101	93	85	82	82	84	82	80	93	89
Armenia	59	65	61	60	59	68	64	61	69	80	72
Georgia	73	74	73	64	68	59	48	63	63	74	65
Selected Latin American countries											
Argentina	56	70	72	81	76	80	73	80	73	69	73
Bolivia	95	111	104	109	106	117	110	105	104	104*	97
Brazil	64	61	70	69	69	64	66	62	57	54	49
Chile	46	46	42	44	46	47	51	54	53	50	52
Colombia	60	68	67	63	65	63	67	68	67	63	66
Costa Rica	39	57	51	45	53	54	55	56	56	68	74
Dominican Republic	79	83	89	76	79	87	87	90	93	90	94
Ecuador	83	115	119	100	92	97	99	99	91	98	104
El Salvador	88	103	99	104	103	104	108	92	96	100	95
Guatemala	87	93	101	97	98	102	107	106	101	110	122
Honduras	107	118	113	101	104	105	104	103	108	113	116
Mexico	63	66	57	61	58	56	56	55	55	58	58
Panama	86	52	62	68	63	70	75	73	83	81	84
Paraguay	100	89	88	94	85	89	95	97	88	91	98
Peru	69	73	71	71	70	71	69	76	70	65	76
Uruguay	52	72	68	62	67	62	62	69	65	64	63

Source: *Cornell University et al. (2013); Cornell University et al. (2014); Cornell University et al. (2015); Cornell University et al. (2016); Cornell University et al. (2017); Cornell University et al. (2018); Cornell University et al. (2019); Cornell University et al., (2020); WIPO, (2021); WIPO, (2022); WIPO, (2023).*

* According to chosen methodology previous yerar`s value was used

In the Caucasus region, Azerbaijan, Armenia, and Georgia show varying trajectories in their innovation index rankings. Azerbaijan's GII rankings have fluctuated over the years, peaking at 82 in 2017 and reaching its lowest point of 105 in 2013. Recent years have shown some improvement, with a score of 89 in 2023. Armenia's innovation index demonstrates a more consistent improvement, moving from 59 in 2013 to a high of 61 in 2020 before slightly declining to 72 in 2023. Georgia, on the other hand, exhibits relatively stable performance with minor fluctuations, achieving its best score of 48 in 2018 and ending with a score of 65 in 2023.

Latin American countries display a wide range of GII scores, reflecting diverse innovation capabilities and development stages.

Argentina’s GII scores show a fluctuating yet generally stable trend. The country started with a score of 56 in 2013 and had minor fluctuations, peaking at 80 in 2018. In recent years, Argentina's score has been relatively stable, with a score of 73 in 2023. This stability suggests a consistent, though modest, innovation capability. Bolivia displays significant variability. Beginning at 95 in 2013, Bolivia's scores peaked at 117 in 2018 but declined to 97 in 2023, highlighting challenges in maintaining a stable innovation environment. Brazil exhibits notable improvement. Starting at 64 in 2013, Brazil's scores improved consistently, reaching 49 in 2023. This indicates successful innovation policies and investments. Chile consistently ranks high, reflecting a robust innovation infrastructure. Starting at 46 in 2013, Chile's scores remained strong, ending at 52 in 2023, showcasing sustained innovation efforts. Colombia shows gradual improvement. Beginning at 60 in 2013, Colombia's scores improved steadily, reaching 66 in 2023, indicating continuous development in its innovation ecosystem. Costa Rica demonstrates significant progress. Starting at 39 in 2013, Costa Rica's scores improved, reaching 74 in 2023, reflecting strong innovation policies. Dominican Republic shows fluctuating trends. Beginning at 79 in 2013, the scores varied, peaking at 79 in 2016 and settling at 94 in 2023, indicating inconsistencies in innovation efforts. Ecuador exhibits significant ups and downs. Starting at 83 in 2013, Ecuador saw peaks and troughs, ending at 104 in 2023, highlighting challenges in sustaining innovation. El Salvador shows modest improvement. Starting at 88 in 2013, the scores fluctuated but improved slightly to 95 in 2023, indicating gradual progress. Guatemala has relatively low but consistent performance. Starting at 87 in 2013, Guatemala saw fluctuations, ending at 122 in 2023, suggesting the need for stronger innovation policies. Honduras shows minor fluctuations but generally low rankings. Starting at 107 in 2013, it ended at 116 in 2023, indicating a need for significant innovation enhancements. Mexico demonstrates improvement. Beginning at 63 in 2013, Mexico's scores improved, reaching 58 in 2023, indicating positive trends in innovation. Panama shows stability with minor fluctuations. Starting at 86 in 2013, Panama's scores remained stable, ending at 66 in 2023, reflecting a steady innovation environment. Paraguay exhibits a declining trend. Starting at 100 in 2013, Paraguay's scores decreased to 112 in 2023, highlighting challenges in maintaining innovation progress. Peru shows stability with slight improvements. Starting at 69 in 2013, Peru's scores improved slightly to 57 in 2023, indicating gradual development. Uruguay consistently ranks high. Starting at 52 in 2013, Uruguay's scores remained strong, ending at 52 in 2023, reflecting robust innovation capabilities.

In table 1 the analysis of GII scores from 2013 to 2023 reveals diverse trends in innovation performance across the Caucasus region and selected Latin American countries. While some countries like Brazil, Chile, and Costa Rica have made significant strides in enhancing their innovation ecosystems, others like Bolivia

and Guatemala face challenges in sustaining innovation growth. Overall, the GII scores highlight the dynamic nature of innovation across these regions and underscore the importance of sustained efforts to drive progress and stability in innovation capabilities.

Table 2. Global Innovation Scores of South Caucsus and Selected Latin American Countries Overall and by Pillars 2022

Global Innovation Scores of South Caucasus and Selected Latin American Countries Overall and by Pillars 2023								
Country	**Overall**	**Institutions**	**Human capital and research**	**Infrastructure**	**Market sophistication**	**Business sophistication**	**Knowledge and technology outputs**	**Creative outputs**
Azerbaijan	23.3	61.2	25.5	29.5	28.8	28.4	11.3	12.6
Armenia	28	49.1	22.7	36.6	27.5	22.7	22.6	26.1
Georgia	29.9	70.6	30.2	36.2	32.3	29.4	21.4	18.8
Argentina	28	30.9	30	39.9	25.2	30.3	19.2	30.3
Bolivia	21.4	12.3	32.5	27	46.9	25.1	12.7	12.2
Brazil	33.6	38.5	33.5	43.5	38.1	36.7	26.8	31.2
Chile	33.3	56.7	33	46.4	38.9	29.8	24.3	26.8
Colombia	29.4	46.7	27	43.1	33.4	36.7	23.7	19.1
Costa Rica	27.9	57.9	27.9	42	27.2	28.7	21.7	16.2
Dominican Republic	22.4	49.3	17.5	37	25.3	23.7	14.4	14.1
Ecuador	20.5	35.1	21.3	36.8	23.3	23.2	13.4	12.9
El Salvador	21.8	37.8	18.3	28.8	24.8	23.8	14.6	19.2
Guatemala	15.8	31.3	13.2	20.7	20.1	22.9	13.7	6.3
Honduras	16.7	26.1	23.7	23.5	22.2	20.8	12.5	7.6
Mexico	31	34.8	31.7	40.4	37.2	25.4	24.7	31.7
Nicaragua	16.9	25.2	14	23.2	37	21.8	10.2	8.7
Panama	25.3	47	19.1	45	23.5	16.3	17.1	23.9
Paraguay	21.4	33.1	10.1	35.4	31.6	23.3	12.3	19.7
Peru	27.7	45.9	34.7	41.4	37.9	31	13.6	20.9
Uruguay	30	67.5	26.7	43.9	28.1	29.2	22.8	19.2

Source: *Cornell University et al. (2013); Cornell University et al. (2014); Cornell University et al. (2015); Cornell University et al. (2016); Cornell University et al. (2017); Cornell University et al. (2018); Cornell University et al. (2019); Cornell University et al., (2020); WIPO, (2021); WIPO, (2022); WIPO, (2023).*

3.1. Institutions

Institutions are fundamental for fostering an environment conducive to innovation. Azerbaijan (61.2) excels in this pillar, demonstrating robust institutional frameworks. Costa Rica (57.9) and Chile (56.7) also

perform well, highlighting their strong governance and regulatory environments. In contrast, Bolivia (12.3) and Nicaragua (25.2) lag behind, suggesting the need for institutional reforms to boost innovation.

3.1.1. Human capital and research

Human capital and research are vital for generating new knowledge and technologies. Georgia (70.6) significantly outperforms other countries in this pillar, reflecting its investment in education and research capabilities. Argentina (30) and Colombia (27.4) also show promising scores. However, countries like Guatemala (13.3) and Nicaragua (21.5) need to enhance their education systems and research infrastructures to compete globally.

3.1.2. Infrastructure

Infrastructure supports the development and diffusion of innovations. Chile (46.4) leads in this pillar, followed by Costa Rica (42) and Argentina (39.9). These countries have invested in reliable infrastructure, essential for technological advancements. Conversely, Bolivia (27) and Honduras (23.5) face challenges in infrastructure development, hindering their innovation potential.

3.1.2. Market sophistication

Market sophistication, which includes factors such as credit, investment, and trade, is crucial for innovation. Brazil (43.5) and Chile (46.4) stand out in this pillar, indicating well-developed markets that facilitate innovation. On the other hand, Guatemala (20.7) and El Salvador (23.8) exhibit lower scores, suggesting the need for market reforms to enhance innovation capacity.

3.1.3. Business sophistication

Business sophistication measures the quality of business networks and innovation capabilities of firms. Argentina (30.3) and Chile (38.9) excel in this area, showcasing dynamic business environments. However, countries like Nicaragua (21.8) and Honduras (20.8) score lower, highlighting the need to support business development and innovation activities.

3.1.4. Knowledge and technology outputs

Knowledge and technology outputs reflect the results of innovative activities. Chile (24.3) and Brazil (31.1) perform well, indicating their ability to produce and commercialize new technologies. In contrast, Bolivia (12.7) and Honduras (12.5) have lower outputs, suggesting the need to enhance their innovation ecosystems to generate more significant technological advancements.

3.1.5. Creative outputs

Creative outputs, such as cultural and creative goods, are essential components of innovation. Argentina (30.3) and Chile (26.8) lead in this pillar, demonstrating strong creative industries. However, countries like Guatemala (6.3) and Nicaragua (8.7) need to foster their creative sectors to boost overall innovation.

3.1.6. The overall innovation scores

The overall innovation scores reveal significant disparities among the countries. Georgia leads the South Caucasus with a score of 29.9, outperforming Azerbaijan (23.3) and Armenia (28). In Latin America, Chile (33.3) and Brazil (33.6) emerge as leaders, with Uruguay (30) and Colombia (29.4) also showing strong performances. Bolivia (21.4) and Honduras (16.7) are among the lowest-scoring countries, indicating room for improvement in their innovation ecosystems.

The 2023 Global Innovation Scores highlight the varying levels of innovation performance among countries in the South Caucasus and selected Latin American regions. While some countries like Chile, Brazil, and Georgia demonstrate strong innovation capabilities, others like Bolivia and Honduras face challenges across multiple pillars. To enhance their innovation ecosystems, these countries must invest in education, infrastructure, and institutional reforms, and foster supportive business environments. By addressing these areas, they can improve their global competitiveness and drive sustainable economic growth.

Table 3. Analysis of GIIs using the European Innovation Scoreboard Approach

Country	GII Rank	Overall GII Score	Performance Score	Category
Azerbaijan	89	23.3	85.07	Moderate Innovators
Armenia	72	28	112.18	Stronger Innovators
Georgia	65	29.9	134.62	Innovation Leaders
Argentina	73	28	121.04	Stronger Innovators
Bolivia	97	21.4	80.74	Moderate Innovators
Brazil	49	33.6	170.59	Innovation Leaders
Chile	52	33.3	164.58	Innovation Leaders
Colombia	66	29.4	140.75	Innovation Leaders
Costa Rica	74	27.9	122.16	Stronger Innovators
Dominican Republic	94	22.4	75.15	Moderate Innovators
Ecuador	104	20.5	65.07	Emerging Innovators
El Salvador	95	21.8	67.33	Emerging Innovators
Guatemala	122	15.8	24.24	Emerging Innovators
Honduras	116	16.7	35.34	Emerging Innovators
Mexico	58	31	143.60	Innovation Leaders
Nicaragua		16.9	37.70	Emerging Innovators
Panama	84	25.3	90.35	Moderate Innovators
Paraguay	98	21.4	65.62	Emerging Innovators
Peru	76	27.7	128.18	Stronger Innovators
Uruguay	63	30	135.68	Innovation Leaders

Source: *Authors` own elaboration*

The GII rank and overall GII score provide a snapshot of a country's innovation ecosystem. Higher scores and ranks indicate better performance in fostering innovation. Here are some key observations:

1. Brazil (49), Chile (52), Mexico (58), and Uruguay (63) are among the top-performing countries in this group, all ranked within the top 65 globally. These countries are categorized as "Innovation Leaders," with Brazil achieving the highest overall GII score of 33.6.

2. Georgia (65) and Colombia (66) also perform well, categorized as "Innovation Leaders" with GII scores of 29.9 and 29.4, respectively.
3. Azerbaijan (89) and Dominican Republic (94) are classified as "Moderate Innovators," with overall GII scores of 23.3 and 22.4, respectively.
4. Guatemala (122) has the lowest GII rank and overall score among the listed countries, indicating significant room for improvement as an "Emerging Innovator."

Performance Scores

Performance scores reflect how well a country converts its innovation inputs into outputs. Here are some notable findings:

1. Brazil (170.59) and Chile (164.58) lead with the highest performance scores, showcasing their efficiency in translating innovation efforts into tangible outcomes.
2. Georgia (134.62) and Mexico (143.60) also exhibit strong performance, reinforcing their positions as innovation leaders.
3. Guatemala (24.24) and Honduras (35.34) have the lowest performance scores, highlighting the challenges they face in achieving effective innovation.

Innovation Categories

Countries are categorized based on their innovation performance:

1. Innovation Leaders: Brazil, Chile, Colombia, Georgia, Mexico, and Uruguay are in this category, demonstrating superior innovation capabilities and outcomes.
2. Stronger Innovators: Armenia, Argentina, Costa Rica, and Peru fall into this category, showing robust but slightly less consistent innovation performance compared to the leaders.
3. Moderate Innovators: Azerbaijan, Bolivia, Dominican Republic, Nicaragua, and Panama are moderate innovators, indicating a balanced but moderate level of innovation activity.
4. Emerging Innovators: Ecuador, El Salvador, Guatemala, and Honduras are categorized as emerging innovators, needing significant improvements to boost their innovation ecosystems.

The Global Innovation Index for 2023 reveals a diverse landscape of innovation performance among South Caucasus and selected Latin American countries. While countries like Brazil, Chile, and Mexico lead with high scores and strong innovation capabilities, others like Guatemala and Honduras face considerable challenges. Enhancing innovation performance across all pillars—institutions, human capital, infrastructure, market and business sophistication, and creative outputs—is crucial for these countries to improve their global competitiveness and drive sustainable development.

4. KEY GII COMPONENTS

Table 4. Rankings of South Caucasus Countries and Selected Latin American Countries on Key GII Components 2023

	Human Capital & Research				Infrastucture	
Country	**2.1.4**	**2.2.2**	**2.3.1**	**2.3.2**	**3.1.3**	**3.1.4**
Azerbaijan	65	47	44	87	81	91

Armenia	n/a	88	n/a	88	63	64
Georgia	70	75	46	83	82	71
Argentina	69	101	50	59	38	51
Bolivia	n/a	n/a	n/a	n/a	97	104
Brazil	68	90	54	34	14	11
Chile	46	63	70	72	30	43
Colombia	62	51	92	78	59	37
Costa Rica	59	95	78	68	70	66
Dominican Republic	79	106	n/a	n/a	79	83
Ecuador	n/a	72	74	65	50	41
El Salvador	n/a	62	93	94	108	97
Guatemala	n/a	109	106	110	92	103
Honduras	n/a	97	82	109	130	130
Mexico	57	41	77	75	31	32
Nicaragua	n/a	n/a	n/a	103	104	115
Panama	76	102	97	93	71	75
Paraguay	n/a	n/a	87	96	84	75
Peru	66	21	n/a	92	37	22
Uruguay	52	99	57	64	52	61
2.1.4	PISA scales in reading, maths and science					
2.2.2	Graduates in science and engineering, %					
2.31.1	Researchers, FTE/mn pop.					
2.3.2	Gross expenditure on R&D, % GDP					
3.1.3	Government’s online service					
3.1.4	E-participation					

Business Sophistication

Country	**5.1.1**	**5.1.3**	**5.1.4**	**5.1.5**	**5.2.1**	**5.2.3**	**5.3.2**	**5.3.3**	**5.3.4**
Azerbaijan	62	89	57	55	25	96	117	114	118
Armenia	77	n/a	71	44	100	73	73	94	95
Georgia	57	n/a	89	39	41	56	76	88	16
Argentina	54	54	63	45	89	42	22	30	92
Bolivia	92	n/a	n/a	64	123	n/a	77	92	124
Brazil	60	n/a	39	52	78	n/a	19	34	45
Chile	48	61	55	61	83	78	38	90	25
Colombia	58	57	22	46	55	66	12	39	40
Costa Rica	72	58	86	65	73	67	64	65	26
Dominican Republic	88	n/a	n/a	77	94	n/a	52	112	42
Ecuador	100	56	97	81	96	64	42	106	101
El Salvador	90	70	54	94	112	70	30	98	67

Guatemala	109	90	74	105	87	94	29	59	68
Honduras	101	88	66	95	106	82	71	56	59
Mexico	75	66	69	74	80	817	81	131	60
Nicaragua	94	n/a	n/a	90	128	n/a	69	122	14
Panama	103	92	91	68	108	44	44	121	85
Paraguay	74	n/a	96	78	125	65	8	132	110
Peru	89	n/a	n/a	67	119	n/a	46	71	75
Uruguay	56	59	82	73	67	57	94	5	43
5.1.1	Knowledge-intensive employment, %								
5.1.3	GERD performed by business, % GDP								
5.1.4	GERD financed by business, %								
5.1.5	Females employed w/advanced degrees, %								
5.2.1	University–industry R&D collaboration								
5.2.3	GERD financed by abroad, % GDP								
5.3.2	High-tech imports, % total trade								
5.3.3	ICT services imports, % total trade								
5.3.4	FDI net inflows, %								

Knowledge and technology outputs						**Creative outputs**				
Country	**6.1.4**	**6.2.3**	**6.3.2**	**6.3.3**	**6.3.4**	**7.2.1**	**7.3.1**	**7.3.2**	**7.3.3**	**7.3.4**
Azerbaijan	112	102	114	118	104	83	98	76	76	97
Armenia	49	58	76	79	9	52	61	52	35	43
Georgia	68	97	67	72	53	68	79	50	34	70
Argentina	92	47	74	86	47	23	64	49	48	57
Bolivia	119	50	105	90	102	95	88	99	90	112
Brazil	61	44	59	58	86	53	89	42	49	40
Chile	43	21	75	70	99	70	77	32	57	71
Colombia	94	79	63	69	85	55	67	28	60	72
Costa Rica	96	32	48	30	15	47	38	83	53	77
Dominican Republic	130	122	61	53	114	n/a	76	79	87	101
Ecuador	75	69	113	102	108	101	80	85	80	93
El Salvador	128	107	60	47	48	105	75	97	82	98
Guatemala	129	125	81	67	40	89	58	98	99	111
Honduras	123	66	94	108	78	n/a	108	104	104	104
Mexico	102	76	20	9	131	110	70	58	81	69
Nicaragua	125	103	100	93	41	n/a	72	109	106	120
Panama	114	77	40	19	79	69	19	77	86	62
Paraguay	121	110	83	77	127	107	86	75	96	100
Peru	106	63	102	95	120	n/a	54	74	72	85
Uruguay	65	71	64	75	7	40	51	38	44	49

6.1.4	Scientific and technical articles/bn PPP$ GDP
6.2.3	Software spending, % GDP
6.3.2	Production and export complexity
6.3.3	High-tech exports, % total trade
6.3.4	ICT services exports, % total trade
7.2.1	Cultural and creative services exports, % total trade
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69
7.3.2	Country-code TLDs/th pop. 15–69
7.3.3	GitHub commits/mn pop. 15–69
7.3.4	Mobile app creation/bn PPP$ GDP

Source: *(World Intellectual Property Organization (WIPO), 2023)*

The education system, as indicated by PISA scores, seems to be the main obstacle to innovation (OECD, 2020).

4.1. Education and Research

The PISA (Programme for International Student Assessment) scores provide insights into the educational performance in reading, math, and science. Countries like Dominican Republic (79) Panama (76) have high scores, suggesting strong educational systems. Georgia (70), Argentina (69), Brazil (68), Peru (66), and Azerbaijan (65) also show considerable performance. However, several countries such as Armenia, Bolivia, Ecuador, El Salvador, Guatemala, and Honduras do not have available data, which may indicate gaps in their educational assessment frameworks.

The percentage of graduates in science and engineering is an important indicator of a country's emphasis on STEM (Science, Technology, Engineering, and Mathematics) education. Dominican Republic (106%), Panama (102%), and Argentina (101%) have the highest percentages, reflecting significant investment in these critical fields. On the lower end, countries like Mexico (41%), Paraguay (21%) show lower percentages, indicating potential areas for improvement.

The number of researchers per million population illustrates the level of investment in research and development. Countries such as Guatemala (106), Panama (97), El Salvador (93), and Colombia (92) have high numbers, signifying strong support for research activities. Conversely, countries like Azerbaijan (44), Georgia (46), and Brazil (54) have fewer researchers per million population, suggesting the need for increased focus on building research capacity.

Gross expenditure on research and development as a percentage of GDP is a critical measure of a country's commitment to innovation. Guatemala (110%), Honduras (109%), and Nicaragua (103%) lead in this area, highlighting their strong emphasis on R&D investment. On the other hand, countries like Brazil (34%), Uruguay (64%), and Ecuador (65%) show lower expenditures, indicating potential areas for boosting R&D funding.

4.2. Infrastructure

Government Online Services and E-Participation indicators are essential for understanding the digital infrastructure and the level of public engagement in governance through online platforms.

Government's Online Service evaluates the extent and quality of online services provided by the government. Higher scores suggest better and more comprehensive online government services. Countries

like Honduras, El Salvador, and Nicaragua have high scores (130, 108 and 104), signifying advanced digital government services. Meanwhile, countries like Brazil (14) and Chile (30) lag significantly, indicating a need for enhanced digital governance infrastructure.

E-participation is an essential component of modern democratic governance and public engagement through digital means. Here, Honduras and Nicaragua show strong participation (130 and 115), reflecting high levels of public engagement in governance through digital platforms. In contrast, Brazil (11), Peru (22), Mexico (32), and Colombia (37) score low, indicating potential barriers to digital public engagement.

4.3. Business Sophistication

The provided table outlines several key metrics related to business sophistication across a diverse set of countries. The metrics included are knowledge-intensive employment, GERD (Gross Domestic Expenditure on R&D) performed and financed by business, females employed with advanced degrees, university-industry R&D collaboration, GERD financed by abroad, high-tech imports, ICT services imports, and FDI (Foreign Direct Investment) net inflows.

Knowledge-intensive employment is a critical indicator of a country's ability to engage in sophisticated business activities. Guatemala leads the list with 109%, followed by Panama and Honduras with 103% and 101%, respectively. High percentages in this metric indicate a strong emphasis on employing individuals in roles that require advanced knowledge and skills. In contrast, Chile (48%), Argentina (54%), and Georgia (57%) lag behind, suggesting potential areas for improvement in workforce development.

The percentage of GERD performed by business reveals the extent to which businesses contribute to R&D. Argentina (54%), Colombia (57%), and Costa Rica (58%) exhibit moderate contributions. Notably, countries like Armenia, Georgia and several Latin American nations do not have available data, indicating possible gaps in business-led R&D activities. Conversely, countries like Panama (92%) and Azerbaijan (89%) show significant business investment in R&D.

The metric of Females Employed with Advanced Degrees assesses gender diversity in advanced roles within the workforce. Guatemala (105%), Honduras (105%), and El Salvador (94%) lead with the highest percentages, reflecting strong gender inclusivity. In contrast, Georgia (39%), Armenia (44%), and Argentina (45%) show lower percentages, indicating potential gender disparities in advanced employment roles.

Collaboration between universities and industries is crucial for innovation. Nicaragua (128%), Paraguay (125%), and Argentina (123%) showcase exceptional collaboration, suggesting strong links between academic research and practical industry applications. Armenia (100%), Honduras (106%), and Panama (108%) also perform well in this regard. However, Georgia (41%) and Azerbaijan (25%) display lower collaboration levels, indicating opportunities for enhancing partnerships between academia and industry.

The percentage of GERD financed by abroad indicates the extent of international collaboration and investment in R&D. Countries like Argentina (42%) and Colombia (66%) have moderate levels of foreign investment in R&D. Conversely, Bolivia and other countries with unavailable data may need to explore international funding opportunities to bolster their R&D activities.

High-tech imports indicate a country's engagement with advanced technologies. Azerbaijan (117%) and Mexico (89%) demonstrate strong high-tech import activities, reflecting a demand for cutting-edge technologies. On the other hand, Paraguay (8%), Colombia (12%), and Brazil (19%) show lower levels, suggesting potential for increasing their technological imports to boost innovation.

ICT services imports provide insights into the digital integration of a country. Paraguay (132%), Mexico (131%), and Nicaragua (122%) stands out with an exceptionally high percentage, followed by Panama (121%), indicating robust digital infrastructure. Uruguay (5%) and Argentina (30%) show lower levels, highlighting opportunities for enhancing their digital service imports.

FDI net inflows as a percentage of GDP reflect a country's attractiveness to foreign investors. Bolivia (124%), Azerbaijan (118%), Paraguay (110%), and Ecuador (101%) have high levels of FDI, indicating favorable investment climates. In contrast, countries like Nicaragua (14%) and Georgia (16%) exhibit lower levels, suggesting challenges in attracting foreign direct investment.

4.4. Knowledge and technology outputs

The production of scientific and technical articles varies significantly among the countries. The Dominican Republic leads with the highest score (130), indicating a strong output relative to its GDP. In contrast, Armenia and Chile show lower outputs (49 and 43 respectively), suggesting potential areas for development in scientific research. High performers like El Salvador (128) and Nicaragua (125) reflect moderate but consistent engagement in scientific publication.

Software spending is a crucial indicator of a country's investment in technology. Guatemala (125) and Dominican Republic (122) show relatively higher investments, which could be correlated with their tech sector growth. Costa Rica (32) and Brazil (50) are at the lower end, potentially indicating lesser emphasis on software development within their economies.

Production and export complexity highlights the sophistication and diversity of a country's production and export capabilities. Countries like Azerbaijan (114) and Bolivia (105) perform well, showcasing diversified and complex export profiles. Conversely, Mexico (20) and Panama (40) rank lower, reflecting more simplified or less varied production structures.

The proportion of high-tech exports relative to total trade is another critical indicator. Azerbaijan (118) excels, suggesting a robust high-tech sector. In contrast, Mexico (9) and Panama (19) lag behind, pointing to limited high-tech export activities.

The export of ICT services is vital for modern economies. Paraguay (127) and Peru (120) are prominent leaders, indicating strong ICT sectors. However, countries like Uruguay (7) and Armenia (9) show minimal contributions from ICT services to their trade, suggesting potential areas for growth.

4.5. Creative Outputs

Mexico (110) and Paraguay (107) lead in exporting cultural and creative services, reflecting vibrant cultural sectors. Argentina (95) and Armenia (101), on the other hand, show lower engagement in these exports, indicating room for enhancement.

The number of generic top-level domains per thousand population aged 15-69 is another indicator of digital presence and innovation. Honduras (108) and Azerbaijan (98) top the list, reflecting a high level of digital activity. Other countries like Brazil (89) and Bolivia (88) also show significant numbers. In contrast, countries like Panama (19), Costa Rica (38), and Uruguay (51) have fewer TLDs, indicating relatively lower digital engagement in this aspect.

Country-code TLDs per thousand population aged 15-69 highlight the use of national digital identities. El Salvador (104), Panama (109), and Ecuador (85) lead in this category, showing a robust national digital presence. Conversely, Armenia (50), Bolivia (32), and Uruguay (38) have lower numbers, suggesting less emphasis on national digital identities.

GitHub commits per million population are a measure of software development and collaborative coding activities. Nicaragua (106), Honduras (104), and Guatemala (96) lead in this category, indicating a strong software development community. Countries like Georgia (34), Armenia (35), and Uruguay (44) lag behind, reflecting lower levels of collaborative coding activities.

Mobile app creation per billion PPP$ GDP is a crucial indicator of innovation in the tech sector. Nicaragua (120), Bolivia (112), and Guatemala (111) are at the forefront, showcasing significant app development activities. In contrast, countries like Brazil (40), Armenia (43), and Uruguay (49) show lesser activity in this field.

This comparative analysis reveals distinct strengths and weaknesses across different countries in terms of education, research, infrastucture, business sophistication, knowledge, technology, and creative outputs. Each country has various results. While some countries show robust performance across several metrics, others exhibit areas needing significant improvement. These insights can guide policymakers and stakeholders in tailoring strategies to bolster their countries' performances in these critical domains, thereby fostering greater economic growth and technological advancement.

5. CONCLUSION

For many years, governments worldwide have effectively utilized the Global Innovation Index (GII) to enhance their economies' innovation performance and develop evidence-based innovation policies. A survey conducted by WIPO in 2023 revealed that 70 percent of WIPO member states were using the GII to improve innovation ecosystems and metrics, as well as to benchmark national innovation policies or economic strategies. It is encouraging to see that the GII is being adopted by a diverse range of economies, from low- to high-income, across all global regions.

One significant advantage of the GII is its emphasis on evidence and metrics in the creation, implementation, and evaluation of innovation policies. The initial step involves uniting statisticians, innovation stakeholders, and policymakers to understand a country's innovation performance using GII metrics. The next step in the policy discussion focuses on capitalizing on domestic innovation opportunities while addressing specific national weaknesses. Both steps require coordination among various public and private innovation stakeholders and government entities. In certain countries, the GII has successfully fostered this dialogue between innovation actors and government bodies.

The global innovation landscape is evolving during this period of pandemic recovery and geopolitical turmoil, affecting not only the leading innovation economies but also a broader range of countries. Consequently, some of the shifts in the GII rankings this year may indicate short-term trends rather than long-term patterns. Today, it is crucial to closely monitor the impacts of the pandemic, downward pressure on risk capital, high interest rates, high debt levels, and disruptions to global supply chains on emerging innovation systems in middle- and low-income economies. This vigilance is necessary to sustain the numerous positive changes achieved over the past two decades in integrating innovation systems and policies into the agendas of policymakers, legislators, and innovation leaders in developing countries.

The initial analysis indicates that countries need to scrutinize the data to identify where enhancements are necessary to boost their innovation potential. They should concentrate not only on improving their GII ranking but also on making effective improvements. It is impractical to attempt advancements in all areas. Most, but not all, economies should prioritize fundamental reforms in their primary and secondary education systems, placing greater emphasis on creative thinking over rote learning. A similar approach is needed within the university system.

Nations and private sector organizations should advocate for and invest in STEM (science, technology, engineering, and mathematics) education. Women should be motivated to pursue advanced degrees and then be hired in both industry and government roles. Universities should offer resources to help their staff achieve proficiency in English writing and publishing. This is not intended to diminish the value of using their native language but to broaden the reach and impact of their research, thereby enhancing their reputation through improved communication.

All in all, pure innovation performance score is not enough to compare the overall economic performance of the country. No country in the world can rely just on innovation performance score to result in economic growth, there needs to be real reforms for that.

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