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The Innovation Potential of the Republic of Serbia: A GII-Based Assessment

Abstract: *This paper examines how the components of the Global Innovation Index (GII) influence the innovation potential of the Republic of Serbia over the period 2011–2025. The analysis is conducted through a comparative study of six Central and Eastern European economies (Serbia, Romania, Bulgaria, Hungary, Slovenia, and Croatia), with the aim of identifying the key predictors of innovation potential in the selected region. In addition, a partial correlation analysis is applied to explore the relationships between GII components and GDP per capita. The findings indicate that infrastructure represents the most consistent and strongest driver of both GDP growth and innovation performance in Serbia. This differs from the top-performing countries in the region, where institutional quality and business sophistication play a decisive role in transforming innovation inputs into outputs. In contrast, investment in human capital appears to be the weakest element of Serbia's innovation system, showing no statistically significant contribution to innovation performance. Such structural imbalance suggests that Serbia's economic growth relies more on investment-driven factors rather than knowledge-based ones. The results point to the need for targeted policies focused on strengthening the institutional framework, improving business sophistication, and strategically investing in human capital, to enhance the efficiency of converting inputs into innovation outputs and to ensure sustainable, innovation-driven development.*

Keywords: *Global Innovation Index; innovation capacity; human capital; infrastructure; institutions; business sophistication; Serbia; GDP per capita; innovation efficiency*

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INTRODUCTION

Innovation capacity has become one of the key determinants of competitiveness and sustainable economic growth in the contemporary global economy. Recognizing the importance of innovation-driven development, the World Intellectual Property Organization (WIPO) has, since 2009, monitored the innovation capabilities of more than 130 countries and innovation clusters worldwide through the Global Innovation Index (GII). This composite index was developed to provide a systematic assessment of the effectiveness of policies, institutional mechanisms, and best practices that foster innovation.

The GII methodology is grounded in the internationally recognized definition of innovation provided in the *Oslo Manual*, jointly developed by Eurostat and the Organization for Economic Co-operation and Development (OECD) (OECD and Eurostat, 2018). The 2018 edition defines innovation as "a new or improved product or process (or a combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)." This definition serves as the conceptual basis for selecting and structuring the indicators included in the GII, ensuring internationally comparable measurement of innovation performance.

The Global Innovation Index (GII) assesses the innovation potential of an economy through a combination of two sub-indices: the input sub-index and the output sub-index. The input sub-index includes the economic factors that support and enable innovative activity. Its underlying idea is fairly straightforward — current investments in innovation, such as infrastructure, human capital, and a business environment that encourages innovation, create the conditions needed for new ideas to emerge. The output sub-index, on the other hand, reflects the results of these efforts, capturing innovative activity across different sectors of the economy. The overall GII score is calculated as the average of the input and output sub-indices, and it serves as the basis for ranking individual economies. A lower GII score indicates a stronger innovation and investment capacity of a given economy.

The structure of the GII consists of seven pillars. Five of these pillars—institutions, human capital and research, infrastructure, market sophistication, and business sophistication—represent the inputs that create conditions for innovation. The remaining two pillars—knowledge and technology outputs, and creative outputs—capture the results of innovation activities. Each pillar is evaluated on a scale from 0 to 100, with higher scores indicating a stronger contribution to the innovation capacity of the economy.

For Serbia, the GII results between 2011 and 2019 indicate a continuous decline in innovation capacity. However, beginning in 2020, an improvement in performance becomes evident, with the final score at the end of the observed period nearly matching the score recorded at its beginning. This paper aims to identify the pillars that have the most significant impact on the development of the innovation potential of the Republic of Serbia and to explore opportunities for improving Serbia's GII performance.

THEORETICAL BACKGROUND

Research on innovation systems over the past two decades consistently emphasizes that a country's innovation capacity depends on a combination of institutional factors, human capital, infrastructure, market mechanisms, and business sophistication. This approach is based on studies that view innovation as the result of complex interactions between different socio-economic subsystems.

Institutions are widely recognized in literature as one of the most important determinants of innovation performance. Furman, Porter, and Stern (2002) argue that institutional quality shapes the innovation climate through regulation, the rule of law, and the stability of public policies. Similarly, Fagerberg and Srholec (2008) demonstrate that institutional capacities influence a country's ability to absorb and generate knowledge, particularly in transition economies.

Human capital and research represent the second key pillar of innovation potential. Numerous studies confirm that investments in education and research and development directly contribute to productivity growth (Filippetti & Archibugi, 2011; Krstić, 2021). Direct channels include increased worker productivity, faster technology adoption, and greater labor-market flexibility. Indirect channels include stimulating innovation, improving institutional quality, and strengthening social capital (Barro, 1991; Hanushek & Woessmann, 2015). Innovation is closely linked to tertiary education, as universities play a central role in generating research and innovation, transferring knowledge to industry, and developing a highly skilled workforce (Aghion et al., 2009). In Central and Eastern European (CEE) countries, Radosevic (2017) highlights that insufficient investment in research infrastructure, and the outflow of highly educated professionals remain major constraints on innovation development.

Infrastructure influences innovation indirectly by increasing mobility, improving logistics, and creating the necessary preconditions for innovative activity. Studies on economic growth find that infrastructure externalities are lower in more developed economies than in less developed economies (Straub, 2010). Roller and Waverman (2001) show that telecommunications infrastructure stimulates economic growth, while Vu (2011) finds that ICT infrastructure has the highest marginal effect on innovation activities. However, most authors emphasize that infrastructure operates primarily through indirect channels, such as improving the business environment and enhancing human capital (Czarnitzki & Hottenrott, 2011).

Market sophistication is identified in the literature as the most volatile element of the innovation system. In developing and transition economies, limited financial-market depth, low levels of venture-capital investment, and weak linkages between markets and innovation actors often lead to discontinuities in innovation performance (Prokop & Stejskal, 2019). This finding is particularly pronounced in the Western Balkans region.

Business sophistication is considered a key mechanism linking innovation inputs and outputs. Porter's framework of competitiveness and innovation emphasizes that technological and organizational sophistication within firms is a primary driver of innovation

outcomes (Porter, 1990). Empirical studies in the EU and CEE regions confirm that countries with stronger business sectors achieve higher scores in knowledge & technology outputs and creative outputs (Carayannis & Grigoroudis, 2016).

Finally, innovation outputs represent the most sensitive component of the innovation system. Hollanders and Es-Sadki (2017) show that outputs respond strongly to economic cycles, institutional changes, and shifts in the business environment. In the CEE region, Švarc and Dabić (2017) find that outputs are particularly vulnerable to crises and political instability, resulting in discontinuities in innovation performance.

Overall, the literature confirms that a country's innovation capacity depends on the interconnected pillars of institutions, human capital, infrastructure, markets, and the business sector.

METHODOLOGY

The assessment of Serbia's relative position in comparison with economically and institutionally similar countries is based on a comparative longitudinal analysis of the innovation performance of Serbia and selected countries in the region—Croatia, Slovenia, Hungary, Romania, and Bulgaria—over the period 2011–2025. These countries were selected due to their geographical and historical proximity to Serbia, similar development trajectories, shared institutional and economic characteristics, and their relevance as appropriate reference points for comparison.

The assessment of Serbia's relative position compared to economically and institutionally similar countries is based on a comparative analysis of innovation performance in Serbia and selected countries in the region (Croatia, Slovenia, Hungary, Romania, and Bulgaria) over the period 2011–2025. The selected countries are geographically and historically close to Serbia, with similar development paths and economic characteristics, which makes them relevant for comparison.

The study employs a comparative, descriptive-analytical methodology that links changes in GII rankings with the level of economic development and GDP growth, to evaluate Serbia's relative position within the group of comparable economies. The analysis of dynamics and the influence of innovation inputs and outputs on overall innovation capacity is conducted through visual examination of systematized data to identify patterns and compare frequencies, complemented by simple statistical techniques such as partial correlation.

The partial correlation coefficient measures the relationship between two variables while controlling for the influence of additional variables suspected to affect the relationship under examination. This approach enables the identification of the unique, isolated association between two variables. Partial correlation analysis is applied in both longitudinal and comparative frameworks to identify direct, statistically significant relationships between GDP per capita and the components of the GII, as well as among the GII pillars themselves, while controlling for the effects of other factors.

INNOVATION PERFORMANCE (GII) OF SERBIA AND REGIONAL PEER ECONOMIES

To better assess the position of the Republic of Serbia in terms of its innovation capacity, the analysis of changes in the GII was conducted for several selected countries with which Serbia has traditionally been connected: Croatia, Slovenia, Hungary, Romania, and Bulgaria. All of these countries are members of the European Union. The GII classifies countries according to the World Bank methodology into low-income, lower-middle-income, upper-middle-income, and high-income groups. Based on its GDP per capita, Serbia is categorized as an upper-middle-income economy. Romania belonged to the same group for most of the observed period, while the remaining four economies fall into the high-income group.

Changes in the GII rankings of these countries between 2011 and 2025 show that the relative positions of Serbia and Romania in the international environment have remained almost unchanged, indicating stagnation in the development of their innovation capacities. The relative positions of Bulgaria and Croatia suggest steady improvement, while the positions of Slovenia and, particularly, Hungary are significantly less favorable in 2025 compared to 2011. Overall, high-income economies tend to have more favorable conditions for developing innovation capacity, but this precondition alone is not sufficient. A clear example is Bulgaria, which has a better GII ranking than Romania, despite Romania having a higher GDP per capita.

A more detailed analysis of economies within the same income group shows that upper-middle-income economies tend to stagnate in the development of their innovation potential, while high-income economies exhibit divergent trends. Countries with the best GII rankings in 2011 show a notable deterioration in their innovation performance by 2025. A direct positive relationship between GII improvement and GDP per capita growth is observed in Bulgaria and Croatia.

Table 1: Relationship Between GII and Income Level in Selected Reference Economies

GII	Serbia	Romania	Bulgaria	Croatia	Hungary	Slovenia
Income level	Upper middle income	Upper medium income until 2022. Then, high income	High income	High income	High income	High income
2011	55	50	42	44	25	30
2025	54	49	37	40	36	35
Change	1	1	5	4	-11	-5
Interpretation of trends	Stagnation	Stagnation	Moderate improvement	Moderate improvement	Significant deterioration	Worsening
Index rasta GDPpc 2025 /2011	2,5	3,3	2,9	2,5	2,4	2,7

Note: *This table illustrates the complexity of the relationship between the development of a country's innovation potential and GDP per capita growth in the observed economies.*

ANALYSIS OF THE STRUCTURE OF GII COLUMNS

For the comparative analysis of the structure of input pillars (Institutions, Human Capital & Research, Infrastructure, Market Sophistication, Business Sophistication), and output pillars (Knowledge & Technology Outputs, Creative Output) of the selected economies, a visual representation of the relative position of pillar values over time was used within each economy. For every economy, the pillar with the best ranking in each year is highlighted in yellow. At the end of the process, the frequency of the best-ranked pillars was calculated. The procedure for this analysis is illustrated in Figure 1.

The results show that economies with better GII performance tend to have either better-ranked institutions (Slovenia, Bulgaria) or a better-ranked Business Sophistication pillar (Hungary). Conversely, economies with the most unfavorably ranked institutions also have the lowest GII scores (Romania, Serbia). Another significant predictor of innovation capacity is the Human Capital & Research pillar. The best-ranked human capital is found in economies with higher GII scores—Slovenia and Croatia—while the lowest rankings appear in economies with the weakest GII performance—Romania and Serbia.

Economies that prioritize infrastructure development (Romania and Serbia) exhibit the least favorable GII results in the entire sample. Infrastructure primarily affects digital readiness, logistics, and the business environment, and as such, represents a precondition for the development of innovation potential. Infrastructure is a prerequisite, but not a generator of innovation. Stable infrastructure corresponds to stable GII performance (Slovenia and Hungary), while unstable infrastructure, characterized by large oscillations, corresponds to unstable GII performance (Serbia and Romania).

The best innovation output results are observed in Slovenia, Croatia, and Bulgaria, as these economies combine strong Knowledge & Technology Outputs with strong Creativity Outputs. The strongest causal chain connects the following pillars:

Institutions + Human capital → Business sophistication → Outputi → GII.

Slovenia shows the strongest profile across all pillars, with the best inputs, outputs, and overall GII. Croatia has stable inputs and outputs and a high GII. Hungary demonstrates strong business sophistication inputs and good outputs. Bulgaria has moderate inputs but above-average outputs, indicating a high efficiency of investment in the country's economic potential, although existing data do not allow for identifying the mechanisms behind this efficiency. Romania displays weak inputs and outputs, while Serbia ranks at the bottom in both categories among the economies in this sample.

Slovenia exhibits the strongest pillar profile, with the best inputs, the best outputs, and the highest overall GII score. Croatia demonstrates stable inputs and stable outputs, resulting in a high GII ranking. Hungary shows strong performance in the Business Sophistication input and solid innovation outputs. Bulgaria has moderate inputs but surprisingly strong outputs, indicating a high level of efficiency in transforming investments into innovation results. Romania

performs poorly in both inputs and outputs, while Serbia ranks at the bottom of the sample in both dimensions. The available data, however, do not provide sufficient insight into the specific mechanisms this economy employs to achieve such a high level of efficiency.

The analysis of the GII structure reveals clear patterns that help explain the innovation potential of the observed countries. The results suggest that institutional quality and human capital are the most stable and strongest pillars of the GII score, which is in line with the dominant literature on national innovation systems. Countries with stronger institutional frameworks and more developed education and research capacities tend to achieve better innovation outcomes.

Figure 1: Best GII scores by countries, by years, total, and by pillars

Slovenia — US$ billion

Income	Year	GII	Institutions	Human capital and research	Infrastructure	Market sofistication	Business sofistication	Knowledge and technology outputs	Creativity outputs	GDP per capita PPP$
HI	2011	30	29	26	27	60	34	32	20	27.004
HI	2012	26	25	27	29	60	34	27	13	29.179
HI	2013	30	25	26	29	43	34	34	35	28.648
HI	2014	28	23	25	34	51	36	27	36	27.900
HI	2015	28	29	24	36	70	35	30	22	28.373
HI	2016	32	23	24	42	84	27	34	27	31.007
HI	2017	32	22	24	34	82	30	43	23	31.007
HI	2018	30	19	28	35	78	29	34	16	34.407
HI	2019	31	20	27	37	37	27	40	24	36.746
HI	2020	32	20	32	27	27	27	35	41	33.579
HI	2021	32	20	28	27	71	27	32	38	38.506
HI	2022	33	37	25	24	68	29	26	56	43.206
HI	2023	33	38	25	20	68	26	27	48	49.968
HI	2024	34	41	24	26	62	32	27	48	51.407
HI	2025	35	48	26	20	63	36	27	53	55.684
	Frequency		8	4	3	-	-	8	7	

Croatia — US$ billion

Income	Year	GII	Institutions	Human capital and research	Infrastructure	Market sofistication	Business sofistication	Knowledge and technology outputs	Creativity outputs	GDP per capita PPP$
HI	2011	44	42	43	37	79	54	57	51	19.805
HI	2012	42	41	51	36	77	64	45	50	18.339
HI	2013	37	48	58	32	64	48	39	52	18.099
HI	2014	42	45	48	37	113	69	40	47	18.191
HI	2015	40	41	47	50	68	50	44	39	18.355
HI	2016	47	42	50	47	73	50	58	48	21.581
HI	2017	41	42	47	33	88	53	51	43	21.581
HI	2018	41	44	48	34	66	45	46	43	24.433
HI	2019	44	45	50	46	71	49	49	51	26.221
HI	2020	41	47	47	52	73	56	43	49	24.208
HI	2021	42	46	47	29	67	65	47	54	27.681
HI	2022	42	77	46	31	56	46	45	39	31.112
HI	2023	44	72	44	26	48	53	33	52	37.550
HI	2024	42	77	46	31	56	46	45	39	42.873
HI	2025	40	65	40	16	54	53	37	44	48.811
	Frequency		4	-	11	-	-	8	7	

Hungary — US$ billion

Income	Year	GII	Institutions	Human capital and research	Infrastructure	Market sofistication	Business sofistication	Knowledge and technology outputs	Creativity outputs	GDP per capita PPP$
HI	2011	25	31	36	39	36	30	18	16	19.764
HI	2012	31	32	38	28	56	38	21	43	19.657
HI	2013	31	38	37	30	87	36	13	37	19.754
HI	2014	35	40	42	36	115	45	24	35	20.065
HI	2015	35	40	43	43	77	57	40	36	20.817
HI	2016	33	40	36	41	80	34	15	40	26.222
HI	2017	39	40	42	46	91	40	33	42	26.222
HI	2018	33	40	38	49	86	32	16	44	29.474
HI	2019	33	41	41	40	76	33	17	38	31.903
HI	2020	35	43	36	34	89	33	22	46	29.732
HI	2021	34	42	36	32	65	31	20	47	32.434
HI	2022	34	48	37	35	67	30	23	46	36.849
HI	2023	35	47	36	42	64	30	26	38	42.132
HI	2024	36	36	34	35	60	28	25	44	43.601
HI	2025	36	36	33	38	49	37	26	38	46.807
	Frequency		3	1	3		9	12	2	

Romania — US$ billion

Income	Year	GII	Institutions	Human capital and research	Infrastructure	Market sofistication	Business sofistication	Knowledge and technology outputs	Creativity outputs	GDP per capita PPP$
UM	2011	50	52	65	54	69	71	36	64	14.278
UM	2012	52	56	67	40	63	77	46	82	12.358
UM	2013	48	55	78	35	85	70	23	80	12.838
UM	2014	55	59	69	50	108	99	37	67	13.396
UM	2015	54	46	73	58	81	67	43	72	13.932
UM	2016	48	48	73	44	77	75	42	53	20.787
UM	2017	42	43	75	37	73	63	37	57	20.787
UM	2018	49	48	65	38	83	55	42	61	24.508
UM	2019	50	52	69	35	92	51	41	71	26.447
UM	2020	46	53	76	37	83	53	28	67	24.443
HI	2021	48	53	76	37	76	54	35	72	30.141
UM	2022	49	75	74	33	63	51	31	57	33.833
HI	2023	47	74	75	34	75	51	35	58	38.097
HI	2024	48	81	70	32	67	47	38	56	41.029
HI	2025	49	85	72	31	62	59	40	52	47.204
	Frequency		2	-	13	-	-	15		

Bulgaria — US$ billion

Income	Year	GII	Institutions	Human capital and research	Infrastructure	Market sofistication	Business sofistication	Knowledge and technology outputs	Creativity outputs	GDP per capita PPP$
UM	2011	42	40	59	59	50	65	50	46	13.333
UM	2012	43	46	56	47	54	84	41	49	13.563
UM	2013	41	51	55	43	83	65	36	49	14.235
UM	2014	44	44	61	47	97	53	38	45	14.499
UM	2015	39	39	58	53	61	60	37	34	15.031
UM	2016	38	38	65	55	59	45	38	29	19.097
UM	2017	36	36	56	48	76	41	32	29	19.097
UM	2018	37	45	63	44	62	31	28	36	21.687
UM	2019	40	48	62	39	66	34	37	41	23.156
UM	2020	37	48	64	30	97	40	29	37	21.742
UM	2021	35	47	65	36	72	42	27	21	23.741
UM	2022	37	67	68	34	62	40	30	23	25.847
UM	2023	38	66	66	28	60	42	34	34	29.178
HI	2024	38	83	62	22	50	44	30	27	33.780
HI	2025	37	81	64	22	35	60	28	32	39.185
	Frequency		6	-	6	-	2	8	8	

Serbia — US$ billion

Income	Year	GII	Institutions	Human capital and research	Infrastructure	Market sofistication	Business sofistication	Knowledge and technology outputs	Creativity outputs	GDP per capita PPP$
UM	2011	55	66	54	83	87	73	65	23	11.719
UM	2012	46	71	44	63	78	86	29	44	10.661
UM	2013	54	54	50	50	97	73	41	84	10.582
UM	2014	67	67	59	53	134	83	44	79	11.269
UM	2015	63	63	64	56	90	95	59	60	11.553
UM	2016	65	65	56	56	109	84	50	82	13.671
UM	2017	62	50	54	52	99	79	53	70	13.671
UM	2018	55	50	58	48	101	70	50	64	15.000
UM	2019	57	47	59	64	103	63	48	65	17.555
UM	2020	53	45	59	44	101	64	41	66	16.207
UM	2021	54	50	62	44	58	63	43	76	18.840
UM	2022	55	53	52	38	83	65	42	76	21.243
UM	2023	53	57	51	36	41	68	41	92	24.084
UM	2024	52	67	60	20	40	63	41	85	26.074
UM	2025	54	73	49	39	77	98	35	87	29.039
	Frequency		2	2	11	-	-	14	1	

Infrastructure appears as a moderate but stable factor of innovation potential, especially through digital and logistical connectivity, while market sophistication stands out as the most volatile pillar of the GII score.

Business sophistication acts as a key link between inputs and outputs. Countries with a stronger business sector and higher levels of technological and organizational sophistication tend to perform better in terms of knowledge and technology outputs, as well as creative outputs. This finding suggests that the business sector is an important driver of innovation in the region.

Overall, the data show that innovation capacity is the outcome of a broader institutional, educational, and market environment. Countries with stable institutions, strong human capital, and a developed business sector achieve higher innovation results, while weaknesses in market sophistication and institutional structures represent key obstacles to further innovation development.

PARTIAL CORRELATION ANALYSIS

The partial correlation coefficient measures the relationship between two variables while controlling for the influence of other variables suspected to affect the relationship under examination. In this way, it enables the identification of a unique, isolated association between two variables.

The analysis was conducted in three segments:

1. Partial correlation between GDP per capita and all GII components, with the aim of identifying which dimensions of the innovation system are directly associated with economic development
2. Partial correlation between Knowledge & Technology Outputs and the remaining GII components, with the aim of examining whether technology- and knowledge-based results depend on input components (institutions, human capital, infrastructure, market sophistication, business sophistication).
3. Partial correlation between Human Capital & Research and the remaining GII components, with the goal of determining whether investments in human capital and research generate innovation outputs or are primarily associated with other input pillars.

This approach enables the mapping of the structure of the innovation system and the identification of key relationships among its components.

The results of the partial correlation analysis between GDP per capita and the GII components for Serbia, Romania, Bulgaria, Hungary, Slovenia, and Croatia during the period 2011–2025 are presented in Table 1. The findings indicate the presence of statistically significant correlations between GDP per capita and all components of the

Global Innovation Index, except for Market Sophistication, Knowledge & Technology Outputs, and Creative Outputs.

A positive and statistically significant correlation exists between GDP per capita and the components Infrastructure, Human Capital & Research, and Business Sophistication. Increases in these components are accompanied by increases in GDP per capita. The highest statistically significant partial correlation coefficient is observed between GDP per capita and the Infrastructure component (0.7280). Conversely, the Institutions component shows a statistically significant negative correlation with GDP per capita.

Table 2. Partial Correlation Between GDP per Capita and the Components of the Global Innovation Index

Variable	Partial Corr.	Semipartial Corr.	Partial Corr.^2	Semipartial Corr.^2	Significance Value
ln_instit~s	-0.4855	-0.2694	0.2357	0.0726	0.0000
ln_hcr	0.4768	0.2632	0.2273	0.0693	0.0000
ln_infras~e	0.7280	0.5153	0.5301	0.2656	0.0000
ln_ms	0.0661	0.0322	0.0044	0.0010	0.5500
ln_bs	0.2992	0.1521	0.0895	0.0231	0.0057
ln_kto	-0.0868	-0.0423	0.0075	0.0018	0.4324
ln_co	-0.1275	-0.0624	0.0162	0.0039	0.2479

The values of the partial correlation coefficients between Knowledge & Technology Outputs and the other components of the Global Innovation Index clearly indicate their association with Business Sophistication. The positive and statistically significant correlation between these two components suggests that investments aimed at achieving knowledge- and technology-based results are a prerequisite for attaining business sophistication, which enhances the market competitiveness of products and services. However, the correlations between Knowledge & Technology Outputs and the remaining components are not statistically significant.

Table 3. Partial Correlation Between Knowledge & Technology Outputs and the Remaining Components of the Global Innovation Index

Variable	Partial Corr.	Semipartial Corr.	Partial Corr.^2	Semipartial Corr.^2	Significance Value
ln_gdp	-0.0868	-0.0719	0.0075	0.0052	0.4324
ln_instit~s	-0.1294	-0.1076	0.0167	0.0116	0.2408
ln_hcr	-0.0437	-0.0360	0.0019	0.0013	0.6933
ln_infras~e	0.0432	0.0357	0.0019	0.0013	0.6963
ln_ms	0.1229	0.1021	0.0151	0.0104	0.2654
ln_bs	0.4377	0.4014	0.1916	0.1611	0.0000
ln_co	-0.0737	-0.0609	0.0054	0.0037	0.5052

The values of the partial correlation coefficients between Human Capital & Research and the other components of the Global Innovation Index are presented in Table 3.

The results of the partial correlation analysis between Human Capital & Research and the other GII components show that a positive and statistically significant correlation exists with the component Institutions and Business Sophistication. In the observed countries, the development of institutions is associated with improvements in human capital and research. Likewise, investments in human capital and research activities are linked to advancements in business sophistication.

The statistically significant negative correlation between Human Capital & Research and the Infrastructure component indicates that higher investments in infrastructure are accompanied by reduced investments in human capital. However, Human Capital & Research is not statistically significantly correlated with Knowledge & Technology Outputs or Creative Outputs, suggesting that investments in human capital and research activities are not followed by increases in knowledge, technology, or creativity-based results.

Table 4. Partial correlation between Human capital and research and other components of the Global Innovation Index

Variable	Partial Corr.	Semipartial Corr.	Partial Corr.^2	Semipartial Corr.^2	Significance Value
ln_gdp	0.4768	0.3351	0.2273	0.1123	0.0000
ln_instit~s	0.3518	0.2321	0.1237	0.0539	0.0010
ln_infras~e	-0.3654	-0.2425	0.1335	0.0588	0.0006
ln_ms	-0.1506	-0.0941	0.0227	0.0089	0.1716
ln_bs	0.2935	0.1897	0.0862	0.0360	0.0067
ln_kto	-0.0437	-0.0270	0.0019	0.0007	0.6933
ln_co	-0.0051	-0.0031	0.0000	0.0000	0.9634

STRUCTURAL DRIVERS AND CONSTRAINTS OF SERBIA'S INNOVATION SYSTEM (2011–2025)

The analysis of pillar-level trends in Serbia from 2011 to 2025 shows that the Infrastructure pillar is the most stable and exhibits continuous improvement throughout the period. GDP per capita growth is strongly associated with infrastructure. The most important structural problem is the negative correlation between GDP growth and human capital. Human capital does not contribute to innovation outputs, indicating that the system does not convert education into innovation. As a result, Serbia produces fewer innovation outputs relative to its level of innovation investments.

Although GDP grows strongly, innovation outputs do not follow this trajectory. The trend in the scores of the two output pillars shows that the key structural problem lies in the conversion of inputs into outputs. The trends of the innovation pillars in the Republic of Serbia are presented in Figure 1.

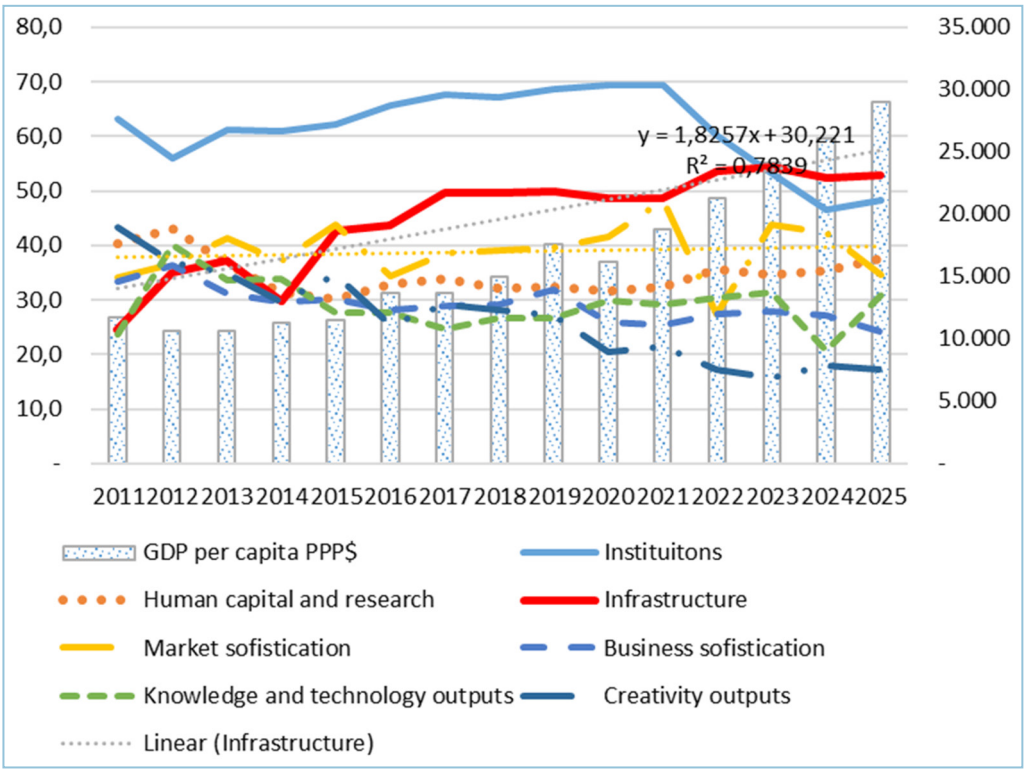
The results show that infrastructure is the most important pillar of innovation potential and a key driver of GDP growth in Serbia. Its role goes beyond simply providing physical and digital capacity. Investments in infrastructure create conditions for a more efficient

flow of information, lower transaction costs, and faster diffusion of technology, which indirectly affects other innovation inputs and outputs.

In contrast, human capital appears to be the weakest element of innovation potential. The indicators suggest that it does not show significant growth, nor does it have a statistically significant impact on innovation performance. The development of human capital seems to be more a result of new investments in the Serbian economy (Beke-Trivunac & Peković, 2022). In this context, underdeveloped human capital acts as a limiting factor, reducing the effects of both infrastructure and other inputs.

The analysis of innovation outputs in the region — both knowledge and creative dimensions — confirms that they largely rely on infrastructure and institutions. Weak institutional development and the lack of contribution from human capital point to a structural imbalance in the innovation system, where results are achieved despite, rather than because of, education and workforce capacities.

Figure 2. Trend of Innovation Capacity Pillars in the Republic of Serbia



Note: *Pillar values range from 0 to 100. Higher values indicate better performance. (Source: Authors)*

Although GDP shows steady growth, innovation potential does not follow the same trend. This divergence suggests that growth is driven more by investment than by

outputs based on knowledge, skills, and creative capacity. It also points to the limited sustainability of the current growth model and the need for strategic measures aimed at strengthening human capital as a fundamental factor in the development of Serbia's innovation potential.

CONCLUSION

The Global Innovation Index (GII) ranks economies according to their innovation potential. This composite index was developed to measure the effectiveness of specific policies, best practices, and mechanisms that support innovation. It evaluates innovation capacity through two sub-indices: the input sub-index, which includes the economic factors that enable and support innovation activities, and the output sub-index, which reflects innovation outcomes. Economies with stronger institutional frameworks and more developed education and research capacities tend to achieve better innovation results.

The assessment of Serbia's relative position in comparison with economically and institutionally similar countries is based on a comparative longitudinal analysis of the innovation performance of Serbia and selected countries in the region—Croatia, Slovenia, Hungary, Romania, and Bulgaria—over the period 2011–2025.

The findings show that economies with the highest innovation potential base their performance mainly on the pillars of Institutions and Business sophistication (Slovenia, Hungary, Croatia, and Bulgaria). In terms of GDP, these economies belong to the high-income group, meaning they have a high GDP per capita. Countries with a stronger business sector and higher levels of technological and organizational sophistication achieve better results in knowledge and technology outputs as well as creative outputs, confirming the central role of the business sector in driving innovation in the region. The importance of this pillar is particularly visible in the investment potential of Hungary.

Economies classified as upper middle-income (Romania in the period 2011–2023 and Serbia) place the greatest emphasis on infrastructure development. However, infrastructure represents a precondition rather than a direct driver of innovation potential, which is reflected in the lower innovation performance of these countries.

The results of the analysis based on partial correlation coefficients indicate that an increase in GDP per capita is associated with improvements in infrastructure, human capital and research, and business sophistication. There is a positive and statistically significant correlation between Knowledge and technology output and Business sophistication. Improvements in human capital and research activities are also significantly related to the development of institutions and business sophistication, but they are not accompanied by a corresponding increase in knowledge-, technology-, and creativity-based outputs.

The very low ranking of the Institutions and Business sophistication pillars for Serbia suggests that further improvement in its innovation potential depends on faster institutional development and a higher level of technological and organizational sophistication

in the business sector. According to annual GII reports, Serbia is typically assessed as an economy whose investment potential is in line with its level of economic development (GDP). In that sense, it can be expected that future GDP growth will also contribute to the improvement of its innovation potential.

POLICY RECOMMENDATIONS

To address the identified structural weaknesses and enhance Serbia's innovation capacity, several policy priorities are recommended, including strengthening institutional quality (especially, fostering institutional mechanisams that support collaboration between government, academia and industry), enhancing business sophistication (especially, introducing incentives for R&D investment), prioritize human capital development (especially, reforming education and training systems to align skills with innovation-driven economic needs), and improve input-output conversion efficiency (especially, involve the private sector in innovation governance to ensure policy relevance).

LIMITATIONS

Several limitations should be acknowledged when interpreting the findings, especially, a limited sample of countries and the absence of efficiency metrics, as the study does not evaluate how effectively countries convert innovation inputs into outputs.

FUTURE RESEARCH DIRECTIONS

To deepen understanding of innovation system dynamics, future research should consider including additional CEE and EU economies for more robust comparative insights, integrating innovation efficiency measures, and exploring causal mechanisms, using micro-level data, by incorporating firm-level or researcher-level datasets to understand micro-drivers of innovation.

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Inovacioni potencijal Republike Srbije: Procena zasnovana na GII

Apstrakt: Ovaj rad ispituje učinak komponenti Globalnog inovacionog indeksa (GII) na inovacioni potencijal Republike Srbije, za period 2011–2025. Ispitivanje se odvija uporednom analizom šest ekonomija Centralne i Istočne Evrope (Srbija, Rumunija, Bugarska, Mađarska, Slovenija i Hrvatska), radi identifikacije ključnih predikatora inovacionog potencijala za izabranu regiju, i parcijalnom korelacionom analizom, radi identifikacije ključnih odnosa između komponenti GII između BDP-a po glavi stanovnika. Rezultati pokazuju da je infrastruktura najstabilniji i najsnažniji pokretač rasta BDP-a i inovacionih rezultata u Srbiji, za razliku od najbolje ocenjenih zemalja u okruženju u kojima stubovi institucija i poslovne sofisticiranosti imaju presudnu ulogu u konverziji inovacionih inputa u outpute. Nasuprot tome, investiranja u ljudski kapital čine najslabiju kariku inovacionog sistema Republike Srbije, bez statistički značajnog doprinosa inovacionim performansama. Ovakva strukturna neravnoteža ukazuje da se ekonomski rast Srbije zasniva na investicionim, a ne na znanjem zasnovanim faktorima. Rezultati ispitivanja ukazuju na potrebu za ciljanim politikama usmerenim na jačanje institucionalnog okvira, unapređenje poslovne sofisticiranosti i strateško ulaganje u ljudski kapital, kako bi se povećala efikasnost pretvaranja inputa u inovacione rezultate i obezbedio održiv, inovaciono zasnovan razvoj.

Ključne reči: Globalni inovacioni indeks; inovacioni kapacitet; ljudski kapital; infrastruktura; institucije; poslovna sofisticiranost; Srbija; BDP per capita; inovaciona efikasnost.