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Economic security of the Republic of Serbia in an era of global disruptions: macroeconomic resilience, social cohesion, energy and food security, and innovation capacity

Ekonomska bezbednost Republike Srbije u eri globalnih poremećaja: makroekonomska otpornost, socijalna kohezija, energetska i prehrambena bezbednost i inovacioni kapacitet

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Abstract

The aim of this study is to assess the economic security of the Republic of Serbia over the period 2021-2025 through a multidimensional framework encompassing macroeconomic resilience, social cohesion, energy and food security, and innovation capacity. The analysis is based on 20 indicators obtained from official Serbian statistical sources. A hierarchical Entropy approach was applied to determine criterion weights, with equal weights assigned to the four dimensions and relative indicator weights within each dimension calculated using the Entropy method. The MARCOS method was then used to rank the observed years, while robustness was assessed by comparison with a conventional Entropy-MARCOS model and a MARCOS model with equal criterion weights. The results show that economic security was highest in 2024, followed by 2025 and 2021, whereas 2022 recorded the least favourable outcome. The dimension-level analysis indicates that the sources of economic resilience changed over time, with innovation capacity reaching its most favourable position in 2025. The identical ranking obtained across all three models confirms the stability of the results and supports the use of a multidimensional approach to assessing national economic security.
Keywords: *economic security, macroeconomic resilience, social cohesion, energy and food security, innovation capacity, Entropy-MARCOS, Serbia*

Sažetak

Cilj istraživanja je procena ekonomske bezbednosti Republike Srbije u periodu 2021-2025. godine kroz multidimenzionalni okvir koji obuhvata makroekonomsku otpornost, socijalnu koheziju, energetsku i prehrambenu bezbednost i inovacioni kapacitet. Analiza je zasnovana na 20 pokazatelja preuzetih iz zvaničnih izvora Republike Srbije. Za određivanje težinskih koeficijenata primenjen je hijerarhijski Entropy pristup, pri čemu je svakoj dimenziji dodeljen jednak ponder, dok su relativni ponderi pokazatelja unutar dimenzija određeni Entropy metodom. Rangiranje godina sprovedeno je MARCOS metodom, a robusnost rezultata proverena je poređenjem sa klasičnim Entropy-MARCOS modelom i modelom sa jednakim ponderima. Rezultati pokazuju da je najviši nivo ekonomske bezbednosti ostvaren 2024. godine, zatim 2025. i 2021, dok je 2022. bila najnepovoljnija. Dimenzionalna analiza pokazuje da su se izvori ekonomske otpornosti tokom perioda menjali, pri čemu je inovacioni kapacitet dostigao najpovoljniji rezultat 2025. godine. Identičan rang u sva tri modela potvrđuje stabilnost dobijenih rezultata i opravdanost multidimenzionalnog pristupa proceni ekonomske bezbednosti.
Ključne reči: *ekonomska bezbednost, makroekonomska otpornost, socijalna kohezija, energetska i prehrambena bezbednost, inovacioni kapacitet, Entropy-MARCOS, Srbija*

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1. Introduction

In recent years, the global economy has been exposed to a series of interconnected disruptions, including the COVID-19 pandemic, supply chain disruptions, the energy crisis, rising inflation, and geopolitical tensions. These developments have once again brought into focus the ability of national economies to absorb external shocks, preserve essential economic and social functions, and adjust to changing conditions. The concept of economic resilience places particular emphasis on the capacity of an economic system to withstand disruption, recover, and, when necessary, adapt or alter its existing development path (Martin & Sunley, 2015). Empirical studies also show that differences in economic structure and other country-specific characteristics significantly affect the ability of economies to respond to recessionary shocks (Martin et al., 2016).

Economic security is closely related to this concept, although it has a broader scope. It refers to the availability of economic resources and capacities that enable the stable functioning of the state and society, as well as the timely identification and mitigation of economic risks. In the context of Serbia, Milošević and Stajić (2018) emphasize that monitoring economic indicators makes it possible to assess risks that may threaten both economic and political stability, making economic security an important component of overall national security.

However, the experience of recent global disruptions suggests that economic security cannot be assessed solely on the basis of economic growth or fiscal stability. Economic resilience also depends on the position of the population in the labour market, income distribution, access to energy and food, and the capacity to generate, apply, and commercialize new knowledge and technologies. Innovation is particularly important in this respect, as European regions with stronger innovation capacities are more likely to withstand economic crises successfully or recover from them more quickly (Bristow & Healy, 2018).

Such a multidimensional approach is particularly relevant for Serbia. In addition to macroeconomic disturbances, the Western Balkan countries face structural challenges in the areas of energy, food security, and innovation. Brankov and Matkovski (2022) point to the importance of food affordability and food self-sufficiency in the region, while Ignjatović et al. (2024) identify energy intensity and dependence on fossil fuels as major development challenges for the Western Balkans. At the same time, Fedajev et al. (2024) show that underdeveloped national innovation systems represent one of the constraints on the future growth of countries in the region.

Although previous studies have examined individual aspects of economic security, resilience, energy, food security, and innovation in Serbia and the Western Balkans, relatively few studies have integrated these components into a single framework for assessing Serbia's economic security. Accordingly, the aim of this study is to assess the level of economic security of the Republic of Serbia over the period 2021–2025 through four interrelated dimensions: macroeconomic resilience, social cohesion, energy and food security, and innovation capacity. These dimensions were operationalized using 20 indicators, while the observed years were ranked by applying an integrated Entropy-MARCOS approach.

2. Literature review

2.1. Macroeconomic resilience

Macroeconomic resilience refers to an economy's ability to limit the effects of external or internal shocks and to restore stable economic activity after a disruption. Martin and Sunley (2015) point out that resilience encompasses several interrelated processes, including resistance to shocks, recovery, and adaptation to changing conditions. The empirical analysis by Martin et al. (2016) further shows that the way economies respond to recessions depends both on their economic structure and on other specific factors that determine their capacity to adjust.

In the context of economic security, macroeconomic resilience implies that economic growth should be accompanied by controlled inflation, sustainable public debt, a sustainable external position, and sufficient reserves to respond to disruptions. Milošević and Stajić (2018), in their discussion of economic security indicators for Serbia, also emphasize the importance of monitoring macroeconomic performance and economic risks as a basis for assessing the stability of the national economy.

Accordingly, in this study, macroeconomic resilience and the capacity to respond to external disruptions are represented by real GDP growth, inflation, public debt, the current account balance, and the adequacy of foreign exchange reserves. This combination makes it possible to capture, at the same time, the dynamics of economic activity, price and fiscal stability, external balance, and the availability of financial buffers for responding to shocks.

2.2. Social cohesion

Economic resilience does not depend solely on aggregate macroeconomic performance. The ability of the population to maintain employment, real incomes, and an acceptable standard of living during a crisis affects social stability and the capacity of society to adjust to economic disruptions. For this reason, the social dimension represents an important component of the broader concept of economic security.

Empirical literature confirms the relationship between social characteristics and economic resilience. Terzo (2021), analysing Italian provinces during the Great Recession, finds that certain forms of social capital are positively associated with the economic resilience of local communities. Similarly, Patel and Gleason (2018) identified a statistically significant positive relationship between social cohesion and community resilience, with social cohesion showing the strongest effect among the characteristics examined. Although their study concerns community resilience in a different institutional context,

the findings support the broader importance of social connectedness and stability for the capacity to respond to shocks.

In this study, social cohesion is operationalized through the employment rate, unemployment rate, risk of poverty, the Gini coefficient, and real growth in net wages. Taken together, these indicators capture labour market conditions, income distribution, and changes in real living standards.

2.3. Energy and food security

Energy security is an important component of economic resilience because almost all production and consumption activities depend on a stable and affordable energy supply. This aspect became particularly important during the European energy crisis, when supply disruptions and sharp changes in energy prices directly affected inflation, production costs, and economic activity.

The Western Balkan countries also face significant structural vulnerabilities. Ignjatović et al. (2024) point to relatively high energy intensity, the considerable share of fossil fuels, and the need to modernize the energy systems of countries in the region. Their findings suggest that the energy transition is not only an environmental issue, but also an important element of long-term economic resilience and stability.

Food security, on the other hand, depends not only on the ability of the domestic economy to produce sufficient quantities of food, but also on its affordability. Brankov and Matkovski (2022), analysing the Western Balkan countries, show that food self-sufficiency does not necessarily guarantee a high level of food security if strong price increases reduce the population's access to food. The authors particularly emphasize inflationary pressures and rising food prices as a significant risk for the region.

For this reason, energy and food security in this study are assessed through indicators of energy production and supply, agricultural production, food production, and changes in food prices. This makes it possible to consider both the physical availability of key resources and their economic accessibility.

2.4. Innovation capacity

Innovation capacity affects an economy's ability to adapt to technological and market changes, create new sources of growth, and transform its existing economic structure (Krstić & Đekić, 2026). Bristow and Healy (2018), using a sample of European regions, showed that regions classified as innovation leaders before the economic crisis were more likely either to withstand the crisis or to recover relatively quickly afterwards. This finding provides direct empirical support for including innovation capacity in the analysis of economic resilience.

The importance of innovation for the Western Balkan countries is further confirmed by Fedajev et al. (2024). By comparing the national innovation systems of the Western Balkan countries with those of Central and Eastern Europe, the authors conclude that insufficient innovation capacity represents one of the constraints on their future growth and convergence towards more developed European economies.

The development of ICT services plays a particularly important role in the contemporary transformation of economies. Cieślik (2022) shows that the information and communication services sector in Central and Eastern European countries recorded strong growth in exports, value added, and productivity, thereby increasing its importance in global value chains. These findings are also relevant for Serbia, given the growing importance of ICT service exports and the information and communication sector.

In this study, innovation capacity is measured through budget allocations for research and development, patent applications filed by domestic applicants, ICT service exports, household broadband connectivity, and the share of the information and communication sector in GDP. In this way, the analysis captures innovation system inputs, innovation outputs, digital infrastructure, and the capacity to commercialize knowledge.

3. Research methodology

The economic security of the Republic of Serbia was analysed for the period 2021–2025 using a multi-criteria approach. The observed years represent the alternatives, while economic security was operationalized through 20 indicators grouped into four dimensions: macroeconomic resilience, social cohesion, energy and food security, and innovation capacity. Each dimension includes five indicators. The criteria were predefined as either benefit criteria, where a higher value indicates a more favourable outcome, or cost criteria, where a lower value is preferable. The indicator structure was developed in accordance with the principles of multidimensional measurement of complex phenomena through composite indicators (OECD & European Union, 2008).

Data for the period 2021–2025 were obtained from official statistical sources of the Republic of Serbia. Indicators of macroeconomic resilience, social cohesion, energy and food security, as well as part of the innovation capacity indicators, were taken from publications and dissemination databases of the Statistical Office of the Republic of Serbia [RZS] (2025, 2026a–2026g). Data on public debt, the current account balance, foreign exchange reserve adequacy, and ICT service exports were obtained from publications of the National Bank of Serbia [NBS] (2026a, 2026b). Data on patent applications filed by domestic applicants were taken from the annual reports of the Intellectual Property Office of the Republic of Serbia [ZIS] (2026). Mutually comparable annual series were used, while for 2025 the latest officially available data at the time the research was conducted were applied. The

Entropy method was used to determine the weights of the criteria. This method assigns weights according to the degree of dispersion in criterion values, that is, according to the amount of information contained in the differences between alternatives (Zhu et al., 2020). For each criterion, the proportions were first calculated as follows:

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}}$$

where $x\,ij$ represents the value of criterion j for alternative $i, p\,ij$ is the normalized proportion of the value of criterion j for alternative i, and m denotes the number of alternatives, that is, the number of observed years.

The entropy of each criterion was then calculated as follows:

$$e_j = -\frac{1}{\ln m}\sum_{i=1}^{m} p_{ij} \ln p_{ij}$$

where $e\,j$ represents the entropy value of criterion j.

The degree of diversification of each criterion was determined using the following expression:

$$d_j = 1 - e_j$$

where $d\,j$ denotes the degree of diversification of criterion j.

Based on this, the relative weights of the criteria were calculated as follows:

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j}$$

where $w\,j$ represents the relative weight of criterion j, while n denotes the total number of criteria. In this study, the number of alternatives is m=5, while the number of criteria is n=20.

Given that the Entropy method assigns greater weight to criteria with higher variability, which in short time series may lead to the concentration of weights on a relatively small number of indicators (Zhu et al., 2020), hierarchical weighting was applied. The four theoretically equivalent dimensions were assigned an equal weight of 0.25, while the relative weights of the five indicators within each dimension were determined using the Entropy method. The final weight of each indicator was obtained by multiplying its relative weight within the dimension by the weight assigned to that dimension. In this way, equal representation of the four main dimensions of economic security was preserved, while allowing for objective differentiation among the indicators within each dimension.

The observed years were ranked using the MARCOS (Measurement of Alternatives and Ranking according to Compromise Solution) method, which determines the position of each alternative in relation to the ideal and anti-ideal solutions (Stević et al., 2020). After the extended matrix was formed, the criteria were normalized according to whether they were defined as benefit or cost criteria and were then weighted using the previously determined hierarchical coefficients. The utility function of each alternative was subsequently calculated, and the final ranking of the observed years was established.

The robustness of the results was assessed by comparing the baseline hierarchical Entropy-MARCOS model with two alternative scenarios: a MARCOS model using Entropy weights determined across all criteria and a MARCOS model with equal weights assigned to all criteria. Comparing different weighting systems makes it possible to assess the stability of the final ranking and represents an important element of sensitivity analysis for composite indicators (Saisana et al., 2005). All calculations were performed in Microsoft Excel.

4. Research results

The initial decision matrix included 20 indicators of the economic security of the Republic of Serbia for the period 2021–2025. The indicators were grouped into four dimensions: macroeconomic resilience, social cohesion, energy and food security, and innovation capacity. The values used in the analysis are presented in Table 1.

Table 1. Initial matrix of economic security indicators of the Republic of Serbia, 2021-2025

Code	Indicator	Direction	2021	2022	2023	2024	2025
M1	Real GDP growth rate (%)	+	7.9	2.7	3.7	3.9	2.0
M2	Average annual inflation rate (%)	−	4.0	11.9	12.1	4.6	3.8
M3	Central government public debt (% of GDP)	−	53.8	52.4	48.0	46.7	44.5
M4	Current account balance (% of GDP)	+	−4.1	−6.6	−2.4	−4.5	−4.8
M5	Import coverage by gross foreign exchange reserves (months)	+	6.0	5.2	6.7	7.3	6.8
S1	Employment rate (%)	+	48.6	50.3	50.2	51.4	51.2
S2	Unemployment rate (%)	−	11.0	9.4	9.4	8.6	8.7
S3	At-risk-of-poverty rate (%)	−	21.4	20.2	19.9	19.7	19.6
S4	Gini coefficient	−	33.3	32.6	31.7	31.9	32.0
S5	Real growth rate of average net wages (%)	+	5.4	1.7	2.4	9.1	7.4

Table 1. Continued

Code	Indicator	Direction	2021	2022	2023	2024	2025
E1	Industrial production index – Energy	+	101.6	98.3	104.5	93.1	96.9
E2	Production index – electricity, gas, steam and air conditioning supply	+	100.7	92.9	112.7	93.5	98.2
E3	Real change in the physical volume of agricultural production (%)	+	−5.0	−8.0	9.0	−8.8	−0.3
E4	Average annual growth rate of food and non-alcoholic beverage prices (%)	−	4.4	18.8	17.9	3.3	3.7
E5	Food production index	+	100.4	100.1	101.4	104.3	98.5
I1	Budget allocations for research and development (% of GDP)	+	0.42	0.39	0.40	0.40	0.41
I2	Patent applications filed by domestic applicants	+	138	127	117	138	119
I3	ICT service exports (EUR million)	+	1,857.1	2,692.0	3,440.0	4,132.8	4,552.4
I4	Households with broadband internet connection (%)	+	81.4	83.2	85.6	88.8	90.1
I5	Share of the information and communication sector in GDP (%)	+	6.3	7.0	8.2	8.5	8.7

Source: RZS (2025, 2026a–2026g), NBS (2026a, 2026b), and ZIS (2026); Authors' calculations

Note: For 2025, the latest officially available result based on quarterly calculations was used for indicator M1, while I5 was calculated from published quarterly data. For E3, official annual estimates published by RZS were used. For the purposes of the MARCOS analysis, M4 was transformed into the absolute value of the deficit and treated as a cost criterion, while E3 was transformed into a chain index (100 + rate of change).

The application of the Entropy method within each of the four dimensions revealed substantial differences in the informational value of individual indicators. Since each dimension was assigned an equal weight of 0.25, the final hierarchical weight was obtained by multiplying the relative Entropy weight within each dimension by the weight assigned to that dimension.

Table 2. Entropy weights of indicators in the hierarchical model

Code	Relative weight within the dimension	Dimension weight	Final weight
M1	0.3742	0.25	0.0936
M2	0.4452	0.25	0.1113
M3	0.0082	0.25	0.0020
M4	0.1509	0.25	0.0377
M5	0.0215	0.25	0.0054
S1	0.0012	0.25	0.0003
S2	0.0246	0.25	0.0062
S3	0.0031	0.25	0.0008
S4	0.0010	0.25	0.0002
S5	0.9701	0.25	0.2425
E1	0.0028	0.25	0.0007
E2	0.0091	0.25	0.0023
E3	0.0079	0.25	0.0020
E4	0.9796	0.25	0.2449
E5	0.0006	0.25	0.0002
I1	0.0057	0.25	0.0014
I2	0.0443	0.25	0.0111
I3	0.8040	0.25	0.2010
I4	0.0131	0.25	0.0033
I5	0.1329	0.25	0.0332

Source: Authors' calculations based on data from RZS, NBS, and ZIS

Within the macroeconomic resilience dimension, the highest weight was assigned to the average annual inflation rate (0.1113), followed by the real GDP growth rate (0.0936). In the social cohesion dimension, the highest weight was assigned to the real growth of average net wages (0.2425), while in the energy and food security dimension, the growth in food and non-alcoholic beverage prices had the dominant weight (0.2449). Within the innovation capacity dimension, ICT service exports received the highest weight (0.2010). After the criteria were normalized and weighted, the MARCOS method was applied. The results of the baseline hierarchical Entropy-MARCOS model are presented in Table 3.

The highest utility function value was recorded in 2024 ($f(K_i) = 0.8386$), which ranked first. This was followed by 2025 (0.7839) and 2021 (0.6436). Lower values were recorded in 2023 (0.4135), while 2022 ranked last with a value of 0.3245.

The movement of the utility function indicates a marked deterioration between 2021 and 2022, followed by a partial recovery in 2023. The greatest improvement was recorded in 2024, while 2025 saw a slight decline in the overall value compared with 2024, although it retained second place in the analysed period. To examine the internal structure of the overall result, the MARCOS

analysis was also conducted separately for the four dimensions of economic security.

Table 3. Results of the hierarchical Entropy-MARCOS model

Year	(S_i)	(K_i^-)	(K_i^+)	$(f(K_i))$	Rang
2021	0.6872	2.3198	0.6872	0.6436	3
2022	0.3465	1.1696	0.3465	0.3245	5
2023	0.4415	1.4905	0.4415	0.4135	4
2024	0.8954	3.0226	0.8954	0.8386	1
2025	0.8370	2.8254	0.8370	0.7839	2

Source: Authors' calculations based on data from RZS, NBS, and ZIS

Table 4. Results of the MARCOS analysis by dimensions of economic security

Year	Macroeconomic resilience $(f(K_i))$ / rank	Social cohesion $(f(K_i))$ / rank	Energy and food security $(f(K_i))$ / rank	Innovation capacity $(f(K_i))$ / rank
2021	**0.8472 / 1**	0.5795 / 3	0.7310 / 3	0.4208 / 5
2022	0.3233 / 5	0.2018 / 5	0.1838 / 5	0.5545 / 4
2023	0.4593 / 4	0.2740 / 4	0.1951 / 4	0.6824 / 3
2024	0.6166 / 2	**0.9662 / 1**	**0.9678 / 1**	0.7985 / 2
2025	0.5992 / 3	0.7908 / 2	0.8660 / 2	**0.8603 / 1**

Source: Authors' calculations based on data from RZS, NBS, and ZIS

The dimensional results show that the structure of economic security was not uniform throughout the entire period. The highest level of macroeconomic resilience was recorded in 2021, while 2022 showed the least favourable result. In the dimensions of social cohesion and energy and food security, the best results were achieved in 2024. By contrast, innovation capacity showed continuous improvement over the analysed period, reaching its highest value in 2025.

Finally, a robustness analysis was conducted by comparing the baseline hierarchical model with the pure Entropy-MARCOS model and the MARCOS model with equal weights.

Table 5. Robustness analysis of the results under alternative weighting systems

Year	Hierarchical Entropy-MARCOS $(f(K_i))$	Rank	Entropy-MARCOS $(f(K_i))$	Rank	Equal weights-MARCOS $(f(K_i))$	Rank
2021	0.6436	3	0.7249	3	0.6587	3
2022	0.3245	5	0.2702	5	0.5674	5
2023	0.4135	4	0.3511	4	0.6397	4
2024	**0.8386**	**1**	**0.8207**	**1**	**0.7101**	**1**
2025	**0.7839**	**2**	**0.7492**	**2**	**0.6979**	**2**

Source: Authors' calculations based on data from RZS, NBS, and ZIS

All three models produced the same ranking of the observed years: 2024 → 2025 → 2021 → 2023 → 2022. Thus, changing the weighting system did not alter the rank of any of the years, confirming the stability of the results. At the same time, differences in the absolute values of the utility function indicate that the choice of weights affects the magnitude of the differences between years, but not their relative ordering.

5. Discussion

The results show marked changes in the economic security of the Republic of Serbia over the period 2021–2025, with the least favourable result recorded in 2022 and the most favourable in 2024. The observed dynamics support the use of a multidimensional approach, since changes in overall economic security were not determined solely by GDP movements, but by a combination of macroeconomic, social, energy, food, and innovation indicators.

The lowest result, recorded in 2022, can primarily be associated with strong inflationary pressures and a deterioration in energy and food security. In our model, average inflation reached 11.9%, while the increase in food and non-alcoholic beverage prices amounted to 18.8%. At the same time, agricultural production declined and energy indicators weakened. This result is consistent with the findings of Brankov and Matkovski (2022), who identified a pronounced deterioration in food affordability in the Western Balkan countries during 2022 and specifically pointed to the strong increase in food prices in Serbia. The authors also show that Serbia's relatively high level of food self-sufficiency does not eliminate the risk of food insecurity when rising prices reduce the economic accessibility of food. This supports our approach, in which the production and price components of food security were considered separately.

The influence of the energy shock on Serbia's unfavourable result in 2022 is also supported by the broader European literature. Szafranek et al. (2024), using the example of Poland as a small open economy, show that specific energy price shocks and global supply disruptions were among the main drivers of the recent inflationary wave. Similarly, Glocker and Wegmüller (2024) start from the fact that the 2021–2022 energy crisis generated strong inflationary pressures in European economies and show that rising energy prices simultaneously affect inflation, output, and the current account. These studies do

not directly confirm the result for Serbia, but they provide a relevant explanation of the mechanism through which external energy shocks may have contributed to Serbia's weaker position in 2022.

The highest overall result, achieved in 2024, reflected a combination of substantially lower inflation, strong real wage growth, and favourable outcomes in the dimensions of social cohesion and energy and food security. It is particularly important that 2024 did not achieve the best result in the macroeconomic dimension, but ranked first in two other dimensions. This indicates that improvements in economic security may arise from the simultaneous strengthening of several interrelated areas, even when individual macroeconomic indicators are not at their highest levels.

The energy component of the results requires additional attention. Ignjatović et al. (2024) show that the Western Balkan countries, including Serbia, are characterized by relatively high energy intensity, a strong dependence on fossil fuels, and the need to modernize their energy sectors. The authors view the energy transition not only as an environmental requirement, but also as a prerequisite for the long-term resilience and energy security of the region. These findings complement our results by showing that the more favourable short-term performance of the energy dimension in 2024 and 2025 does not mean that the structural vulnerabilities of the energy system have been eliminated.

The result for 2025 is particularly noteworthy. Although real GDP growth slowed, overall economic security remained in second place, while innovation capacity reached its highest value in the analysed period. This result was primarily associated with the strong growth of ICT service exports, the expansion of broadband connectivity, and the increasing economic importance of the information and communication sector. Cieślik (2022) found that ICT services in Central and Eastern European countries recorded particularly strong growth in exports, value added, and productivity during the observed period and that, in a number of countries, they may have a positive impact on integration into global value chains. Although Serbia was not included in the sample of that study, the findings provide a relevant regional framework for interpreting the growing importance of the ICT sector in the structure of Serbia's economic resilience.

The dimensional results show that the sources of economic security change over time. Macroeconomic resilience was highest in 2021, social cohesion and energy and food security in 2024, while innovation capacity recorded its most favourable result in 2025. This finding supports the view that resilience is not a static condition, but rather the ability of an economy to absorb and overcome external disruptions through different channels. In this sense, the results indicate not only a recovery after 2022, but also a change in the structure of the factors supporting Serbia's economic security.

The robustness analysis provides additional support for the reliability of the results. The hierarchical Entropy-MARCOS model, the conventional Entropy-MARCOS model, and the MARCOS model with equal weights produced the same ranking: 2024 → 2025 → 2021 → 2023 → 2022. The final ranking is therefore not the result of a single weighting procedure. At the same time, the concentration of conventional Entropy weights on indicators with the largest short-term fluctuations supports the use of the hierarchical model, which ensures equal representation of the four theoretically defined dimensions.

The findings suggest that strengthening Serbia's economic security requires the simultaneous preservation of macroeconomic stability, real living standards and food affordability, a reduction in energy vulnerabilities, and further development of innovation and digital capacity. The growth of the ICT sector stands out as a potential structural source of resilience, but its expansion cannot fully compensate for the risks arising from inflation, energy dependence, and instability in agricultural production.

A particular contribution of this study lies in integrating four interrelated dimensions of economic security, namely macroeconomic resilience, social cohesion, energy and food security, and innovation capacity, into a single analytical framework for the Republic of Serbia. Unlike approaches that examine individual components of economic resilience separately, the proposed model enables the simultaneous assessment of short-term shocks and the structural capacities of the economy. Additional methodological value is provided by combining hierarchical Entropy weighting with the MARCOS method and testing the robustness of the results using alternative weighting systems.

6. Conclusion

The study showed that the economic security of the Republic of Serbia changed unevenly over the period 2021–2025 and was shaped by the simultaneous influence of macroeconomic, social, energy, food, and innovation factors. The most favourable overall result was recorded in 2024, followed by 2025 and 2021, while 2022 was the least favourable year. The same ranking was obtained using the hierarchical Entropy-MARCOS model, the conventional Entropy-MARCOS approach, and the MARCOS model with equal weights, indicating the stability of the results.

The results by individual dimensions show that the sources of economic security were not the same throughout the analysed period. Macroeconomic resilience was strongest in 2021, social cohesion and energy and food security achieved their best results in 2024, while innovation capacity reached its most favourable level in 2025. This pattern confirms that economic security cannot be adequately assessed solely on the basis of GDP movements or other individual macroeconomic indicators.

The findings support a multidimensional understanding of economic security. They are consistent with the view of economic resilience as the ability of an economic system to withstand shocks, recover, and adjust to changing conditions, with resilience depending on a broader set of structural and institutional characteristics rather than only on short-term changes in economic activity (Martin & Sunley, 2015; Martin et al., 2016).

The results also support the inclusion of social, energy and food, and innovation dimensions within the broader concept of economic security. The importance of social factors for the ability of economic systems and communities to respond to shocks has also been confirmed in previous research (Terzo, 2021). The inclusion of food affordability is supported by the findings of Brankov and Matkovski (2022), who show that production self-sufficiency alone does not guarantee food security when rising prices restrict access to food. The structural importance of energy vulnerabilities for the Western Balkan countries is emphasized by Ignjatović et al. (2024), while the role of innovation capacity in strengthening economic resilience is supported by Bristow and Healy (2018) and Fedajev et al. (2024).

The contribution of this study lies in integrating these interrelated components into a single framework for assessing Serbia's economic security. An additional methodological contribution is the use of hierarchical weighting, which ensured equal representation of the four theoretically defined dimensions, while the Entropy method was used to differentiate indicators objectively within each dimension.

From a practical perspective, the findings suggest that Serbia's economic security policy should be based on a combination of measures aimed at preserving macroeconomic stability, real living standards, security of energy and food supply, and the development of innovation capacity. The experience of 2022 in particular shows that strong inflationary, energy, and food-related disruptions can significantly weaken overall economic security within a relatively short period.

At the same time, the results for 2024 and 2025 show that improvements in social indicators, lower inflationary pressures, and stronger innovation capacity can increase economic resilience even when real economic growth is not at its highest level. The growth of ICT service exports and the increasing importance of the information and communication sector suggest that the further development of the digital and innovation economy could become an important structural source of Serbia's resilience to future external shocks.

The study also has several limitations. First, the analysed period covers only five years, meaning that the model primarily captures relative changes during a period of intense global disruptions, while long-term structural trends would require a longer time series. The analysis is based on annual data, so short-term changes within individual years are not captured.

The selection of indicators was partly determined by the availability of methodologically comparable data for all five years. For some indicators referring to 2025, the latest officially available data were used, although they had not yet been published as final annual estimates at the time of the research. In addition, the results of the composite model depend on the selection of criteria and the weighting procedure. Nevertheless, the fact that three different weighting systems produced an identical ranking of the observed years reduces the likelihood that the main conclusion is driven by a single methodological specification.

Future research should extend the time horizon of the analysis, which would make it possible to distinguish more reliably between the short-term effects of crises and longer-term structural changes. It would also be useful to apply the same framework to the Western Balkan countries or to a broader sample of European countries in order to assess Serbia's relative position and identify differences in the sources of economic resilience.

The model could also be expanded by including indicators of energy dependence, the share of renewable energy sources, total research and development expenditure, research personnel, and other aspects of the innovation system once fully comparable annual series become available. Additional robustness checks could be conducted by applying other MCDM methods and alternative weighting systems, as well as by comparing results based on different structures of the composite index.

Declaration of generative AI in the writing process

During the preparation of this manuscript, the author(s) did not use generative AI or AI-assisted technologies in the writing process.

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