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Economic Performance of Balkan Countries

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ABSTRACT - The issue of analyzing the factors of the dynamics of the economic performance of each economy, which means the countries of the Balkans (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Kosovo, North Macedonia, Montenegro, Romania, Serbia, Slovenia, Greece and Turkey), Southeastern Europe, is continuously very current, challenging, significant and complex. Adequate control of key factors can have a significant impact on the achievement of the target economic performance of each economy, including the Balkan countries. The application of multi-criteria decision-making methods enables adequate control of the key factors of the economic performance of the economies of the Balkan countries. In terms of economic performance, Serbia is in a better position than Croatia and Slovenia. Kosovo is in the worst economic position. The target economic performance of the countrymen of the Balkans can be achieved by managing inflation, and unemployment, and receiving personal remittances as effectively as possible.

Izvirni znanstveni članek

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KLJUČNE BESEDE: gospodarstvo, zmogljivost, balkanske države, metoda LMAW-DNMA.

POVZETEK - Problematika analize dejavnikov dinamike gospodarske uspešnosti posameznega gospodarstva, kar pomeni države Balkana (Albanija, Bosna in Hercegovina, Bolgarija, Hrvaška, Kosovo, Severna Makedonija, Črna gora, Romunija, Srbija, Slovenija, Grčija in Turčija), jugovzhodna Evropa, je vseskozi zelo aktualna, zahtevna, pomembna in kompleksna. Ustrezen nadzor ključnih dejavnikov lahko pomembno vpliva na doseganje ciljne gospodarske uspešnosti vsakega gospodarstva, tudi balkanskih držav. Uporaba večkriterijskih metod odločanja omogoča ustrezen nadzor nad ključnimi dejavniki gospodarske uspešnosti gospodarstev balkanskih držav. Srbija je po gospodarski uspešnosti v boljšem položaju kot Hrvaška in Slovenija. Kosovo je v najslabšem gospodarskem položaju. Ciljno gospodarsko uspešnost balkanskih državljanov je mogoče doseči s čim bolj učinkovitim obvladovanjem inflacije in brezposelnosti ter prejemanjem osebnih nakazil.

1 Introduction

The motivation for researching the problem addressed in this paper is to use a mathematical approach to assess the economic performance of Balkan countries as accurately as possible. The goal of this is to improve the economic performance of Western Balkan countries in the future by taking appropriate measures based on this knowledge. The basic research hypothesis of the problem discussed in this study is based on the fact that only the continuous control of key factors contributes to the improvement of the economic performance of Balkan countries. The function of this is the application of the LMAW–DNMA method.

Researching the factors of the dynamics of the economic performance of each economy, which also includes the countries of the Balkans (Albania, Bosnia and

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Herzegovina, Bulgaria, Croatia, Kosovo, North Macedonia, Montenegro, Romania, Serbia, Slovenia, Greece, and Turkey) in Southeastern Europe, is very challenging, significant, complex, and continuously topical. It indicates the critical factors and what measures should be taken to achieve the target economic performance. Bearing that in mind, this paper comparatively analyzes the economic performance of the economies of Balkan countries using the LMAW–DNMA (Logarithm Methodology of Additive Weights – Double Normalization-based Multiple Aggregation) method. Based on a complex comparative analysis using the given methodology, the real situation in terms of the achieved economic performance of the economy of Balkan countries can be viewed, and relevant measures for future improvement can be proposed, such as effective management of the growth of the gross domestic product, inflation, industry, agriculture, import, export, income, taxes, etc.

Permanent control of key factors is a basic assumption for improving the economic performance of the economies of Balkan countries. In addition to the application of ratio analysis, a significant role is played by statistical analysis, DEA (Data Envelopment Analysis), and the use of multi-criteria decision-making methods, including the LMAW–DNMA method. In contrast to classical analysis, their integrated application gives more accurate results of the achieved economic performance of the economies of Balkan countries as a basis for future improvement by applying adequate measures. In this paper, the comparative analysis of economic performance factors of the economy of Balkan countries is based on ratio analysis, statistical analysis, and, in particular, on the use of the LMAW–DNMA method, which enables the ranking of alternatives (in this particular case, the alternatives are the Balkan countries) based on the simultaneous use of several selected criteria. Knowing the positioning of individual Balkan countries is a prerequisite for future improvement by applying relevant economic and other measures.

The literature devoted to the analysis of the economic performance of each economy is very rich. In classical literature, the analysis of the economic performance of the economy is mainly based on financial analysis, ratio analysis, and statistical analysis. In contemporary literature, DEA (Data Envelopment Analysis) models are increasingly used in the world when analyzing the efficiency of companies from all countries and economic sectors (Park & Kim, 2022; Zohreh Moghaddas et al., 2022; Amirteimoori et al., 2022; Alam et al., 2022; Photos Čiković & Lozić, 2022; Sala-Garrido, 2023; Andersen & Petersen, 1993; Banker et al., 1984; Chen et al., 2021; Chang et al., 2020; Guo & Cai, 2020; Lee et al., 2011; Lin et al., 2020; Pendharkar et al., 2021; Tone, 2002; Dobrović et al., 2021; Podinovski et al., 2021; Rostamzadeh et al., 2021; Fenyves & Tarnóczi, 2020; Amini et al., 2019; Tsai et al., 2021; Cooper et al., 1999; Amin & Hajjami, 2021; Chen et al., 2018, 2020, 2021a, 2021b; Stević et al., 2022; Rasoulzadeh et al., 2021). This is the case, for example, with the analysis of the efficiency of companies in Serbia (Đurić et al., 2020; Mandić et al., 2017; Martić & Savić, 2001; Radonjić, 2020; Lukic et al., 2017, 2020; Lukic, 2018, 2022a, 2022b, 2022c, 2023c; Lukic & Kozarevic, 2019; Lukic & Hadrovic Zekic, 2019; Vojteški Kljenak & Lukić, 2022). DEA models give a realistic picture of which domestic or

foreign companies are efficient and which are not, and what measures should be taken to increase efficiency.

Recently, in world literature, multi-criteria decision-making methods (ARAS – Additive Ratio Assessment, TOPSIS – Technique for Order Preference by Similarity to Ideal Solution, WASPAS – Weighted Aggregates Sum Product Assessment, etc.) are increasingly applied when analyzing the performance of companies from all countries of the world and economic sectors (Ayçin & Arsu, 2021; Popović et al., 2022; Ecer & Aycin, 2022; Mishra et al., 2022; Nguyen et al., 2022; Rani et al., 2022; Toslak et al., 2022). The situation is the same, for example, with literature in Serbia (Stojanović et al., 2022; Lukic, 2021, 2023a, 2023b, 2023e, 2023f, 2023g, 2023h, 2023j, 2023k). Because multi-criteria decision-making methods (DCDM) lead to more realistic results compared to classical methods (such as financial analysis and ratio analysis) as a basis for future improvement by applying relevant eco-friendly and other measures. Based on that, in this paper, the economic performance factors of the economies of Balkan countries are comparatively analyzed using, in addition to ratio analysis and statistical analysis, especially the LMAW–DNMA method. LMAW–DNMA is a newer multi -criteria decision-making method. Compared to the classical methods, for example, ratio analysis, this method gives more accurate results as they simultaneously integrate several indicators. This enables the selection of adequate economic and other measures to improve the economic performance of the economies of Balkan countries in the future.

2 Methodology

In this paper, the required empirical data from the World Bank is used, for the reason that they fully correspond to the researched aspect of economic performance factors of the economies of Balkan countries.

Using the LMAW and DNMA methods, we will evaluate the economic performance factors of the economies of Balkan countries, based on statistical data from the World Bank. In the following, we will present the basic characteristics of the given methods.

The LMAW (Logarithm Methodology of Additive Weights) method is the latest method used to calculate criteria weights and rank alternatives (Liao & Wu, 2020; Demir, 2022). It takes place through the following steps: m alternatives $A=\{A_1,A_2,...,A_m\}$ are evaluated in comparison with n criteria $C=\{C_1,C_2,...,C_n\}$ with the participation of k experts $E=\{E_1,E_2,...,E_k\}$ and according to a predefined linguistic scale (Pamučar et al, 2021).

Step 1: Determination of weight coefficients of criteria

Experts $E=\{E_1,E_2,...,E_k\}$ set priorities with criteria $C=\{C_1,C_2,...,C_n\}$ in relation to the previously defined values of the linguistic scale. At the same time, they assign a higher value to the criterion of greater importance and a lower value to the criterion of

lesser importance on the linguistic scale. Thus, the priority vector is obtained. The label γ_{cn}^{e} represents the value of the linguistic scale that the expert $e(1 \leq e \leq k)$ assigns to the criterion C_t $(1 \leq t \leq n)$

Step 1.1: Defining the absolute anti-ideal point γ_{AIP}

The absolute ideal point should be less than the smallest value in the priority vector. It is calculated according to the equation:

$$\gamma_{AIP} = \frac{\gamma_{min}^{e}}{S}$$

where γ^{e}_{min} is the minimum value of the priority vector and S should be greater than the base logarithmic function. In the case of using the function *Ln*, the value of *S* can be chosen as 3.

Step 1.2: Determining the relationship between the priority vector and the absolute anti-ideal point

The relationship between the priority vector and the absolute anti-ideal point is calculated using the following equation:

$$n_{Cn}^{e} = \frac{\gamma_{Cn}^{e}}{\gamma_{AIP}} \quad (1)$$

So, the relational vector $R^e=(n^e_{C1}, n^e_{C2},\ldots n^e_{Cn})$ is obtained, where n^e_{Cn} represents the value of the relational vector derived from the previous equation, and represents the relational vector e $(1 \leq e \leq k)$.

Step 1.3: Determination of the vector of weight coefficients

The vector of weight coefficients $w= (w_1,w_2,\ldots,w_n)^T$ is calculated by the expert $e(1 \leq e \leq k)$ using the following equation:

$$w_j^e = \frac{\log_A(n_{Cn}^e)}{\log_A\left(\prod_{J=1}^{n} n_{Cn}^e\right)}, A > 1 \quad (2)$$

where w^e_j represents the weighting coefficients obtained according to expert evaluations e^{th} and the n^e_{Cn} elements of the realization vector *R*. The obtained values for the weighting coefficients must meet the following condition: $\sum^{n}_{(j=1)} w^e_j = 1$.

By applying the Bonferroni aggregator shown in the following equation, the aggregated vector of weight coefficients $w= (w_1,w_2,\ldots,w_n)^T$ is determined:

$$W_j = \left(\frac{1}{k.(k-1)} \cdot \sum_{x=1}^{k} \left(w_j^{(x)}\right)^p \cdot \sum_{\substack{y=1 \\ y \neq x}}^{k} \left(w_{ij}^{(y)}\right)^q \right)^{\frac{1}{p+q}} \quad (3)$$

The values of p and q are stabilization parameters and $p,q \geq 0$. The resulting weight coefficients should fulfill the condition that $\sum^{n}_{(j=1)} w^e = 1$.

The DNMA (Double Normalization-based Multiple Aggregation) method is a newer method for showing alternatives (Demir, 2022). Two different normalized (linear and vector) techniques are used, as well as three different coupling functions (Complete Compensatory Model – CCM, Uncompensatory Model – UCM, and Incomplete Compensatory Model – ICM). The steps for applying this method are as follows (Liao & Wu, 2020; Ecer, 2020):

Step 1: Normalized decision matrix

The elements of the decision matrix are normalized with linear $(\hat{x}_{ij}^{1N})$ normalization using the following equation

$$\hat{x}_{ij}^{1N} = 1 - \frac{|x^{ij} - r_j|}{max\left\{\max_i x^{ij}, r_j\right\} - min\left\{\min_i x^{ij}, r_j\right\}} \quad (4)$$

The vector $(\hat{x}_{ij}^{2N})$ is normalized using the following equation:

$$\hat{x}_{ij}^{2N} = 1 - \frac{|x^{ij} - r_j|}{\sqrt{\sum_{i=1}^{m}(x^{ij})^2 + \left(r_j\right)^2}} \quad (5)$$

The value r_j is the target value for the c_j criterion and is considered $\max_i x^{ij}$ for both utility and $\min_i x^{ij}$ cost criteria.

Step 2: Determining the weight of the criteria

This step consists of three phases:

Step 2.1: In this phase, the standard deviation (σ_j) for the criterion c_1 is determined with the following equation, where m is the number of alternatives:

$$\sigma_j = \sqrt{\frac{\sum_{i=1}^{m}\left(\frac{x^{ij}}{\max_i x^{ij}} - \frac{1}{m}\sum_{i=1}^{m}\left(\frac{x^{ij}}{\max_i x^{ij}}\right)\right)^2}{m}} \quad (6)$$

Step 2.2: Values of the standard deviation calculated for the criteria are normalized with the following equation:

$$w_j^{\sigma} = \frac{\sigma_j}{\sum_{i=1}^{n}\sigma_j} \quad (7)$$

Step 2.3: Finally, the weights are adjusted with the following equation:

$$\widehat{w}_j = \frac{\sqrt{w_j^{\sigma}.w_j}}{\sum_{i=1}^{n}\sqrt{w_j^{\sigma}.w_j}} \quad (8)$$

Step 3: Calculating the aggregation model

Three aggregation functions (CCM, UCM, and ICM) are calculated separately for each alternative.

The CCM (Complete Compensatory Model) is calculated using the following equation:

$$u_1(a_i) = \sum_{j=1}^{n} \frac{\hat{w}_j . \hat{x}_{ij}^{1N}}{\max_i \hat{x}_{ij}^{1N}} \quad (9)$$

The UCM (Uncompensatory Model) is calculated using the following equation:

$$u_2(a_i) = \max_j \hat{w}_j \left(\frac{1 - \hat{x}_{ij}^{1N}}{\max_i \hat{x}_{ij}^{1N}} \right) \quad (10)$$

The ICM (Incomplete Compensatory Model) is calculated using the following equation:

$$u_3(a_i) = \prod_{j=1}^{n} \left(\frac{\hat{x}_{ij}^{2N}}{\max_i \hat{x}_{ij}^{2N}} \right)^{\hat{w}_j} \quad (11)$$

Step 4: Integration of utility values

The calculated utility functions are integrated with the following equation using the Euclidean distance principle:

$$\begin{aligned} DN_i = {} & w_1 \sqrt{\varphi \left(\frac{u_1(a_i)}{\max_i u_1(a_i)} \right)^2 + (1-\varphi) \left(\frac{m - r_{1(a_i)+1}}{m} \right)^2} \\ & - w_2 \sqrt{\varphi \left(\frac{u_2(a_i)}{\max_i u_2(a_i)} \right)^2 + (1-\varphi) \left(\frac{r_2(a_i)}{m} \right)^2} \\ & + w_3 \sqrt{\varphi \left(\frac{u_3(a_i)}{\max_i u_3(a_i)} \right)^2 + (1-\varphi) \left(\frac{m - r_3(a_i) + 1}{m} \right)^2} \end{aligned} \quad (12)$$

In this case, the means $r_1(a_i)$ *and* $r_3(a_i)$ represent the ordinal number of the alternative a_i sorted by CCM and ICM functions in descending value (higher value first). On the other hand, $r_2(a_i)$ shows the sequence number in the obtained order according to the increasing value (smaller value first) for the UCM function used. The label φ is the relative importance of the child value used and is within the range [0.1]. It can be considered as φ=0.5. The coefficients w_1, w_2, w_3 are the obtained weights of the used functions CCM, UCM, and ICM, respectively. The sum should be equal to $w_1 + w_2 + w_3 = 1$. When determining the weights, if the decision maker attaches importance to a wider range of performance alternatives, he or she can set a higher value for w_1. In case the decision maker is not willing to take risks, i.e., to choose a poor

alternative according to some criterion, he or she can assign a higher weight to w_2. However, the decision maker may assign a greater weight to w_3, if he or she simultaneously considers overall performance and risk. Finally, the DN values are sorted in descending order, with the higher-value alternatives being the best.

3 Empirical results and discussion

The key issue in the application of the LMAW–DNMA method to the evaluation of the economic performance of the economies of Balkan countries is the selection of appropriate criteria and the determination of their weighting coefficients (weights). In this paper, the choice of criteria (C1 – GDP (current US$) – billion; C2 – GDP per capita (current US$); C3 – GDP growth (annual %); C4 – Unemployment, total (% of total labor force) – modeled ILO estimate; C5 – Inflation, consumer prices (annual %); and C6 – Personnel remittances, received (% of GDP)) was carried out according to the nature of the research of the problem in question. The criteria are shown in Table 1 and fully correspond to the nature of the problem of a comparative analysis of economic performance factors of the economies of Balkan countries. The alternatives are the Balkan countries (A1 – Albania, A2 – Bosnia and Herzegovina, A3 – Bulgaria, A4 – Croatia, A5 – Kosovo, A6 – North Macedonia, A7 – Montenegro, A8 – Romania, A9 – Serbia, A10 – Slovenia, A11 – Greece, and A12 – Turkey), which are also shown in the same table. Figure 1 shows a ratio analysis of the observed economic performance indicators of the economies of Balkan countries for 2022.

Table 1

Initial data, 2022

		GDP (current US$) (billion)	*GDP per capita (current US$)*	*GDP growth (annual %)*	*Unemployment, total (% of total labor force) (modeled ILO estimate)*	*Inflation, consumer prices (annual %)*	*Personal remittances received (% of GDP)*
		C1	C2	C3	C4	C5	C6
A1	Albania	18.88	6,802.2	4.8	11.8	6.7	9.2
A2	Bosnia and Herzegovina	24.53	7,585.4	3.9	14.1	14.0	10.1
A3	Bulgaria	89.04	13,772.5	3.4	4.4	15.3	2.3
A4	Croatia	70.96	18,413.2	6.3	6.7	10.8	7.6
A5	Kosovo	9.43	5,351.4	3.5	0	11.6	17.1
A6	North Macedonia	13.56	6,591.5	2.1	15.1	14.2	3.4
A7	Montenegro	6.1	9,893.5	6.1	15.4	13.0	13.6
A8	Romania	301.26	15,892.1	4.8	5.4	13.8	2.9
A9	Serbia	63.5	9,393.6	2.3	9.5	12.0	8.8
A10	Slovenia	62.12	29,457.4	5.4	4.2	8.8	1.1
A11	Greece	219.07	20,732.1	5.9	12.2	9.6	0.3

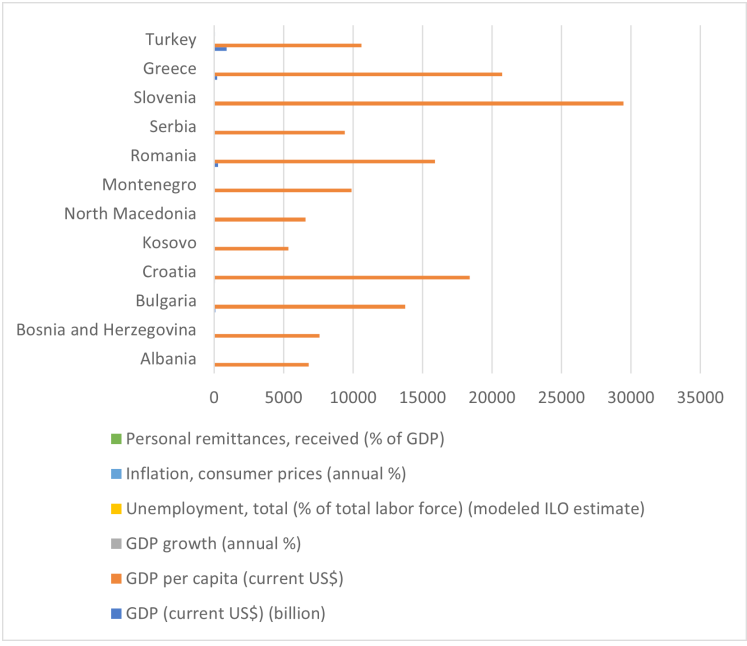
A12	Turkey	905.99	10,616.1	5.6	10.0	72.3	0.1
	Statistics						
	Mean	148.7033	12875.0833	4.5083	9.0667	16.8417	6.3750
	Median	62.8100	10254.8000	4.8000	9.7500	12.5000	5.5000
	Std. Deviation	255.18936	7162.70570	1.45005	4.92587	17.64408	5.54406
	Minimum	6.10	5351.40	2.10	.00	6.70	.10
	Maximum	905.99	29457.40	6.30	15.40	72.30	17.10

Note: Author's statistics

Source: The World Bank. https://data.worldbank.org/country

Figure 1

Economic performance indicators of the Balkan countries



Source: Author's picture

In the specific case, the gross domestic product per capita is the highest in Slovenia, and the lowest in Kosovo. The growth rate of the gross domestic product is the highest in Croatia and the lowest in North Macedonia. The unemployment rate is the highest in Montenegro (there is no data for Kosovo). Inflation is the highest in Turkey and the lowest in Albania. Received personal remittances are the highest in Kosovo and the lowest in Turkey. The differences are caused by the different levels of economic development of these Balkan countries.

In this case, therefore, there is a strong statistically significant correlation between the criteria C1 (Gross domestic product) and C5 (Inflation). In other words, this me-

ans that the target gross domestic product can be achieved in the Balkan countries by adequately managing inflation, for example, through the interest rate.

The Friedman Test is shown in Table 2 and Figure 2.

Table 2

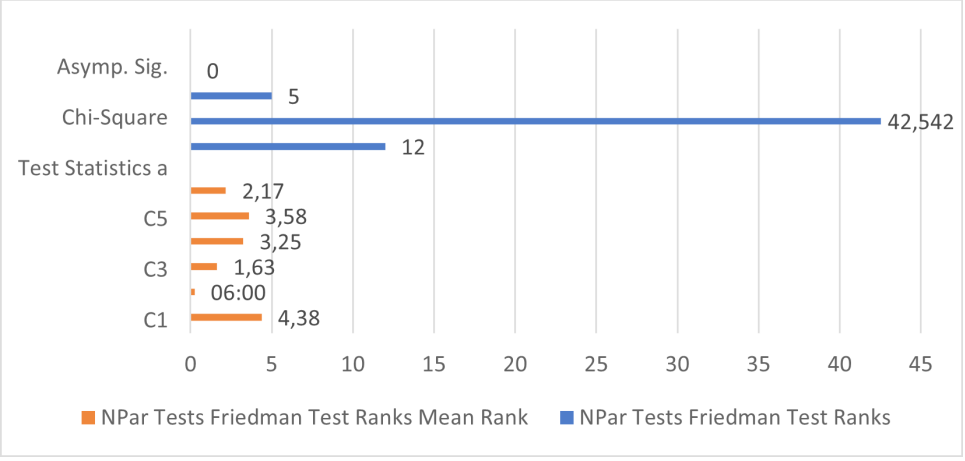
Friedman test

NPar Tests	
Friedman Test	
Ranks	
	Mean Rank
C1	4.38
C2	6:00
C3	1.63
C4	3.25
C5	3.58
C6	2.17
Test Statistics a	
N	12
Chi-Square	42.542
df	5
Asymp. Sig.	.000
a. Friedman Test	

Note: Author's statistics

Figure 2

Friedman Test



Source: Author's picture

Therefore, there is a significant statistical difference between the analyzed variables in this particular case (Asymp. Sig. .000).

Table 3 shows the prioritization scale.

Table 3

Prioritization scale

Prioritization Scale		
Linguistic Variables	*Abbreviation*	*Prioritization*
Low	AL	1
Very Low	VL	1.5
Low	L	2
Medium	M	2.5
Equal	E	3
Medium High	MH	3.5
High	H	4
Very High	VH	4.5
High	AH	5

Source: Demir, 2022

Table 4 and Figure 3 shows the evaluation and weight coefficients of the criteria.

Table 4

Evaluation and weight coefficients of the criteria

KIND	*1*	*1*	*1*	*1*	*1*	*1*
	C1	*C2*	*C3*	*C4*	*C5*	*C6*
E1	H	AH	H	E	MH	MH
E2	VH	VH	MH	H	H	MH
E3	E	MH	VH	AH	AH	H
E4	MH	E	E	VH	AH	E

ϒAIP	*0.5*						
	C1	C2	C3	C4	C5	C6	LN(Πη)
R1	8	10	8	6	7	7	12.145
R2	9	9	7	8	8	7	12.445
R3	6	7	9	10	10	8	12.620
R4	7	6	6	9	10	6	11.821

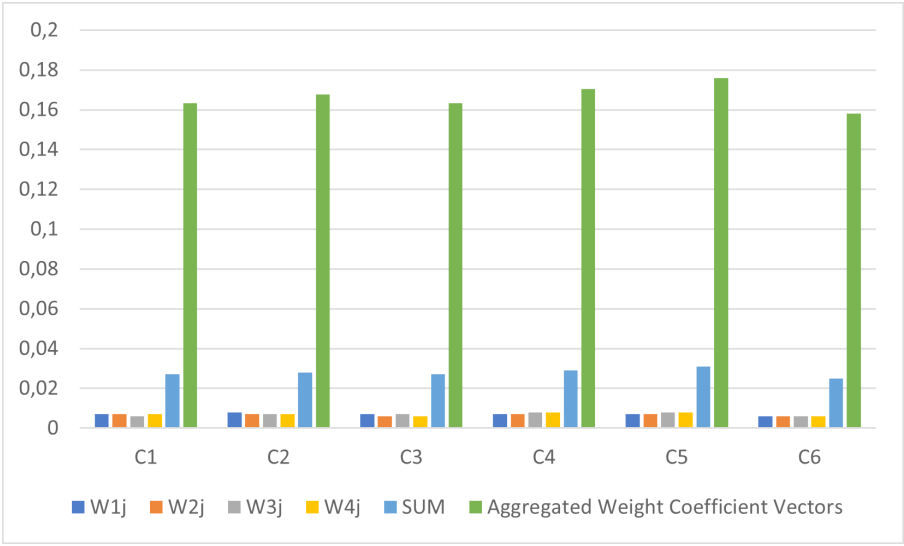
Weight Coefficients Vector	*C1*	*C2*	*C3*	*C4*	*C5*	*C6*
W1j	0.171	0.190	0.171	0.148	0.160	0.160
W2j	0.177	0.177	0.156	0.167	0.167	0.156
W3j	0.142	0.154	0.174	0.182	0.182	0.165
W4j	0.165	0.152	0.152	0.186	0.195	0.152

Aggregated Fuzzy Vectors	*C1*	*C2*	*C3*	*C4*	*C5*	*C6*
W1j	0.007	0.008	0.007	0.007	0.007	0.006
W2j	0.007	0.007	0.006	0.007	0.007	0.006
W3j	0.006	0.007	0.007	0.008	0.008	0.006
W4j	0.007	0.007	0.006	0.008	0.008	0.006
SUM	0.027	0.028	0.027	0.029	0.031	0.025
Aggregated Weight Coefficient Vectors	0.1634	0.1677	0.1632	0.1705	0.1760	0.1582

Note: Author's statistics

Figure 3

Aggregated Weight Coefficient Vectors



Source: Author's picture

In this specific case, therefore, the most important criterion is inflation (C5). In other words, this means that effective management of inflation can influence the achievement of the target economic performance of Balkan countries.

We will rank the countries of the Balkans according to their economic performance in 2022 using the LMAW–DNMA method. All the calculations and results of the LMAW–DNMA method are shown in further presentations of the studied problem (Tables 5–11, Figure 4). The meaning of individual symbols in the tables shown below is given in the analysis of the methods themselves.

Table 5

Initial Matrix

INITIAL MATRIX	*KIND*	*1*	*1*	*1*	*1*	*1*	*1*
	Weight	0.1634	0.1677	0.1632	0.1705	0.1760	0.1582
		C1	C2	C3	C4	C5	C6
	A1	18.88	6,802.20	4.8	11.8	6.7	9.2
	A2	24.53	7,585.40	3.9	14.1	14	10.1
	A3	89.04	13,772.50	3.4	4.4	15.3	2.3
	A4	70.96	18,413.20	6.3	6.7	10.8	7.6
	A5	9.43	5,351.40	3.5	0	11.6	17.1
	A6	13.56	6,591.50	2.1	15.1	14.2	3.4
	A7	6.1	9,893.50	6.1	15.4	13	13.6
	A8	301.26	15,892.10	4.8	5.4	13.8	2.9
	A9	63.5	9,393.60	2.3	9.5	12	8.8
	A10	62.12	29,457.40	5.4	4.2	8.8	1.1

	A11	219.07	20,732.10	5.9	12.2	9.6	0.3
	A12	905.99	10,616.10	5.6	10	72.3	0.1
	MAX	905.9900	29457.4000	6.3000	15.4000	72.3000	17.1000
	MIN	6.1000	5351.4000	2.1000	0.0000	6.7000	0.1000

Note: Author's calculation

Table 6

Linear Normalization Matrix

Linear Normalization MATRIX		*C1*	*C2*	*C3*	*C4*	*C5*	*C6*	*MAX*
	A1	0.0142	0.0602	0.6429	0.7662	0.0000	0.5353	0.7662
	A2	0.0205	0.0927	0.4286	0.9156	0.1113	0.5882	0.9156
	A3	0.0922	0.3493	0.3095	0.2857	0.1311	0.1294	0.3493
	A4	0.0721	0.5418	1.0000	0.4351	0.0625	0.4412	1.0000
	A5	0.0037	0.0000	0.3333	0.0000	0.0747	1.0000	1.0000
	A6	0.0083	0.0514	0.0000	0.9805	0.1143	0.1941	0.9805
	A7	0.0000	0.1884	0.9524	1.0000	0.0960	0.7941	1.0000
	A8	0.3280	0.4373	0.6429	0.3506	0.1082	0.1647	0.6429
	A9	0.0638	0.1677	0.0476	0.6169	0.0808	0.5118	0.6169
	A10	0.0623	1.0000	0.7857	0.2727	0.0320	0.0588	1.0000
	A11	0.2367	0.6380	0.9048	0.7922	0.0442	0.0118	0.9048
	A12	1.0000	0.2184	0.8333	0.6494	1.0000	0.0000	1.0000

Note: Author's calculation

Table 7

Vector Normalization Matrix

Vector Normalization MATRIX		*C1*	*C2*	*C3*	*C4*	*C5*	*C6*	*MAX*
	A1	0.3392	0.6127	0.9144	0.9068	0.4025	0.7638	0.9144
	A2	0.3435	0.6261	0.8630	0.9663	0.4690	0.7907	0.9663
	A3	0.3915	0.7318	0.8344	0.7151	0.4809	0.5574	0.8344
	A4	0.3780	0.8112	1.0000	0.7747	0.4399	0.7159	1.0000
	A5	0.3322	0.5879	0.8401	0.0000	0.4472	1.0000	1.0000
	A6	0.3353	0.6091	0.7602	0.9922	0.4708	0.5903	0.9922
	A7	0.3297	0.6655	0.9886	1.0000	0.4599	0.8953	1.0000
	A8	0.5496	0.7681	0.9144	0.7410	0.4672	0.5754	0.9144
	A9	0.3725	0.6570	0.7716	0.8472	0.4508	0.7518	0.8472
	A10	0.3715	1.0000	0.9486	0.7099	0.4217	0.5215	1.0000
	A11	0.4884	0.8508	0.9772	0.9171	0.4289	0.4976	0.9772
	A12	1.0000	0.6779	0.9600	0.8601	1.0000	0.4916	1.0000
	Adj Wj	0.1707	0.1606	0.1542	0.1694	0.1649	0.1802	

Note: Author's calculation

Table 8

CCM (Complete Compensatory Model)

CCM (Complete Compensatory Model)	*u1(ai)*	*C1*	*C2*	*C3*	*C4*	*C5*	*C6*	*SUM*
	A1	0.0032	0.0126	0.1294	0.1694	0.0000	0.1259	0.4405
	A2	0.0038	0.0163	0.0722	0.1694	0.0200	0.1158	0.3975
	A3	0.0450	0.1606	0.1366	0.1386	0.0619	0.0667	0.6095
	A4	0.0123	0.0870	0.1542	0.0737	0.0103	0.0795	0.4170
	A5	0.0006	0.0000	0.0514	0.0000	0.0123	0.1802	0.2445
	A6	0.0014	0.0084	0.0000	0.1694	0.0192	0.0357	0.2342
	A7	0.0000	0.0303	0.1468	0.1694	0.0158	0.1431	0.5055
	A8	0.0871	0.1093	0.1542	0.0924	0.0278	0.0462	0.5169
	A9	0.0176	0.0437	0.0119	0.1694	0.0216	0.1495	0.4137
	A10	0.0106	0.1606	0.1211	0.0462	0.0053	0.0106	0.3545
	A11	0.0446	0.1133	0.1542	0.1484	0.0081	0.0023	0.4709
	A12	0.1707	0.0351	0.1285	0.1100	0.1649	0.0000	0.6092

Note: Author's calculation

Table 9

UCM (Uncompensatory Model)

UCM (Uncompensatory Model)	*u2(ai)*	*C1*	*C2*	*C3*	*C4*	*C5*	*C6*	*MAX*
	A1	0.1675	0.1480	0.0248	0.0000	0.1649	0.0543	0.1675
	A2	0.1669	0.1444	0.0820	0.0000	0.1448	0.0644	0.1669
	A3	0.1256	0.0000	0.0176	0.0309	0.1030	0.1134	0.1256
	A4	0.1584	0.0736	0.0000	0.0957	0.1546	0.1007	0.1584
	A5	0.1700	0.1606	0.1028	0.0000	0.1526	0.0000	0.1700
	A6	0.1692	0.1522	0.1542	0.0000	0.1456	0.1445	0.1692
	A7	0.1707	0.1304	0.0073	0.0000	0.1490	0.0371	0.1707
	A8	0.0836	0.0514	0.0000	0.0770	0.1371	0.1340	0.1371
	A9	0.1530	0.1170	0.1423	0.0000	0.1433	0.0307	0.1530
	A10	0.1600	0.0000	0.0330	0.1232	0.1596	0.1696	0.1696
	A11	0.1260	0.0474	0.0000	0.0211	0.1568	0.1778	0.1778
	A12	0.0000	0.1256	0.0257	0.0594	0.0000	0.1802	0.1802

Note: Author's calculation

Table 10

ICM (Incomplete Compensatory Model)

ICM (Incomplete Compensatory Model)	*u3(ai)*	*C1*	*C2*	*C3*	*C4*	*C5*	*C6*	*MAX*
	A1	0.8443	0.9377	1.0000	0.9986	0.8735	0.9681	0.6685
	A2	0.8382	0.9326	0.9827	1.0000	0.8876	0.9645	0.6577
	A3	0.8788	0.9791	1.0000	0.9742	0.9131	0.9299	0.7118
	A4	0.8470	0.9669	1.0000	0.9577	0.8734	0.9416	0.6450
	A5	0.8285	0.9182	0.9735	0.0000	0.8757	1.0000	0.0000
	A6	0.8310	0.9246	0.9598	1.0000	0.8844	0.9107	0.5939
	A7	0.8275	0.9367	0.9982	1.0000	0.8798	0.9803	0.6673
	A8	0.9168	0.9724	1.0000	0.9650	0.8952	0.9199	0.7084

	A9	0.8691	0.9600	0.9857	1.0000	0.9012	0.9787	0.7254
	A10	0.8445	1.0000	0.9919	0.9436	0.8673	0.8893	0.6096
	A11	0.8884	0.9780	1.0000	0.9893	0.8731	0.8855	0.6645
	A12	1.0000	0.9395	0.9937	0.9748	1.0000	0.8799	0.8007

Note: Author's calculation

Table 11

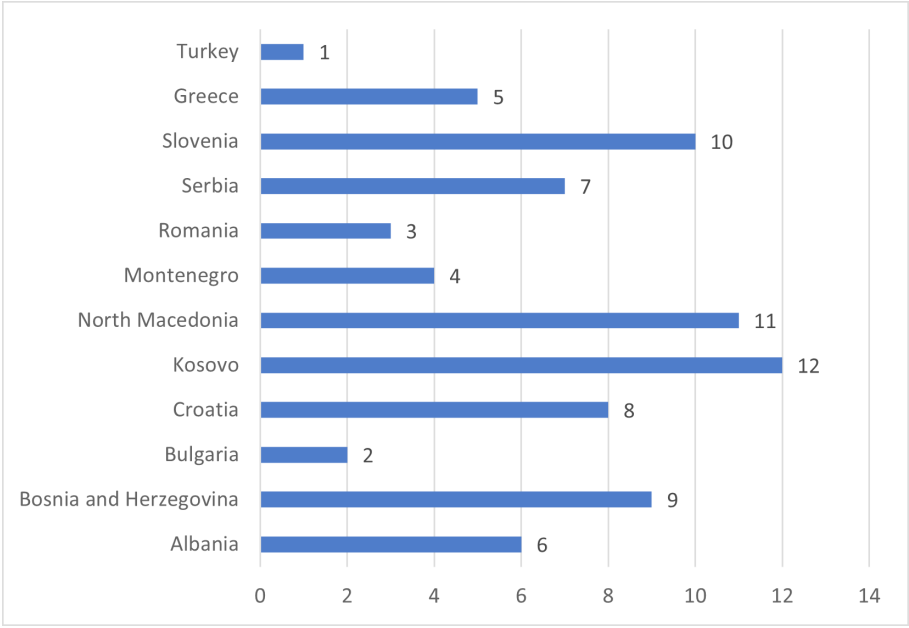
Rank Order

											w1	*w2*	*w3*	
											0.6	*0.1*	*0.3*	
		CCM		*φ*	*UCM*		*φ*	*ICM*		*φ*	*Utility Values*			*Rank Order*
		u1(ai)	*Rank*	*0.5*	*u2(ai)*	*Rank*	*0.5*	*u3(ai)*	*Rank*	*0.5*				
Albania	A1	0.4405	6	0.6567	0.1675	6	0.7465	0.6685	5	0.7555	0.6953	0.6953		6
Bosnia and Herzegovina	A2	0.3975	9	0.5179	0.1669	5	0.7181	0.6577	8	0.6512	0.5779	0.5779		9
Bulgaria	A3	0.6095	1	1.0000	0.1256	1	0.4966	0.7118	3	0.8616	0.9081	0.9081		2
Croatia	A4	0.4170	7	0.5992	0.1584	4	0.6647	0.6450	9	0.6164	0.6109	0.6109		8
Kosovo	A5	0.2445	11	0.3072	0.1700	9	0.8524	0.0000	12	0.0589	0.2872	0.2872		12
North Macedonia	A6	0.2342	12	0.2780	0.1692	7	0.7818	0.5939	11	0.5375	0.4063	0.4063		11
Montenegro	A7	0.5055	4	0.7907	0.1707	10	0.8921	0.6673	6	0.7193	0.7794	0.7794		4
Romania	A8	0.5169	3	0.8407	0.1371	2	0.5509	0.7084	4	0.8201	0.8056	0.8056		3
Serbia	A9	0.4137	8	0.5632	0.1530	3	0.6260	0.7254	2	0.9113	0.6739	0.6739		7
Slovenia	A10	0.3545	10	0.4477	0.1696	8	0.8156	0.6096	10	0.5666	0.5201	0.5201		10
Greece	A11	0.4709	5	0.7216	0.1778	11	0.9525	0.6645	7	0.6851	0.7337	0.7337		5
Turkey	A12	0.6092	2	0.9589	0.1802	12	1.0000	0.8007	1	1.0000	0.9754	0.9754		1
	MAX	0.6095			0.1802			0.8007						

Note: Author's calculation

Figure 4

Rank Order



Source: Author's picture

In this case, therefore, the ranking of the Balkan countries by economic performance according to the LMAW–DNMA method is as follows: Turkey, Bulgaria, Romania, Montenegro, Greece, Albania, Serbia, Croatia, Bosnia and Herzegovina, Slovenia, North Macedonia, and Kosovo. In terms of economic performance, Serbia is in a better position than Croatia and Slovenia.

The target economic performances of Balkan countries can be achieved, among other things, by managing inflation and unemployment, and by receiving personal remittances as efficiently as possible. Another method is adequate control of the key factors of economic performance, such as geopolitical and economic climate, foreign direct investments, energy crisis, climate change, the concept of sustainable development, digitalization of the company's entire business, etc.

The research in this paper, using the LMAW–DNMA method, has demonstrated that applying the multi-criteria decision-making method and the DEA model, in addition to classical methodology, to the evaluation of the economic performance of the economies of Balkan countries is justified, as they give more accurate results. Therefore, it is recommended that they be used as much as possible in the analysis of the economic performance of the economies of Balkan countries.

4 Conclusion

Empirical research of the problem discussed in this paper, using the LMAW–DNMA method, has shown that the ranking of Balkan countries according to economic performance is as follows: Turkey, Bulgaria, Romania, Montenegro, Greece, Albania, Serbia, Croatia, Bosnia and Herzegovina, Slovenia, North Macedonia, and Kosovo. In terms of economic performance, Serbia is in a better position than Croatia and Slovenia. Kosovo is in the worst economic position.

The target economic performances of Balkan countries can be achieved, among other things, by managing inflation and unemployment, and by receiving personal remittances as efficiently as possible. Another method is adequate control of the key factors of economic performance, such as geopolitical and economic climate, foreign direct investments, energy crisis, climate change, the concept of sustainable development, digitalization of the company's entire business, etc.

The comparative application of multi-criteria decision-making methods (including the LMAW–DNMA method) with other relevant methods to the evaluation of the economic performance of Balkan countries gives more accurate results in terms of future improvements by applying relevant measures. That is why, along with the classical methodology, it is recommended to use multi-criteria decision-making methods for these purposes.

Dr. Radojko Lukić

Gospodarska uspešnost Balkanskih držav

Raziskovanje dejavnikov dinamike gospodarske uspešnosti posameznega gospodarstva, kar pomeni tudi držav Balkana oz. jugovzhodne Evrope (Albanija, Bosna in Hercegovina, Bolgarija, Hrvaška, Kosovo, Severna Makedonija, Črna gora, Romunija, Srbija, Slovenija, Grčija in Turčija) je zelo zahtevno, pomembno in nenehno aktualno. Navaja kritične dejavnike in ukrepe, ki jih je treba sprejeti za dosego ciljne gospodarske uspešnosti. Prispevek primerjalno analizira ekonomsko uspešnost gospodarstev balkanskih držav z metodo LMAW-DNMA (Logarithm Methodology of Additive Weights – Double Normalization-based Multiple Aggregation). Na podlagi kompleksne primerjalne analize po podani metodologiji je mogoče videti realno stanje dosežene gospodarske uspešnosti gospodarstev balkanskih držav in predlagati ustrezne ukrepe za izboljšanje v prihodnosti, kot je učinkovito upravljanje rasti bruto domačega proizvoda, inflacije, industrije, kmetijstva, uvoza, izvoza, dohodka, davkov itd.

Stalna kontrola ključnih dejavnikov je osnovna predpostavka za izboljšanje gospodarske uspešnosti gospodarstev balkanskih držav. Poleg ratio analize, statistične analize, DEA analize in uporabe večkriterijskih metod odločanja smo vključili tudi

metodo LMAW-DNMA, ki ima pri tem pomembno vlogo. Glede na klasično analizo daje njihova celostna uporaba natančnejše rezultate o doseženi gospodarski uspešnosti gospodarstev balkanskih držav in osnovo za izboljšave v prihodnosti z uporabo ustreznih ukrepov. Primerjalna analiza dejavnikov ekonomske uspešnosti gospodarstev balkanskih držav v prispevku temelji na racio analizi, statistični analizi, predvsem pa na uporabi metode LMAW-DNMA, ki omogoča razvrščanje alternativ (v konkretnem primeru so alternative balkanske države) na podlagi hkratne uporabe več izbranih kriterijev. Poznavanje položaja posameznih balkanskih držav je predpogoj za izboljšanje gospodarstva v prihodnosti z uporabo ustreznih ekonomskih in drugih ukrepov.

Literatura, namenjena analizi gospodarske uspešnosti posameznega gospodarstva, je zelo bogata. V klasični literaturi analiza ekonomske uspešnosti gospodarstva temelji predvsem na finančni analizi, analizi razmerij in statistični analizi. V sodobni literaturi se v svetu vedno pogosteje uporabljajo modeli DEA (Data Envelopment Analysis) pri analizi učinkovitosti podjetij iz vseh držav in gospodarskih sektorjev (Park in Kim, 2022; Zohreh Moghaddas idr., 2022; Amirteimoori idr., 2022; Alam idr., 2022; fotografije Čiković in Lozić, 2022; Sala-Garrido, 2023; Andersen in Petersen, 1993; Banker idr., 1984; Chen idr., 2021, Chang idr., 2020; Guo in Cai, 2020; Lee idr., 2011; Lin idr., 2020; Pendharkar idr., 2021; Tone, 2002; Dobrović idr., 2021; Podinovski idr., 2021; Rostamzadeh idr., 2021; Fenyves in Tarnóczi, 2020; Amini idr., 2019; Tsai idr., 2021; Cooper idr., 1999; Amin in Hajjami, 2021; Chen idr., 2018, 2020, 2021a, b; Stević idr., 2022; Rasoulzadeh idr., 2021). Tako je na primer pri analizi učinkovitosti podjetij v Srbiji (Đurić idr., 2020; Mandić idr., 2017; Martić in Savić, 2001; Radonjić, 2020; Lukic idr., 2017, 2020; Lukic, 2018, 2022a, b, c, 2023c; Lukic in Kozarevic, 2019; Lukic in Hadrovic Zekic, 2019; Vojteški Kljenak in Lukić, 2022). Modeli DEA dajejo realno sliko o tem, katera domača ali tuja podjetja so učinkovita in katera ne ter kakšne ukrepe je treba sprejeti za povečanje učinkovitosti.

V zadnjem času se v svetovni literaturi vse pogosteje uporabljajo večkriterijske metode odločanja (ARAS – Additive Ratio Assessment, TOPSIS – Technique for Order Preference by Similarity to Ideal Solution, WASPAS – Weighted aggregates sum product assessment itd.) pri analizi uspešnosti podjetij iz vseh držav sveta in gospodarskih sektorjev (Ayçin in Arsu, 2021; Popović idr., 2022; Ecer in Aycin, 2022; Mishra idr., 2022; Nguyen idr., 2022; Rani idr., 2022; Toslak idr., 2022). Enako je na primer z literaturo v Srbiji (Stojanović idr., 2022; Lukic, 2021, 2023a, b, e, f, g, h, j, k), ker večkriterijske metode odločanja (DCDM) vodijo do realnejših rezultatov v primerjavi s klasičnimi metodami (kot so finančna analiza in racio analiza) kot podlago za izboljšave v prihodnosti z uporabo ustreznih okolju prijaznih in drugih ukrepov. Na podlagi tega so v tem prispevku primerjalno analizirani dejavniki gospodarske uspešnosti gospodarstev balkanskih držav z uporabo metode LMAW-DNMA, poleg analize razmerij in statistične analize. LMAW-DNMA je novejša večkriterijska metoda odločanja. V primerjavi s klasično metodo, na primer racio analizo, daje ta metoda natančnejše rezultate, saj hkrati integrira več indikatorjev. To omogoča izbor

ustreznih ekonomskih in drugih ukrepov za izboljšanje gospodarske uspešnosti gospodarstev balkanskih držav v prihodnosti.

V prispevku so uporabljeni potrebni empirični podatki Svetovne banke iz razloga, ker v celoti ustrezajo opazovanemu vidiku raziskave dejavnikov ekonomske uspešnosti gospodarstev balkanskih držav.

Z metodo LMAW in DNMA bomo na podlagi statističnih podatkov Svetovne banke ocenili dejavnike gospodarske uspešnosti gospodarstev balkanskih držav.

Ključno vprašanje pri uporabi metode LMAW-DNMA pri vrednotenju gospodarske uspešnosti gospodarstev balkanskih držav je izbira ustreznih kriterijev in določitev njihovih utežnih koeficientov (uteži). V tem prispevku je bila izbira kriterijev (C1 – BDP, trenutni USD) (milijardi), C2 – BDP na prebivalca (trenutni USD), C3 – rast BDP (letna v %), C4 – brezposelnost, skupaj (% celotne delovne sile) (modelirana ocena ILO), C5 – inflacija, cene življenjskih potrebščin (letno v %) in C6 – prejeta nakazila osebja (% BDP)) izvedena po naravi raziskave obravnavanega problema. Prikazani so v tabeli 1 in v celoti ustrezajo naravi problematike primerjalne analize dejavnikov gospodarske uspešnosti gospodarstev balkanskih držav. Alternative so balkanske države (A1 – Albanija, A2 – Bosna in Hercegovina, A3 – Bolgarija, A4 – Hrvaška, A5 – Kosovo, A6 – Severna Makedonija, A7 – Črna gora, A8 – Romunija, A9 – Srbija, A10 – Slovenija, A11 – Grčija in A12 – Turčija). Slika 1 prikazuje racio analizo opazovanih kazalnikov gospodarske uspešnosti gospodarstev balkanskih držav za leto 2022.

V tem primeru torej obstaja močna korelacija med kriterijema C1 in C5 na ravni statistične pomembnosti. To z drugimi besedami pomeni, da je ciljni bruto domači proizvod v balkanskih državah mogoče doseči z ustreznim obvladovanjem inflacije, na primer z obrestno mero.

V konkretnem primeru imamo najvišji bruto domači proizvod na prebivalca v Sloveniji, najmanjši pa na Kosovu. Razlike so posledica različne stopnje gospodarskega razvoja balkanskih držav.

Zato obstaja pomembna statistična razlika med analiziranimi spremenljivkami v tem konkretnem primeru (Asymp. Sig.:,000).

V konkretnem primeru je torej najpomembnejši kriterij inflacija. To z drugimi besedami pomeni, da lahko učinkovito obvladovanje inflacije vpliva na doseganje ciljne gospodarske uspešnosti balkanskih držav.

Države Balkana bomo razvrstili po gospodarski uspešnosti v letu 2022 z metodo LMAW-DNMA.

V tem primeru je torej razvrstitev držav Balkana po gospodarski uspešnosti po metodi LMAW-DNMA naslednja: Turčija, Bolgarija, Romunija, Črna gora, Grčija, Albanija, Srbija, Hrvaška, Bosna in Hercegovina, Slovenija, Severna Makedonija in Kosovo. Srbija je po gospodarski uspešnosti v boljšem položaju, kot sta Hrvaška in Slovenija.

Ciljno gospodarsko uspešnost balkanskih držav je mogoče doseči med drugim z obvladovanjem inflacije in brezposelnosti ter čim bolj učinkovitim prejemanjem osebnih nakazil. Pomemben pa je tudi ustrezen nadzor nad ključnimi dejavniki gospodarske uspešnosti, kot so geopolitična in gospodarska klima, neposredne tuje investicije, energetska kriza, podnebne spremembe, koncept trajnostnega razvoja, digitalizacija celotnega poslovanja podjetja itd.

Raziskava v prispevku je na primeru metode LMAW-DNMA pokazala upravičenost uporabe, poleg klasične metodologije, tako večkriterijske metode odločanja pri ocenjevanju gospodarske uspešnosti gospodarstev držav Balkana kot tudi modela DEA, ker dajeta natančnejše rezultate. Zato je priporočljivo, da se ju čim bolj pogosto uporablja pri analizi gospodarske uspešnosti gospodarstev balkanskih držav.

Empirična raziskava, ki v prispevku obravnava problematiko z metodo LMAW -DNMA, je pokazala, da je razvrstitev balkanskih držav glede na gospodarsko uspešnost naslednja: Turčija, Bolgarija, Romunija, Črna gora, Grčija, Albanija, Srbija, Hrvaška, Bosna in Hercegovina, Slovenija, Severna Makedonija in Kosovo. Srbija je po gospodarski uspešnosti v boljšem položaju, kot sta Hrvaška in Slovenija. Kosovo je v najslabšem gospodarskem položaju.

Ciljno gospodarsko uspešnost balkanskih držav je mogoče doseči med drugim z obvladovanjem inflacije in brezposelnosti ter čim bolj učinkovitim prejemanjem osebnih nakazil. Pomemben je tudi ustrezen nadzor nad ključnimi dejavniki gospodarske uspešnosti, kot so geopolitična in gospodarska klima, neposredne tuje investicije, energetska kriza, podnebne spremembe, koncept trajnostnega razvoja, digitalizacija celotnega poslovanja podjetja itd.

Primerjalna uporaba večkriterijskih metod odločanja (vključno z metodo LMAW -DNMA) z drugimi relevantnimi metodami pri vrednotenju gospodarske uspešnosti balkanskih držav daje natančnejše rezultate v smislu prihodnjih izboljšav z uporabo ustreznih ukrepov. Zato je poleg klasične metodologije za te namene priporočljiva uporaba večkriterijske metode odločanja.

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