Economic Performance of the Economy of Kosovo and Metohija

Radojko LUKIC[1]

DOI: 10.24818/mer/2024.01-08

ABSTRACT

The problem of analysing the factors of the dynamics of the economic performance of every economy, which means the economy of the southern provinces of Serbia, the economy of Kosovo and Metohija, is continuously very current, challenging, significant, and complex. Adequate control of key factors can significantly influence the achievement of the target economic performance of any economy. The application of multi-criteria decision-making methods enables adequate control of the key factors of the economic performance of each economy. Taking this into account, this paper analyses the dynamics of the economic performance of the economy of Kosovo and Metohija in the period 2013 - 2022 based on the LMAW-DNMA method. In the top five years according to the economic performance of the economy of Kosovo and Metohija according to the LMAW-DNMA methods, it falls in the following order: 2022, 2021, 2019, 2017 and 2018. The worst economic performance of the economy of Kosovo and Metohija was achieved in 2020, partly due to the corona virus pandemic. Recently, the economic performance of the economy of Kosovo has improved significantly and Metohija. Adequate management of the analysed statistical variables (gross domestic product, inflation, agriculture, industry, export, import, capital, income, and taxes) influenced this. Similarly, the economic climate, foreign direct investments, the energy crisis, the digitalisation of the company's entire operation, and other factors. Their adequate control can greatly influence the achievement of the target economic performance of the economy of Kosovo and Metohija.

KEYWORDS: *performance, economy, Kosovo and Metohija, LMAW-DNMA method*

JEL CLASSIFICATION: *C61, L32.*

1. INTRODUCTION

Researching the factors influencing the economic performance dynamics of every economy, which means Kosovo and Metohija, is a notably challenging, significant, intricate, and continuously relevant endeavour. It indicates the critical factors and what measures should be taken in order to achieve the target economic performance. Bearing this in mind, this paper analyses the dynamic factors of the economic performance of the economy of Kosovo and Metohija using the LMAW-DNMA method. On the basis of a complex analysis using the given methodology, the real situation in terms of the achieved economic performance of the economy of Kosovo and Metohija can be viewed and relevant measures for improvement in the future 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 economy of Kosovo and Metohija. In addition to the application of ratio

[1] Corresponding author: Radojko Lukic, Faculty of Economics, University of Belgrade, radojko.lukic@ekof.bg.ac.rs

analysis, statistical analysis, DEA analysis, and the use of multi-criteria decision-making methods, including the LMAW-DNMA method, a significant role is played in this. In relation to the classical analysis, their integrated application gives more accurate results of the achieved economic performance of the economy of Kosovo and Metohija as a basis for improvement in the future by applying adequate measures. In this paper, with that in mind, the analysis of factors of the dynamics of the economic performance of the economy of Kosovo and Metohija 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 observed years) based on the simultaneous use of several selected criteria. Knowing the positioning of the observed alternatives is a prerequisite for improvement in the future by applying relevant economic and other measures.

The literature devoted to analysing the economic performance of each economy is extensive. In the classical literature, the analysis of the economic performance of the economy is mainly based on financial analysis, ratio analysis, and statistical analysis. In the modern literature, DEA (Data Envelopment Analysis) models are increasingly used in the world when analysing the efficiency of companies (Alam et al., 2022; Amin, & Hajjami, 2021; Amini et al., 2019; Amirteimoori et al., 2022; Andersen & Petersen, 1993; Banker et al., 1984; Chang et al., 2020; Chen et al., 2021; Chen et al., 2018, 2020, 2021a,b; Cooper et al., 1999; Dobrović et al., 2021; Fenyves, & Tarnóczi, 2020; Guo, & Cai, 2020; Lee et al., 2011; Lin et al., 2020; Park, & Kim, 2022; Pendharkar et al., 2021; Podinovski et al., 2021; Photos Čiković & Lozić, 2022; Rasoulzadeh et al., 2021; Rostamzadeh et al., 2021; Sala-Garrido, 2023; Stević et al., 2022; Tone, 2002; Tsai et al., 2021; Zohreh Moghaddas et al., 2022).

The same is the case with the analysis of the efficiency of companies in Serbia (Đurić et al., 2020; Lukic et al., 2017, 2020; Lukic, 2018, 2022a, b,c,d, 2023c; Lukic & Kozarevic, 2019; Lukic & Hadrovic Zekic, 2019; Mandić et al., 2017; Martić, & Savić, 2001; Radonjić, 2020; Vojteški Kljenak & Lukić, 2022). DEA models give a realistic picture of which companies are efficient and which are not and what measures should be taken to increase efficiency.

Recently, in the world literature, multi-criteria decision-making methods (ARAS; MARCOS, PROMETHEE, TOPSIS, WASPAS, REF, etc.) are increasingly being applied in the analysis of company performance (Ayçin & Arsu, 2021; Ecer & Aycin, 2022; Mishra et al., 2022; Nguyen et al., 2022; Popović et al., 2022; Rani et al., 2022; Toslak et al., 2022).

The situation is the same as the literature in Serbia (Lukic, 2021, 2023a, b, e, f, g, h, jk; Stojanović et al., 2022). Because they lead to more realistic results compared to classical methods (such as financial analysis, ratio analysis) as a basis for improvement in the future by applying relevant eco-friendly and other measures. Based on that, this paper analyses the factors of economic performance dynamics of the economy of Kosovo and Metohija using, in addition to ratio analysis and statistical analysis, the LMAW-DNMA method. LMAW-DNMA is a newer multi-criteria decision-making method. Compared to the classic method, for example, ratio analysis, this method gives more accurate results considering that it simultaneously integrates several indicators. This enables the selection of adequate of both economic and other measures to improve the economic performance of the economy of Kosovo and Metohija in the future.

In this paper, as far as empirical data is concerned, the data of the World Bank are used because it aligns comprehensively with the observed aspects of the research on the factors influencing the dynamic economic performance of Kosovo and Metohija's economy.

2. METHODS

Using the LMAW and DNMA methods, we will evaluate the dynamic factors of the economic performance of the Serbian economy 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 (Demir, 2022; Liao, & Wu, 2020). It takes place through the following steps: m alternatives $A = \{A_1, A_2, \dots, A_m\}$ are evaluated in comparison with n criteria $C = \{C_1, C_2, \dots, C_n\}$with the participation of k experts $E = \{E_1, E_2, \dots, E_k\}$ and according to a predefined linguistic scale (Pamučar et al., 2021) .

Step 1: Determination of weight coefficients of criteria

Experts $E = \{E_1, E_2, \dots, E_k\}$set priorities with criteria $C = \{C_1, C_2, \dots, C_n\}$in relation to 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 less importance on the linguistic scale. By the way, the priority vector is obtained. The label γ_{cn}^{e}represents the value of the linguistic scale that the expert $e(1 \le e \le k)$ assigns to the criterion $C_t(1 \le t \le n)$.

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

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

$$\gamma_{AIP} = \frac{\gamma_{min}^{e}}{S} \qquad (1)$$

where is $\gamma_{min}^{e}$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:

$$n_{Cn}^{e} = \frac{\gamma_{Cn}^{e}}{\gamma_{AIP}} \qquad (2)$$

So the relational vector $R^e = (n_{C1}^{e}, n_{C2}^{e}, \dots, n_{Cn}^{e})$ is obtained. Where it n_{Cn}^{e}represents the value of the realation vector derived from the previous equation, and R^{e} represents the relational vector $e(1 \le e \le k)$.

Step 1.3: Determination of the vector of weight coefficients

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

$$w_j^e = \frac{\log_A(n_{Cn}^{e})}{\log_A\left(\prod_{j=1}^{n} n_{Cn}^{e}\right)}, A > 1 \qquad (3)$$

where w_j^eit represents the weighting, coefficients obtained according to expert evaluations e^{th} and the n_{Cn}^{e}elements of the realisation vector *R*. The obtained values for the weighting coefficients must meet the condition that $\sum_{j=1}^{n} w_j^e = 1$.

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

$$W_j = \left(\frac{1}{k.(k-1)} . \sum_{x=1}^{k} \left(w_j^{(x)}\right)^p . \sum_{\substack{y=1 \\ y \neq x}}^{k} \left(w_{ij}^{(y)}\right)^q\right)^{\frac{1}{p+q}} \quad (4)$$

The value of p and q are stabilisation parameters and $p, q \geq 0$. The resulting weight coefficients should fulfill the condition that $\sum_{j=1}^{n} w_j = 1$.

DNMA (Double Normalisation-based Multiple Aggregation) method is a newer method to show alternatives (Demir, 2022). Two different normalised (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 of applying this method are as follows (Ecer, 2020; Liao & Wu, 2020):

Step 1: Normalised decision matrix

The elements of the decision matrix are normalised with linear $\left(\hat{x}_{ij}^{1N}\right)$ normalisation using the following equation:

$$\hat{x}_{ij}^{1N} = 1 - \frac{\left|x^{ij} - r_j\right|}{max\left\{\max_i x^{ij}, r_j\right\} - min\left\{\min_i x^{ij}, r_j\right\}} \quad (5)$$

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

$$\hat{x}_{ij}^{2N} = 1 - \frac{\left|x^{ij} - r_j\right|}{\sqrt{\sum_{i=1}^{m} (x^{ij})^2 + \left(r_j\right)^2}} \quad (6)$$

The value $r_j$is the target value for $c_j$the 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 $\left(\sigma_j\right)$ for the criterion $c_j$is determined with the following equation where *m is* the number of alternatives:

$$\sigma_j = \sqrt{\frac{\sum_{i=1}^{m} \left(\frac{x^{ij}}{\max_i x^{ij}} - \frac{1}{m} \sum_{i=1}^{m} \left(\frac{x^{ij}}{\max_i x^{ij}}\right)\right)^2}{m}} \quad (7)$$

Step 2.2: Values of the standard deviation calculated for the criteria se normalise with the following equation:

$$w_j^{\sigma} = \frac{\sigma_j}{\sum_{i=1}^{n} \sigma_j} \quad (8)$$

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

$$\widehat{w}_j = \frac{\sqrt{w_j^{\sigma} . w_j}}{\sum_{i=1}^{n} \sqrt{w_j^{\sigma} . w_j}} \quad (9)$$

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:

$$u_1(a_i) = \sum_{j=1}^{n} \frac{\widehat{w}_j . \hat{x}_{ij}^{1N}}{\max_i \hat{x}_{ij}^{1N}} \quad (10)$$

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

$$u_2(a_i) = \max_j \widehat{w}_j \left(\frac{1 - \hat{x}_{ij}^{1N}}{\max_i \hat{x}_{ij}^{1N}} \right) \quad (11)$$

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

$$u_3(a_i) = \prod_{j=1}^{n} \left(\frac{\hat{x}_{ij}^{2N}}{\max_i \hat{x}_{ij}^{2N}} \right)^{\widehat{w}_j} \quad (12)$$

Step 4: Integration of utility values

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

$$DN_i = w_1 \sqrt{\varphi \left(\frac{u_1(a_i)}{\max_i u_1(a_i)} \right)^2 + (1-\varphi) \left(\frac{m - r_{1(a_i)+1}}{m} \right)^2} - w_2 \sqrt{\varphi \left(\frac{u_2(a_i)}{\max_i u_2(a_i)} \right)^2 + (1-\varphi) \left(\frac{r_2(a_i)}{m} \right)^2} + w_3 \sqrt{\varphi \left(\frac{u_3(a_i)}{\max_i u_3(a_i)} \right)^2 + (1-\varphi) \left(\frac{m - r_3(a_i) + 1}{m} \right)^2} \quad (13)$$

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 $\varphi$is the relative importance of the child value used and is in the range [0.1]. It is considered that it can be taken as $\varphi = 0.5$. The coefficients $w_1, w_2, w_3$are obtained weights of the used functions CCM, UCM and ICM, respectively. The sum should be equal $w_1 + w_2 + w_3 = 1$. When determining the weights, if the decision maker attaches importance to a wider range of performance alternatives, he 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 can assign a higher weight to w_2. However, the decision maker may assign a greater weight to $w_3$if he simultaneously considers overall performance and risk. Finally, the *DN* values are sorted in descending order, with the higher value alternatives being the best.

3. RESULTS AND DISCUSSION

The key issue in the application of the LMAW-DNMA method in the evaluation of the economic performance of the economy of Kosovo and Metohija is the selection of appropriate criteria and the determination of their weight coefficients (weights), as well as alternatives. In this paper, the selection of criteria was made according to the nature of the research of the problem treated. They are shown in Table 1 and fully correspond to the problematic character of the analysis of factors of the dynamics of economic performance, with special reference to Kosovo and Metohija. The alternatives are observed years (2013-2022) and they are also shown in the same table. Figure 1 shows a ratio analysis of the observed economic performance indicators of the economy of Kosovo and Metohija for the period 2013-2022.

Table 1. Initial data

	GDP (current US$) (billion)	GDP growth (annual %)	Inflation, GDP deflator (annual %)	Agriculture, forestry, and fishing, value added (% of GDP)	(Industry including construction), value added (% of GDP)	Exports of goods and services (% of GDP)	Imports of goods and services (% of GDP)	Gross capital formation (% of GDP)	Domestic credit provided by financial sector (% of GDP)
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
2013 – A1	6.73	5.3	0.4	8.4	27.2	23	52.1	30	26.5
2014 – A2	7.07	3.3	1.6	8.3	26.5	23.5	53.5	27.8	29.9
2015 – A3	6.29	5.9	0.6	7.7	26.9	22.5	51.6	30.4	32.5
2016 – A4	6.68	5.6	0.8	8.2	26.9	23.8	51.2	33.5	36.4
2017 – A5	7.18	4.8	0.4	7.4	27.5	27.3	53.1	34.7	39.9
2018 – A6	7.88	3.4	1.5	6.5	27.9	29.1	57.3	36.3	45.3
2019 – A7	7.90	4.8	1	7.2	27.1	29.3	56.4	34.6	49.5
2020 – A8	7.72	-5.3	1.4	7.4	27.6	21.7	53.9	33.4	59.5
2021 – A9	9.41	10.7	6.1	6.9	27.4	33.4	65.2	36	57.1
2022 – A10	9.43	3.5	8.7	7.4	28.2	38.5	70.8	34.8	58.1
Statistics									
Mean	7.6290	4.2000	2.2500	7.5400	27.3200	27.2100	56.5100	33.1500	43.4700
Median	7.4500	4.8000	1.2000	7.4000	27.3000	25.5500	53.7000	34.0500	42.6000
Std. Deviation	1.08403	3.96120	2.81593	.61860	.50728	5.47102	6.49452	2.81987	12.25507
The minimum	6.29	-5.30	.40	6.50	26.50	21.70	51.20	27.80	26.50
Maximum	9.43	10.70	8.70	8.40	28.20	38.50	70.80	36.30	59.50

Note: Author's statistics
Source: The Word Bank.
https://data.worldbank.org/country/kosovo?view=charthttps://data.worldbank.org/country/kosovo?view=chart

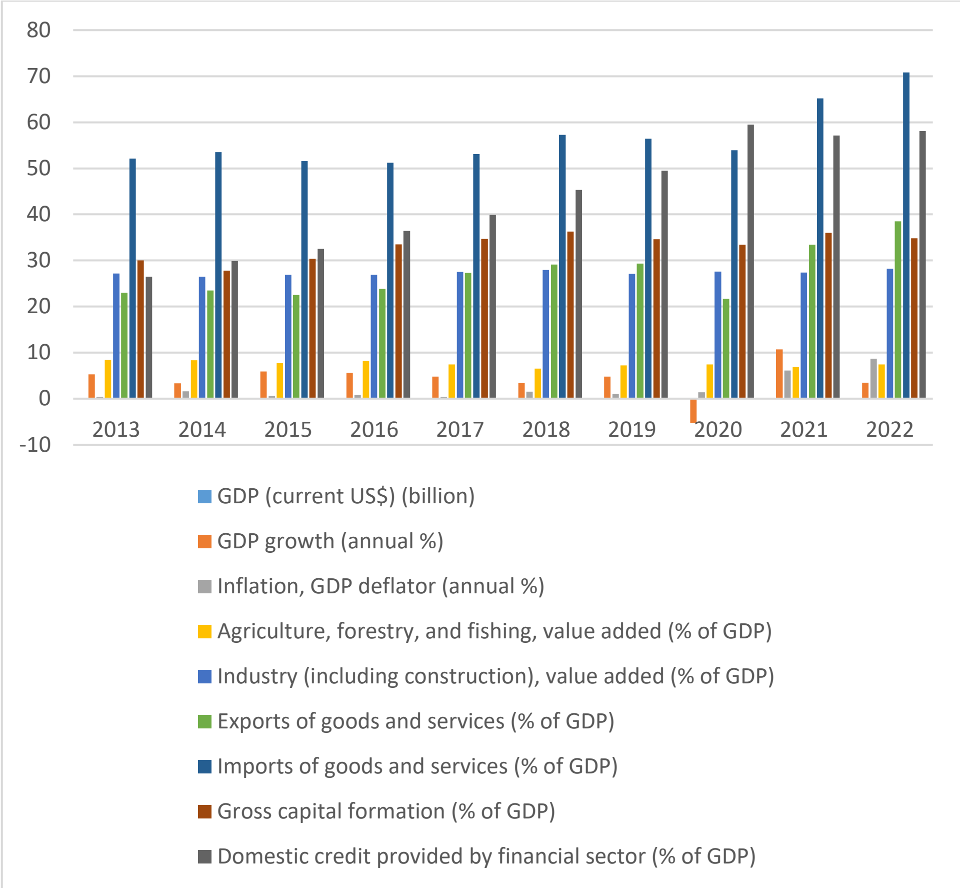

Figure 1. Economic performance indicators of the economy of Kosovo and Metohija
Source: author's picture

Table 2 shows the correlation matrix of the criteria.

Table 2. Correlation

Correlations										
		C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
C 1	Pearson Correlation	1	.131	.885 **	-.619	.664 *	.885 **	.946 **	.644 *	.837 **
	Sig. (2-tailed)		.719	.001	.057	.036	.001	.000	.044	.003
	N	10	10	10	10	10	10	10	10	10
C2	Pearson Correlation	.131	1	.210	-.033	-.218	.361	.219	.114	-.249
	Sig. (2-tailed)	.719		.561	.928	.545	.306	.544	.754	.487
	N	10	10	10	10	10	10	10	10	10
C3	Pearson Correlation	.885 **	.210	1	-.325	.569	.866 **	.970 **	.388	.642 *
	Sig. (2-tailed)	.001	.561		.360	.086	.001	.000	.269	.045
	N	10	10	10	10	10	10	10	10	10
C4	Pearson Correlation	-.619	-.033	-.325	1	-.651 *	-.555	-.494	-.832 **	-.701 *
	Sig. (2-tailed)	.057	.928	.360		.042	.096	.146	.003	.024
	N	10	10	10	10	10	10	10	10	10
C5	Pearson Correlation	.664 *	-.218	.569	-.651 *	1	.660 *	.664 *	.723 *	.684 *
	Sig. (2-tailed)	.036	.545	.086	.042		.038	.036	.018	.029

Correlations										
		C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
	N	10	10	10	10	10	10	10	10	10
C6	Pearson Correlation	.885 **	.361	.866 **	-.555	.660 *	1	.943 **	.640 *	.621
	Sig. (2-tailed)	.001	.306	.001	.096	.038		.000	.046	.056
	N	10	10	10	10	10	10	10	10	10
C7	Pearson Correlation	.946 **	.219	.970 **	-.494	.664 *	.943 **	1	.524	.706 *
	Sig. (2-tailed)	.000	.544	.000	.146	.036	.000		.120	.023
	N	10	10	10	10	10	10	10	10	10
C8	Pearson Correlation	.644 *	.114	.388	-.832 **	.723 *	.640 *	.524	1	.739 *
	Sig. (2-tailed)	.044	.754	.269	.003	.018	.046	.120		.015
	N	10	10	10	10	10	10	10	10	10
C9	Pearson Correlation	.837 **	-.249	.642 *	-.701 *	.684 *	.621	.706 *	.739 *	1
	Sig. (2-tailed)	.003	.487	.045	.024	.029	.056	.023	.015	
	N	10	10	10	10	10	10	10	10	10
**. Correlation is significant at the 0.01 level (2-tailed).										
*. Correlation is significant at the 0.05 level (2-tailed).										

Source: author's statistics

In this case, there is a strong correlation between C1 and the other criteria, except for C2 and C4, at the level of statistical significance. Therefore, increasing the gross domestic product can influence the improvement of the economic performance of the economy of Kosovo and Metohija. Table 3 and Figure 2 show the Friedman test.

Table 3. Friedman test

NPar Tests	
Friedman Test	
Ranks	
	Mean Rank
C1	3.40
C2	2.00
C3	1.30
C4	3.30
C5	5.70
C6	5.50
C7	8.90
C8	7.00
C9	7.90
Test Statistics [a]	
N	10
Chi-Square	75,333
df	8
Asymp. Sig.	.000
a. Friedman Test	

Source: author's statistics

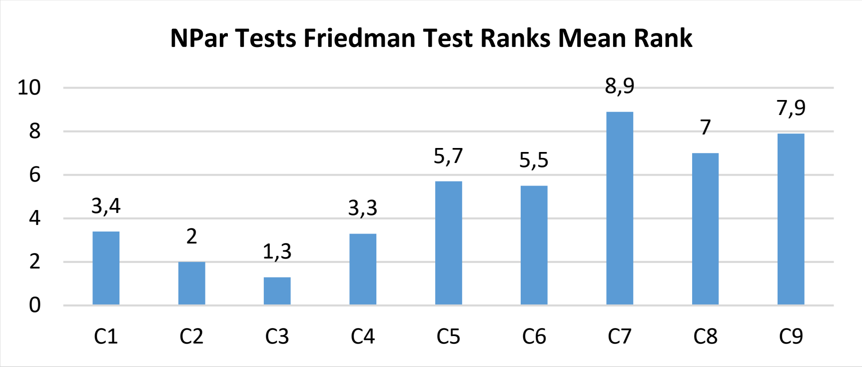

Figure 2. Mean Rank
Source: author's picture

Thus, substantial distinctions exist among the observed criteria for the economic performance of Kosovo and Metohija's economy. (Asymp. Sig. .000).
Table 4 shows the prioritisation scale.

Table 4. Prioritisation scale

Prioritisation Scale		
Linguistic Variables	**Abbreviation**	**Prioritisation**
Absolutely 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
Absolutely High	**AH**	5

Source: author's statistics

Determining the weighting coefficients of the criteria using the LMAW method are shown in Table 5 and Figure 3. (The author's calculation.)

Table 5. Weight coefficients of the criteria

KIND	1	1	1	1	1	1	1	1	1
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
E1	**H**	**AH**	**H**	**E**	**MH**	**MH**	**H**	**VH**	**E**
E2	**VH**	**VH**	**MH**	**H**	**H**	**MH**	**AH**	**AH**	**L**
E3	**E**	**MH**	**VH**	**AH**	**AH**	**H**	**E**	**E**	**H**
E4	**MH**	**E**	**E**	**VH**	**AH**	**E**	**AH**	**H**	**H**

ϒAIP	0.5									
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**LN(Πη)**
R1	8	10	8	6	7	7	8	9	6	18.213
R2	9	9	7	8	8	7	10	10	4	18.437
R3	6	7	9	10	10	8	6	6	8	18.282
R4	7	6	6	9	10	6	10	8	8	18.282

Aggregated Fuzzy Vectors	C1	C2	C3	C4	C5	C6	C7	C8	C9
W1j	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002
W2j	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.003	0.002
W3j	0.003	0.003	0.003	0.003	0.004	0.003	0.003	0.003	0.003
W4j	0.003	0.003	0.003	0.003	0.004	0.003	0.004	0.003	0.003

Weight Coefficients Vector	C1	C2	C3	C4	C5	C6	C7	C8	C9
W1j	0.114	0.126	0.114	0.098	0.107	0.107	0.114	0.121	0.098
W2j	0.119	0.119	0.106	0.113	0.113	0.106	0.125	0.125	0.075
W3j	0.098	0.106	0.120	0.126	0.126	0.114	0.098	0.098	0.114
W4j	0.106	0.098	0.098	0.120	0.126	0.098	0.126	0.114	0.114
SUM	0.012	0.013	0.012	0.013	0.014	0.011	0.013	0.013	0.010
Aggregated Weight Coefficient Vectors	0.1093	0.1123	0.1094	0.1142	0.1178	0.1060	0.1156	0.1142	0.0998

Source: Author's statistics

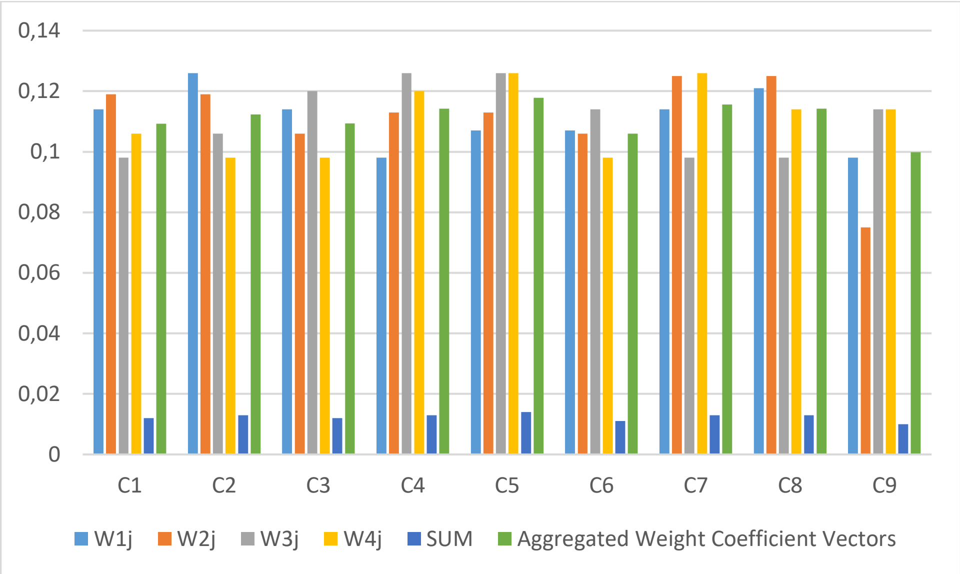

Figure 3. Weight coefficients of criteria

Source: Author's picture

The most important criterion in this case is therefore C5 - (Industry including construction), value added (% of GDP). Increasing the added value in the industry can therefore significantly influence the improvement of the economic performance of the economy of Kosovo and Metohija.

The results of the economic performance research of the economy of Kosovo and Metohija using the LMAW-DNMA method are shown in Tables 6 - 12 and Figure 4 (the author's calculation).

Table 6. Initial Matrix

INITIAL MATRIX	KIND	1	1	1	1	1	1	1	1	1
	Weight	0.1093	0.1123	0.1094	0.1142	0.1178	0.1060	0.1156	0.1142	0.0998
		C1	C2	C3	C4	C5	C6	C7	C8	C9
	A1	6.73	5.3	0.4	8.4	27.2	23	52.1	30	26.5
	A2	7.07	3.3	1.6	8.3	26.5	23.5	53.5	27.8	29.9
	A3	6.29	5.9	0.6	7.7	26.9	22.5	51.6	30.4	32.5

INITIAL MATRIX	KIND	1	1	1	1	1	1	1	1	1
	Weight	0.1093	0.1123	0.1094	0.1142	0.1178	0.1060	0.1156	0.1142	0.0998
		C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
	A4	6.68	5.6	0.8	8.2	26.9	23.8	51.2	33.5	36.4
	A5	7.18	4.8	0.4	7.4	27.5	27.3	53.1	34.7	39.9
	A6	7.88	3.4	1.5	6.5	27.9	29.1	57.3	36.3	45.3
	A7	7.9	4.8	1	7.2	27.1	29.3	56.4	34.6	49.5
	A8	7.72	-5.3	1.4	7.4	27.6	21.7	53.9	33.4	59.5
	A9	9.41	10.7	6.1	6.9	27.4	33.4	65.2	36	57.1
	A10	9.43	3.5	8.7	7.4	28.2	38.5	70.8	34.8	58.1
	MAX	9.4300	10.7000	8.7000	8.4000	28.2000	38.5000	70.8000	36.3000	59.5000
	MIN	6.2900	-5.3000	0.4000	6.5000	26.5000	21.7000	51.2000	27.8000	26.5000

Source: Author's statistics

Table 7. Linear Normalisation Matrix

Linear Normalization MATRIX		C1	C2	C3	C4	C5	C6	C7	C8	C9	MAX
	A1	0.1401	0.6625	0.0000	1.0000	0.4118	0.0774	0.0459	0.2588	0.0000	1.0000
	A2	0.2484	0.5375	0.1446	0.9474	0.0000	0.1071	0.1173	0.0000	0.1030	0.9474
	A3	0.0000	0.7000	0.0241	0.6316	0.2353	0.0476	0.0204	0.3059	0.1818	0.7000
	A4	0.1242	0.6813	0.0482	0.8947	0.2353	0.1250	0.0000	0.6706	0.3000	0.8947
	A5	0.2834	0.6313	0.0000	0.4737	0.5882	0.3333	0.0969	0.8118	0.4061	0.8118
	A6	0.5064	0.5438	0.1325	0.0000	0.8235	0.4405	0.3112	1.0000	0.5697	1.0000
	A7	0.5127	0.6313	0.0723	0.3684	0.3529	0.4524	0.2653	0.8000	0.6970	0.8000
	A8	0.4554	0.0000	0.1205	0.4737	0.6471	0.0000	0.1378	0.6588	1.0000	1.0000
	A9	0.9936	1.0000	0.6867	0.2105	0.5294	0.6964	0.7143	0.9647	0.9273	1.0000
	A10	1.0000	0.5500	1.0000	0.4737	1.0000	1.0000	1.0000	0.8235	0.9576	1.0000

Source: Author's statistics

Table 8. Vector Normalisation Matrix

Vector Normalisation MATRIX		C1	C2	C3	C4	C5	C6	C7	C8	C9	MAX
	A1	0.8966	0.7402	0.4097	1.0000	0.9890	0.8380	0.9032	0.9434	0.7860	1.0000
	A2	0.9096	0.6440	0.4950	0.9961	0.9813	0.8432	0.9105	0.9236	0.8081	0.9961
	A3	0.8797	0.7691	0.4239	0.9724	0.9857	0.8328	0.9006	0.9470	0.8249	0.9857
	A4	0.8947	0.7547	0.4381	0.9921	0.9857	0.8464	0.8986	0.9748	0.8502	0.9921
	A5	0.9138	0.7162	0.4097	0.9605	0.9923	0.8829	0.9084	0.9856	0.8729	0.9923
	A6	0.9406	0.6488	0.4879	0.9250	0.9967	0.9018	0.9301	1.0000	0.9079	1.0000
	A7	0.9414	0.7162	0.4523	0.9527	0.9879	0.9039	0.9255	0.9847	0.9352	0.9879
	A8	0.9345	0.0000	0.4808	0.9605	0.9934	0.8244	0.9125	0.9739	1.0000	1.0000
	A9	0.9992	1.0000	0.8151	0.9408	0.9912	0.9467	0.9710	0.9973	0.9844	1.0000
	A10	1.0000	0.6536	1.0000	0.9605	1.0000	1.0000	1.0000	0.9865	0.9909	1.0000
	Adj Wj	0.1065	0.1442	0.1787	0.0871	0.0437	0.1165	0.0978	0.0894	0.1362	

Source: Author's statistics

Table 9. CCM (Complete Compensatory Model)

CCM (Complete Compensatory Model)	u1(ai)	C1	C2	C3	C4	C5	C6	C7	C8	C9	SUM
	A1	0.0149	0.0955	0.0000	0.0871	0.0180	0.0090	0.0045	0.0231	0.0000	0.2522
	A2	0.0279	0.0818	0.0273	0.0871	0.0000	0.0132	0.0121	0.0000	0.0148	0.2642
	A3	0.0000	0.1442	0.0062	0.0786	0.0147	0.0079	0.0029	0.0391	0.0354	0.3288

CCM (Complete Compensatory Model)	**u1(ai)**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**SUM**
	A1	0.0149	0.0955	0.0000	0.0871	0.0180	0.0090	0.0045	0.0231	0.0000	0.2522
	A2	0.0279	0.0818	0.0273	0.0871	0.0000	0.0132	0.0121	0.0000	0.0148	0.2642
	A3	0.0000	0.1442	0.0062	0.0786	0.0147	0.0079	0.0029	0.0391	0.0354	0.3288
	A4	0.0148	0.1098	0.0096	0.0871	0.0115	0.0163	0.0000	0.0670	0.0457	0.3617
	A5	0.0372	0.1121	0.0000	0.0508	0.0317	0.0479	0.0117	0.0894	0.0681	0.4489
	A6	0.0539	0.0784	0.0237	0.0000	0.0360	0.0513	0.0304	0.0894	0.0776	0.4408
	A7	0.0682	0.1138	0.0161	0.0401	0.0193	0.0659	0.0324	0.0894	0.1186	0.5639
	A8	0.0485	0.0000	0.0215	0.0412	0.0283	0.0000	0.0135	0.0589	0.1362	0.3481
	A9	0.1058	0.1442	0.1227	0.0183	0.0231	0.0812	0.0698	0.0863	0.1263	0.7777
	A10	0.1065	0.0793	0.1787	0.0412	0.0437	0.1165	0.0978	0.0736	0.1304	0.8677

Source: Author's statistics

Table 10. UCM (Uncompensatory Model)

UCM (Uncompensatory Model)	**u2(ai)**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**MAX**
	A1	0.0915	0.0487	0.1787	0.0000	0.0257	0.1075	0.0933	0.0663	0.1362	0.1787
	A2	0.0785	0.0624	0.1514	0.0000	0.0437	0.1034	0.0857	0.0894	0.1214	0.1514
	A3	0.1065	0.0000	0.1725	0.0085	0.0290	0.1086	0.0949	0.0503	0.1008	0.1725
	A4	0.0917	0.0344	0.1690	0.0000	0.0322	0.1003	0.0978	0.0224	0.0905	0.1690
	A5	0.0693	0.0321	0.1787	0.0363	0.0120	0.0687	0.0861	0.0000	0.0681	0.1787
	A6	0.0526	0.0658	0.1550	0.0871	0.0077	0.0652	0.0673	0.0000	0.0586	0.1550
	A7	0.0382	0.0304	0.1625	0.0470	0.0244	0.0506	0.0653	0.0000	0.0175	0.1625
	A8	0.0580	0.0000	0.1571	0.0458	0.0154	0.1165	0.0843	0.0305	0.0000	0.1571
	A9	0.0007	0.0000	0.0560	0.0687	0.0206	0.0354	0.0279	0.0032	0.0099	0.0687
	A10	0.0000	0.0649	0.0000	0.0458	0.0000	0.0000	0.0000	0.0158	0.0058	0.0649

Source: Author's statistics

Table 11. ICM (Incomplete Compensation Model)

ICM (Incomplete Compensatory Model)	**u3(ai)**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**MAX**
	A1	0.9884	0.9576	0.8526	1.0000	0.9995	0.9796	0.9901	0.9948	0.9677	0.7532
	A2	0.9904	0.9391	0.8826	1.0000	0.9993	0.9808	0.9913	0.9933	0.9719	0.7699
	A3	0.9880	0.9649	0.8601	0.9988	1.0000	0.9805	0.9912	0.9964	0.9760	0.7740
	A4	0.9891	0.9613	0.8641	1.0000	0.9997	0.9817	0.9904	0.9984	0.9792	0.7807
	A5	0.9913	0.9541	0.8538	0.9972	1.0000	0.9865	0.9914	0.9994	0.9827	0.7734
	A6	0.9935	0.9395	0.8797	0.9932	0.9999	0.9880	0.9929	1.0000	0.9869	0.7895
	A7	0.9949	0.9547	0.8697	0.9968	1.0000	0.9897	0.9936	0.9997	0.9926	0.8035
	A8	0.9928	0.0000	0.8774	0.9965	0.9997	0.9778	0.9911	0.9976	1.0000	0.0000
	A9	0.9999	1.0000	0.9641	0.9947	0.9996	0.9936	0.9971	0.9998	0.9979	0.7532
	A10	1.0000	0.9405	1.0000	0.9965	1.0000	1.0000	1.0000	0.9988	0.9988	0.7699

Source: Author's statistics

Table 12. 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**				
2013	**A1**	0.2522	10	0.2173	0.1787	10	1.0000	0.7532	9	0.5796	0.4043	0.4043		**8**
2014	**A2**	0.2642	9	0.2576	0.1514	3	0.6356	0.7699	8	0.6125	0.4018	0.4018		**9**
2015	**A3**	0.3288	8	0.3418	0.1725	8	0.8867	0.7740	6	0.6773	0.4969	0.4969		**7**
2016	**A4**	0.3617	6	0.4603	0.1690	7	0.8322	0.7807	5	0.7207	0.5756	0.5756		**6**

2017	**A5**	0.4489	4	0.6155	0.1787	10	1.0000	0.7734	7	0.6428	0.6621	0.6621	**4**
2018	**A6**	0.4408	5	0.5559	0.1550	4	0.6755	0.7895	4	0.7695	0.6319	0.6319	**5**
2019	**A7**	0.5639	3	0.7288	0.1625	6	0.7705	0.8035	3	0.8244	0.7617	0.7617	**3**
2020	**A8**	0.3481	7	0.4006	0.1571	5	0.7154	0.0000	10	0.0707	0.3331	0.3331	**10**
2021	**A9**	0.7777	2	0.8981	0.0687	2	0.3066	0.9475	1	1.0000	0.8695	0.8695	**2**
2022	**A10**	0.8677	1	1.0000	0.0649	1	0.2664	0.9349	2	0.9444	0.9100	0.9100	**1**
	MAX	0.8677			0.1787			0.9475					

Source: Author's statistics

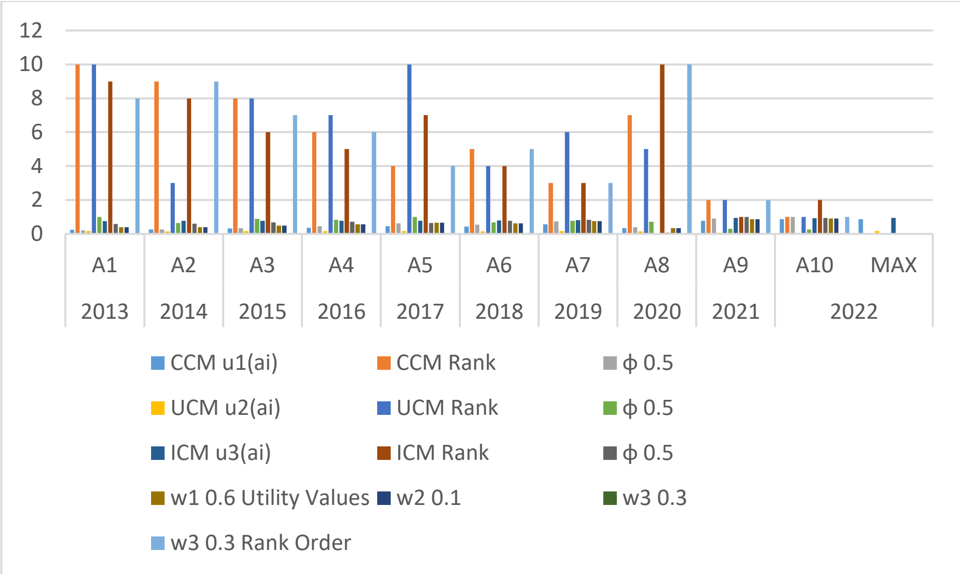

Figure 4. Rank Order

Source: Author's picture

In this particular case, the top five years based on the economic performance of Kosovo and Metohija, as per the LMAW-DNMA methods, are ranked in the following order: 2022, 2021, 2019, 2017 and 2018. In the period 2013 - 2022, the worst economic performance of the economy of Kosovo and Metohija was achieved in 2020, partly due to the pandemic of the corona virus COVID-19. All in all, it can be concluded, based on the given empirical analysis, that the economic performance of the economy of Kosovo and Metohija has improved significantly in recent times. Adequate management of analysed statistical variables as factors (gross domestic product, inflation, agriculture, industry, import, export, capital, income, taxes) had a positive effect on that. Likewise, the geopolitical and economic climate, foreign direct investments, the energy crisis, the digitalisation of the entire company's operations, etc.

The research in this paper, using the example of the LMAW-DNMA method, demonstrated the justification of applying, in addition to the classic methodology, the method of multi-criteria decision-making in the evaluation of the economic performance of the economy of Kosovo and Metohija, as well as the DEA model. Because 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 economy of Kosovo and Metohija.

4. CONCLUSIONS

Empirical research of the problem treated in this paper using the LMAW-DNMA method showed that in the top five years in terms of economic performance, the economy of Kosovo and Metohija fall in the following order: 2022, 2021, 2019, 2017 and 2018. In the period 2013 - 2022, the worst economic performance of the economy of Kosovo and Metohija was achieved in 2020. Overall, the economic performance of the economy of Kosovo and Metohija has improved significantly recently. Adequate management of analysed statistical variables as factors (gross domestic product, inflation, agriculture, industry, import, export, capital, income, taxes) contributed to this.

Significant determinants of the economic performance of the economy of Kosovo and Mtohija also include: the economic climate, the foreign direct investments, the digitisation of the entire business of companies, the energy crisis, and so on. To some extent, the negative effects of the COVID-19 pandemic on the economic performance of the economy of Kosovo and Metohija have been mitigated by the application of digitisation. The economy of Kosovo and Mtohija can achieve the target economic performance by adequately controlling the critical factors of business success (price, costs, time, quality, innovation, and growth).

REFERENCES

Alam, T.E., González, A.D. and Raman, S. (2022). Benchmarking of academic departments using data envelopment analysis (DEA). *Journal of Applied Research in Higher Education*, Vol. ahead of-print No. ahead-of-print., 1-30. https://doi.org/10.1108/JARHE-03-2021-0087

Amini, A., Alinezhad, A., & Yazdipoor, F. (2019). A TOPSIS, VIKOR and DEA integrated evaluation method with belief structure under uncertainty to rank alternatives. *International Journal of Advanced Operations Management*, *11*(3), 171–188.

Amin, G. R., & Hajjami, M. (2021). Improving DEA cross-efficiency optimization in portfolio selection. *Expert Systems with Applications*, *168*, 114280.

Amirteimoori, A., Mehdizadeh, S., & Kordrostami, S., (2022). Stochastic performance measurement in two-stage network processes: A data envelopment analysis approach. *Kybernetika*, *58*(2), 200-217. http://doi.org/10.14736/kyb-2022-2-0200

Andersen, P., & Petersen, N.C. (1993). A procedure for ranking efficient units in data envelopment analysis. *Management Science*, *39*, 1261-1264.

Ayçin, E., & Arsu, T. (2021). Sosyal Gelişme Endeksine Göre Ülkelerin Değerlendirilmesi: MEREC ve MARCOS Yöntemleri ile Bir Uygulama. *İzmir Yönetim Dergisi*, 2(2), 75-88.

Banker, R.D., A. Charnes, A., & Cooper, WW (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, *30*(9), 1078-1092.

Chang, X., & Wang, X. (2020). Research Performance Evaluation of University Based on Super DEA Model. *2020 IEEE 9th Joint International Information Technology and Artificial Intelligence Conference (ITAIC)*, 1252-1255. https://doi.org/10.1109/ITAIC49862.2020.9339131.

Chen, W., Gai, Y., & Gupta, P. (2018). Efficiency evaluation of fuzzy portfolio in different risk measures via DEA. *Annals of Operations Research*, *269*(1), 103-127. DOI: https://doi.org/10.1007/s10479-017-2411-9

Chen, W., Li, S. S., Zhang, J., & Mehlawat, M. K. (2020). A comprehensive model for fuzzy multi-objective portfolio selection based on DEA cross-efficiency model. *Soft computing*, *24*(4), 2515-2526.

Chen, W., Li, S. S., Mehlawat, M. K., Jia, L., & Kumar, A. (2021). Portfolio Selection Using Data Envelopment Analysis Cross-Efficiency Evaluation with Undesirable Fuzzy Inputs and Outputs. *International Journal of Fuzzy Systems*, *23*(5), 1478-1509.

Chen, Chunhua, Liu, Haohua, Tang, Lijun & Ren, Jianwei. (2021). A Range Adjusted Measure of Super-Efficiency in Integer-Valued Data Envelopment Analysis with

Undesirable Outputs. *Journal of Systems Science and Information*, *9*(4), 378-398. https://doi.org/10.21078/JSSI-2021-378-21

Cooper, W. W., Park, K. S., & Pastor, J. T. (1999). RAM: a range adjusted measure of inefficiency for use with additive models, and relations to other models and measures in DEA. *Journal of Productivity analysis*, *11*(1), 5-42. https://doi.org/10.1023/A: 1007701304281.

Demir, G. (2022). Analysis of the financial performance of the deposit banking sector in the Covid-19 period with LMAW-DNMA methods. *International Journal of Insurance and Finance*, *2*(2), 17-36. https://doi.org/10.52898/ijif.2022.7.

Ecer, F. (2020). *Multi-criteriad Decision-making comprehensive approach from past to present*. Seçkin Publications.

Ecer, F. & Aycin, E. (2022). Novel Comprehensive MEREC Weighting-Based Score Aggregation Model for Measuring Innovation Performance: The Case of G7 Countries. *Informatica*, 1-31, https://doi.org/10.15388/22-INFOR494.

Đurić, Z., Jakšić,M. & Krstić, A. (2020). DEA window analysis of insurance sector efficiency in the Republic of Serbia. *Economic Themes*, *58*(3), 291-310. https://doi.org/10.2478/ethemes-2020-0017.

Fenyves, V., & Tarnóczi, T. (2020). Data envelopment analysis for measuring performance in a competitive market. *Problems and Perspectives in Management*, *18*(1), 315-325. http://dx.doi.org/10.21511/ppm.18(1).2020.27.

Fotova Čiković, K., & Lozić, J. (2022). Application of Data Envelopment Analysis (DEA) in Information and Communication Technologies. *Tehnički glasnik*, *16*(1), 129-134. https://doi.org/10.31803/tg-20210906103816

Guo, D., & Cai, Z.Q. (2020). Super-Efficiency Infeasibility in the Presence of Nonradial Measurement. *Mathematical Problems in Engineering*, 2020 Article ID 6264852, 7 pages. https://doi.org/10.1155/2020/6264852

Liao, H., & Wu, X. (2020). DNMA: A double normalization-based multiple aggregation methods for multi-expert multi-criteria decision making. *Omega*, *94*, 102058. https://doi.org/10.1016/j.omega.2019.04.001

Lee, H.S., Chu, C.W., & J. Zhu, J. (2011). Super-efficiency DEA in the presence of infeasibility. *European Journal of Operational Research*, *212*(1), 141–147.

Lin, R. (2020). Cross-efficiency evaluation capable of dealing with negative data: A directional distance function based approach. *Journal of the Operational Research Society, 71(3), 505-516.*

Lukic, R., Sokic, M., & Kljenak, D.V. (2017). Efficiency analysis of the banking sector in the Republic of Serbia. *Business Excellence and Management*, *7*, 5-17.

Lukic, R. (2018). Analysis of the efficiency of insurance companies. In: Insurance in the post-crisis era, Belgrade: Faculty of Economics, University of Belgrade. ISBN: 978-86-403-1548-7.

Lukic, R., & Hadrovic Zekic, B. (2019). Evaluation of efficiency of trade companies in Serbia using the DEA approach. *Proceedings of the 19 th International Scientific Conference Business Logistics in Modern Management*, October 10-11, Osijek, Croatia, Josip Juraj Strossmayer University of Osijek, Faculty of Economics in Osijek, 145-165.

Lukić, R., & Kozarević, E. (2019). Analysis of selected countries trade efficiency based on the DEA models. December 2019, *Conference: The Sixth Scientific Conference with International Participation "Economy of Integration" ICEI 2019 - (E) Migrations and Competitiveness of South-Eastern European Countries*. At: Tuzla, Bosnia and Herzegovina, 61-71.

Lukić, R., Hanić, H., & Bugarčić, M. (2020). Analysis of profitability and efficiency of trade in Serbia. *Economic Analusis*, *53*(2), 39-50.

Lukić, R. (2021). Evaluation of the efficiency of public companies in Serbia using the ARAS method. *Proceedings of the Conference*, 43-53.

Lukic, R. (2022a). Analysis of efficiency factors of companies in Serbia based on artificial neural networks. *Анали Економског факултета у Суботици – The Annals of the Faculty of Economics in Subotica*, *58*(47), 097-115. https://doi.org/10.5937/AnEkSub2247097L.

Lukic, R. (2022b). Evaluation of financial performance and efficiency of companies in Serbia. *Journal of engineering management and competitiveness (JEMC)*, *12*(2), 132-141. http://dx.doi.org/10.5937/JEMC2202132L.

Lukic, R. (2022c). Measurement and Analysis of the Dynamics of Financial Performance and Efficiency of Trade in Serbia Based on the DEA Super-Radial Model. *Review of International Comparative Management*, 23(5), 630-645. https://doi.org/10.0.96.242/RMCL2022.5.630.

Lukic, R. (2022d). Analysis of Kosovo and Metohija Trade Performance. *Management and Economics Review*, *7*(3), 379-391. https://doi.org/10.24818/mer/2022.10-08.

Lukić, R.(2023a). Measurement and Analysis of The Information Performance of Companies in The European Union and Serbia Based on The Fuzzy LMAW and MARCOS Methods. *Informatica Economică*, *27*(1), 17 – 31. https://doi.org/10.24818/issn14531305/27.1.2023.02.

Lukić, R. (2023b). Analysis of the performance of the Serbian economy based on the MEREC-WASPAS method. *MARSONIA: Časopis za društvena i humanistička istraživanja*, *2*(1), 39-53.

Lukić, R. (2023c). Influence of Net Working Capital on Trade Profitability in Serbia. *European Journal of Interdisciplinary Studies*, *15*(1), 48-67. http://doi.org/10.24818/ejis.2023.04

Lukić, R. (2023d). Analysis of the performance of companies in Serbia listed on the Belgrade stock exchange. Zbornik radova / Conference Proceedings, *Računovodstvo i revizija u teoriji i praksi / Accounting and audit in theory and practice*, Banja Luka College / Besjeda Banja Luka, *5*(5), 69-80. http://dx.doi.org/10.7251/ZRRRTP2301069L.

Lukić, R. (2023e). Comparative analysis of transport and storage information systems of the European Union and Serbia using fuzzy LMAW and MARCOS methods. *Economy, Business & Development*, *4*(1). 1-17. http://doi.org/10.47063/ebd.00011.

Lukić, R. (2023f). Application of PROMETHEE Method in Evaluation of Insurance Efficiency in Serbia. *Revija za ekonomske in poslovne vede, Journal of Economic and Business Sciences*, *10*(1), 3-19. https://doi.org/10.55707/eb.v10i1.121.

Lukić, R. (2023g). Performance analysis of trading companies in Serbia based on DIBR – WASPAS methods. *Conference proceedings [Elektronski izvor] / 28th International Scientific Conference Strategic Management and Decision Support Systems in Strategic Management SM 2023*, Subotica, 18-19 May, 2023. Subotica: Faculty of Economics, 2023, 361-372. http://dx.doi.org/10.46541/978-86-7233-416-6_47.

Lukic, R. (2023h). Analysis of the Trade Performance of the European Union and Serbia on the Base of FF-WASPAS and WASPAS Methods. *Review of International Comparative Management*, *24*(2), 228-250. https://doi.org/10.24818/RMCI.2023.2.228.

Lukic, R. (2023i). Analysis of the efficiency of companies in Serbia based on the DEA super-radial approach. *Journal of engineering management and competitiveness (JEMC)*, *13*(1), 21-29. http://dx.doi.org/10.5937/JEMC2301021L.

Lukic, R. (2023j). Measurement and Analysis of Dynamics of Financial Performance and Efficiency of Trade in Serbia Using Iftopsis and Topsis Methods. *Management and Economics Review*, *8*(2), 201-219. http://dx.doi.org/10.24818/mer/2023.06-06.

Lukic, R. (2023k). Merenje i analiza dinamike profitabilnosti bankarskog sektora u Srbiji na bazi FLMAW-MARCOS metoda. Measurement and Analysis of Profitability Dynamics of the Banking Sector in Serbia Based on the FLMAW-MARCOS Method. *Banking – Bankarstvo*, *8*(47). http://dx.doi.org/10.5937/bankarstvo2301028L.

Mandić, K., Delibašić, B., Knežević, S. & Benković, S. (2017). Analysis of the efficiency of insurance companies in Serbia using the fuzzy AHP and TOPSIS methods. *Economic Research*, *30*(1), 550-565.

Martić, M., & Savić, G. (2001). An application of DEA for comparative analysis and ranking of regions in Serbia with regards to social-economic development. *European Journal of Operational Research*, *132*(2), 343-356. https://doi.org/10.1016/S0377-2217(00)00156-9.

Mishra, A.R., Saha, A., Rani, P., & Hezam, I.M. et al., (2022). An Integrated Decision Support Framework Using Single-Valued-MEREC-MULTIMOORA for Low Carbon Tourism Strategy Assessment", in *IEEE Access*, *10*, 24411-24432.

Nguyen, H.-Q., Nguyen, V.-T., Phan, D.-P., Tran, Q.-H., & Vu, N.-P. (2022). Multi-Criteria Decision Making in the PMEDM Process by Using MARCOS, TOPSIS, and MAIRCA Methods. *Applied Sciences*, *12*, 3720. https://doi.org/10.3390/ app12083720.

Zohreh Moghaddas, Z., Oukil, A., & Vaez-Ghasemi, M. (2022). Global multi-period performance evaluation - new model and productivity index. *RAIRO - Operations Research*, 56, 1503-1521. https://doi.org/10.1051/ro/2022065

Park, W., & Kim. S-G. (2022). Integrating quantitative and qualitative methodologies to build a national R&D plan using data envelopment analysis based on R&D stakeholders' perspectives. *PLoS ONE*, *17*(3), e0265058. https://doi.org/10.1371/journal.pone.0265058.

Pamučar, D., Žižović, M., Biswas, S., & Božanić, D. (2021). A new Logarithm Methodology of additive weights (LMAW) for multi-criteria decision-making: application in logistics. *Facta Universitatis Series: Mechanical Engineering*, *19*(3), Special Issue: 361-380. https://doi.org/10.22190/FUME210214031P

Pendharkar, PC (2021). Hybrid radial basis function DEA and its applications to regression, segmentation and cluster analysis problems. *Machine Learning with Applications*, *6*, 100092. https://doi.org/10.1016/j.mlwa.2021.100092 .

Podinovski, V.V., & Bouzdine-Chameeva, T. (2021). Optimal solutions of multiplier DEA models. *Journal of Productivity Analysis*, *56*, 45-68. https://doi.org/10.1007/s11123-021-00610-3

Popović, G., Pucar, Đ. & Florentin Smarandache, F. (2022). Merec-Cobra Approach in E-Commerce Development Strategy Selection. *Journal of Process Management and New Technologies*, *10*(3-4), 66-74.

Radonjić, Lj. (2020). Comparative Analysis of the Regional Efficiency in Serbia: DEA Approach. *Indistrija*, *48*(2), 1-19. http://dx.doi.org/10.5937/industrija48-24343.

Rani, P, Mishra, A. R., Saha, A., Hezam, I.M., Pamucar, D. (2022). Fermatean fuzzy Heronian mean operators and MEREC-based additive ratio assessment method: An application to food waste treatment technology selection. *International Journal of Intelligent Systems*, *37*, 2612-2647. https://doi.org/10.1002/int.22787.

Rasoulzadeh, M., Edalatpanah, S. A., Fallah, M., & Najafi, S. E. (2022). A multi-objective approach based on Markowitz and DEA cross-efficiency models for the intuitionistic fuzzy portfolio selection problem. *Decision Making: Applications in Management and Engineering*, *5*(2), 241-259. https://doi.org/10.31181/dmame0324062022

Rostamzadeh, R., Akbarian, O., Banaitis, A., & Soltani, Z. (2021). Application of DEA in benchmarking: a systematic literature review from 2003-2020. *Technological and*

Economic Development of Economy, *27*(1), 175-222. https://doi.org/10.3846/tede.2021.13406

Sala-Garrido, R., Mocholí-Arce, M., Maziotis, A., & Molinos-Senante, M. (2023). Benchmarking theperformance of water companies for regulatory purposes to improve its sustainability. *npj Clean Water* 6, *1*. https://doi.org/10.1038/s41545-022-00218-6

Stević, Ž., Miškić, S., Vojinović, D., Huskanović, E., Stanković, M., & Pamučar, D. (2022). Development of a Model for Evaluating the Efficiency of Transport Companies: PCA–DEA–MCDM Model. *Axioms*, *11*, 140. https://doi.org/10.3390/axioms11030140

Stojanović, I.., Puška, A. ., & Selaković, M. (2022). A Multi-Criteria Approach to The Comparative Analysis Of The Global Innovation Index On The Example Of The Western Balkan Countries. *Economics - Innovative and Economics Research JournaL*, *10*(2). https://doi.org/10.2478/eoik-2022-0019

Toslak, M., Aktürk, B., & Ulutaş, A. (2022). MEREC ve WEDBA Yöntemleri ile Bir Lojistik Firmasının Yıllara Göre Performansının Değerlendirilmesi. *Avrupa Bilim ve Teknoloji Dergisi*, *33*, 363-372.

Tone, K. (2002). A slacks-based measure of super-efficiency in data envelopment analysis. *European Journal of Operational Research*, *143*, 32-41.

Tsai, Chi-Mao, Lee, Hsuan-Shih, & Gan, Guo-Ya (2021). A New Fuzzy DEA Model for Solving the MCDM Problems in Supplier Selection. *Journal of Marine Science and Technology*: *29*(1), Article 7. https://doi.org/10.51400/2709-6998.1006.

Vojteški Kljenak, D., & Lukić, R. (2022). Evaluation of the efficiency of providers of financial leasing in Serbia. *Glasnik društvenih nauka - Journal of Social Sciences*, *14*(XIV), 113-144.

Zhu, N., & He, K. (2023). The efficiency of major industrial enterprises in Sichuan province of china: a super slacks-based measure analysis. *Journal of Industrial and Management Optimization*, *19*(2), 1328–1349. https://doi.org/10.3934/jimo.2021231.