RESEARCH OF THE DYNAMICS OF THE ECONOMIC PERFORMANCE OF THE SERBIAN ECONOMY BASED ON LMAW-DNMA METHODS

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Abstract

The issue of analyzing the factors of the dynamics of the economic performance of every economy, which means Serbia as well, is continuously very current, challenging, significant, and complex. Adequate control of key factors can significantly influence the achievement of the target economic performance of the economy. The application of multi-criteria decision-making methods enables adequate control of the key factors of economic performance of the economy. Bearing that in mind, this paper analyzes the dynamics of the economic performance of the Serbian economy in the period 2013 - 2022 based on the LMAW-DNMA method. The top five years according to the economic performance of the Serbian economy according to the LMAW-DNMA method are in order: 2021, 2019, 2018, 2013, and 2022. The worst economic performance of the Serbian economy was achieved in 2014. Recently, the economic performance of the Serbian economy has improved significantly. Adequate management of the analyzed statistical variables (gross domestic product, inflation, agriculture, industry, export, import, capital, income, and taxes) influenced this. Likewise, the geopolitical and economic climate, foreign direct investments, the COVID-19 pandemic, the energy crisis, the digitalization of the entire company's operations, and other factors. Their adequate control can greatly influence the achievement of the target performance of the Serbian economy.

Keywords: economy, performance, economy, Serbia, LMAW-DNMA method

JEL classification: C61. L32

1.Introduction

Research into the dynamic factors of the economic performance of every economy, which means Serbia as well, is very challenging, significant, complex, and continuously current. It indicates the critical factors and what measures should be taken to achieve the target economic performance. Bearing that in mind, this paper analyzes the dynamic factors of the economic performance of the Serbian economy using the LMAW-DNMA method. Based on a complex analysis by applying the given methodology, the real situation in terms of the achieved economic performance of the Serbian economy 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, imports, exports, incomes, taxes, etc.

Permanent control of key factors is a basic assumption for improving the economic performance of the Serbian economy. In addition to the application of ratio 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. About the classical analysis, their integrated application gives more accurate results of the achieved economic performance of the Serbian economy as a basis for improvement in the future by applying adequate measures. In this paper, considering that the analysis of factors of the dynamics of the economic performance of the Serbian economy 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 the specific case, the alternatives are the observed years) based on using several selected criteria at the same time. 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 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 modern literature, DEA (Data Envelopment Analysis) models are increasingly used in the world when analyzing the efficiency of companies (Park, & Kim, 2022; Zohreh Moghaddas et al., 2022; Amirteimoori et al., 2022; Alam et al., 2022; Fotova 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,b; Stević et al., 2022; Rasoulzadeh et al., 2021). The same is the case 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, b,c, 2023c; Lukic & Kozarevic, 2019; Lukic & Hadrovic Zekic, 2019; 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, etc.) are increasingly applied in the analysis of company performance (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 with literature in Serbia (Stojanović et al., 2022; Lukic, 2021, 2023a,b,e,f,g,h,j,k). Because they lead to more realistic results compared to classical methods (such as financial analysis, and ratio analysis) as a basis for improvement in the future by applying relevant eco-friendly and other measures. Based on that, this paper analyzes the factors of the dynamics of the economic performance of the Serbian economy by 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 economic and other measures to improve the economic performance of the Serbian economy in the future.

The data statistics for the analysis of the economic performance of the Serbian economy are very rich. These are the Statistical Yearbook of the Republic of Serbia, Chamber of Commerce of Serbia, National Bank of Serbia, Agency for Business Registers of the Republic of Serbia, EUROSTAT, World Bank, as well as literature. In this paper, data from the World Bank is used because they fully correspond to the observed aspect of the research on factors of the dynamics of the economic performance of the Serbian 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 (Liao, & Wu, 2020; Demir, 2022). 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 $C = \{C_1, C_2, \dots, C_n\}$ about 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 $e(1 \leq e \leq k)$assigns to the criterion $C_t(1 \leq t \leq n)$.

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 equation:

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

where is γ_{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:

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

So the relational vector $R^e = (n_{C1}^{e}, n_{C2}^{e}, \dots, n_{Cn}^{e})$ is obtained. Where n_{Cn}^{e} represents the value of the relation vector derived from the previous equation, and R^e 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 $w = (w_1, w_2, \dots, w_n)^T$ 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_j^e represents the weighting coefficients obtained according to expert evaluations e^{th} and the n_{Cn}^{e} elements of the realization 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 $w = (w_1, w_2, \dots, w_n)^T$:

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

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

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 $\left(\hat{x}_{ij}^{1N}\right)$ normalization using the following equation:

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

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

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

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:

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

Step 2.2: Values of the standard deviation calculated for the criteria se

normalize 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:

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

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:

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

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 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 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 can set a higher value for w_1. In case the decision maker is not willing to take risks, ie. 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 Serbian economy is the selection of appropriate criteria and the determination of their weighting coefficients, as well as alternatives. In this paper, the selection of criteria was made according to the nature of the research of the treated problem. They are shown in Table 1 and fully correspond to the nature of the problematic analysis of the factors of the dynamics of economic performance, with special reference to Serbia. The alternatives are observed years (2013-2022) and they are also shown in the same table.

Table 1 Initial data

		GDP (current US$) (billions)	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)	Revenue, excluding grants (% of GDP)	Tax revenue (% of GDP)
		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
A1	2013	48.39	2.89	5.13	7.41	26.84	39.85	48.07	17.38	37.43	20.84
A2	2014	47.06	-1.59	2.59	7.07	25.24	42.08	50.15	16.52	38.95	21.97
A3	2015	39.65	1.81	1.87	6.71	25.80	45.18	52.22	18.68	39.01	22.36
A4	2016	40.69	3.34	1.55	6.81	25.82	48.52	53.34	18.08	39.77	23.29
A5	2017	44.17	2.10	2.97	6.01	26.08	50.47	57.06	19.58	40.60	24.07
A6	2018	50.64	4.50	1.97	6.34	25.50	50.43	59.06	22.65	40.28	23.60
A7	2019	51.51	4.33	2.44	5.95	25.60	51.01	60.94	25.09	41.08	24.05
A8	2020	53.35	-0.90	2.45	6.34	24.90	48.22	56.50	24.19	41.29	23.49
A9	2021	63.08	7.55	5.91	6.29	25.00	54.48	62.28	25.01	36.25	20.62
A10	2022	63.56	5.16	10.35	6.46	25.57	63.84	74.81	26.51	0.00	0.00

Source: The World Bank, World Development Indicators. https://databank.worldbank.org/reports.aspx?source=2&country=SRB#

According to the ratio analysis of the indicators, taken as a whole, the economic performance of the Serbian economy has recently improved. In 2022, compared to 2021, the economic performance of the Serbian economy improved significantly in almost all analyzed indicators, except for indicators C2. This was positively influenced by the effective management of the relevant macroeconomic aggregates and, in the context of that, the successful mitigation of the negative effects of the COVID-19 pandemic.

Table 2 shows the linguistic terms.

Table 2 Linguistic terms

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 3 and Figure 1 show the evaluation and weighting coefficients of the criteria. (All calculations and results are the authors').

Table 3 Evaluation and weight coefficients of the criteria

KIND	1	1	1	1	1	1	1	1	1	1
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
E1	**VH**	**VH**	**H**	**MH**	**MH**	**MH**	**E**	**MH**	**VH**	**MH**
E2	**MH**	**M**	**M**	**E**	**H**	**M**	**MH**	**AH**	**L**	**VL**
E3	**H**	**E**	**E**	**H**	**E**	**E**	**H**	**E**	**H**	**M**
E4	**M**	**AH**	**VH**	**VH**	**M**	**AH**	**E**	**VH**	**M**	**VH**

E5	**AH**	**H**	**AH**	**AH**	**AH**	**VH**	**VH**	**M**	**AH**	**AH**

YAIP	0.5										
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**LN(Πη)**
R1	9	9	8	7	7	7	6	7	9	7	20.192
R2	7	5	5	6	8	5	7	10	4	3	17.379
R3	8	6	6	8	6	6	8	6	8	5	18.886
R4	5	10	9	9	5	10	6	9	5	9	20.014
R5	10	8	10	10	10	9	9	5	10	10	21.899

Weight Coefficients Vector	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
W1j	0.109	0.109	0.103	0.096	0.096	0.096	0.089	0.096	0.109	0.096
W2j	0.112	0.093	0.093	0.103	0.120	0.093	0.112	0.132	0.080	0.063
W3j	0.110	0.095	0.095	0.110	0.095	0.095	0.110	0.095	0.110	0.085
W4j	0.080	0.115	0.110	0.110	0.080	0.115	0.090	0.110	0.080	0.110
W5j	0.105	0.095	0.105	0.105	0.105	0.100	0.100	0.073	0.105	0.105

Aggregated Fuzzy Vectors	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
W1j	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
W2j	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001
W3j	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
W4j	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
W5j	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	0.011	0.010	0.010	0.011	0.010	0.010	0.010	0.010	0.009	0.008
Aggregated Weight Coefficient Vectors	0.1031	0.1012	0.1010	0.1049	0.0991	0.0998	0.1000	0.1009	0.0966	0.0916

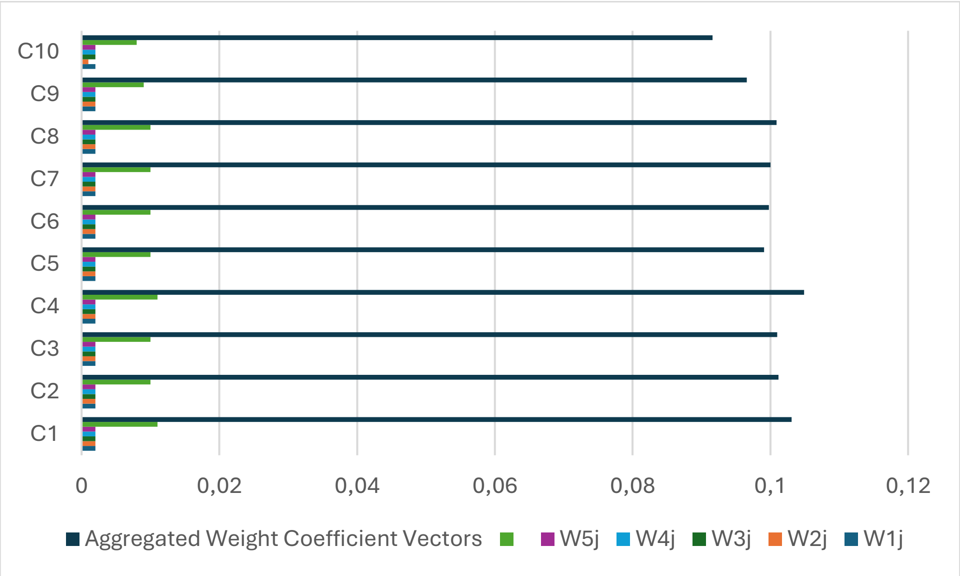

Figure 1 Weight coefficients of criteria

Source: Author's picture

In this case, therefore, the most important criterion is criterion C4 - Agriculture, forestry, and fishing, value added (% of GDP). This means, in other words, that, among other things, the improvement of the agricultural sector can significantly influence the improvement of the economic performance of the Serbian economy.

Tables 4 - 10 show the calculations and results of the application of the LMAW-DNMA method in the evaluation of the economic performance of the Serbian economy. (All calculations and results are by the authors.)

Table 4 Initial Matrix

INITIAL MATRIX	**KIND**	1	1	1	1	1	1	1	1	1	1
	Weight	0.1031	0.1012	0.1010	0.1049	0.0991	0.0998	0.1000	0.1009	0.0966	0.0916
		C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
	A1	48.39	2.89	5.13	7.41	26.84	39.85	48.07	17.38	37.43	20.84
	A2	47.06	-1.59	2.59	7.07	25.24	42.08	50.15	16.52	38.95	21.97
	A3	39.65	1.81	1.87	6.71	25.8	45.18	52.22	18.68	39.01	22.36
	A4	40.69	3.34	1.55	6.81	25.82	48.52	53.34	18.08	39.77	23.29
	A5	44.17	2.1	2.97	6.01	26.08	50.47	57.06	19.58	40.6	24.07
	A6	50.64	4.5	1.97	6.34	25.5	50.43	59.06	22.65	40.28	23.6
	A7	51.51	4.33	2.44	5.95	25.6	51.01	60.94	25.09	41.08	24.05
	A8	53.35	-0.9	2.45	6.34	24.9	48.22	56.5	24.19	41.29	23.49
	A9	63.08	7.55	5.91	6.29	25	54.48	62.28	25.01	36.25	20.62
	A10	63.56	5.16	10.35	6.46	25.57	63.84	74.81	26.51	0	0
	MAX	63.5600	7.5500	10.3500	7.4100	26.8400	63.8400	74.8100	26.5100	41.2900	24.0700
	MIN	39.6500	-1.5900	1.5500	5.9500	24.9000	39.8500	48.0700	16.5200	0.0000	0.0000

Table 5 Linear Normalization Matrix

		C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**MAX**
Linear Normalization MATRIX	A1	0.3655	0.4902	0.4068	1.0000	1.0000	0.0000	0.0000	0.0861	0.9065	0.8658	1.0000
	A2	0.3099	0.0000	0.1182	0.7671	0.1753	0.0930	0.0778	0.0000	0.9433	0.9128	0.9433
	A3	0.0000	0.3720	0.0364	0.5205	0.4639	0.2222	0.1552	0.2162	0.9448	0.9290	0.9448
	A4	0.0435	0.5394	0.0000	0.5890	0.4742	0.3614	0.1971	0.1562	0.9632	0.9676	0.9676
	A5	0.1890	0.4037	0.1614	0.0411	0.6082	0.4427	0.3362	0.3063	0.9833	1.0000	1.0000
	A6	0.4596	0.6663	0.0477	0.2671	0.3093	0.4410	0.4110	0.6136	0.9755	0.9805	0.9805
	A7	0.4960	0.6477	0.1011	0.0000	0.3608	0.4652	0.4813	0.8579	0.9949	0.9992	0.9992
	A8	0.5730	0.0000	0.1023	0.2671	0.0000	0.3489	0.3153	0.7678	1.0000	0.9759	1.0000
	A9	0.9799	1.0000	0.4955	0.2329	0.0515	0.6098	0.5314	0.8498	0.8779	0.8567	1.0000
	A10	1.0000	0.7385	1.0000	0.3493	0.3454	1.0000	1.0000	1.0000	0.0000	0.0000	1.0000

Table 6 Vector Normalization Matrix

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	MAX
Vector Normalization MATRIX	A1	0.9122	0.6786	0.7048	1.0000	1.0000	0.8589	0.8648	0.8757	0.9692	0.9553	1.0000
	A2	0.9045	0.0000	0.5612	0.9846	0.9813	0.8720	0.8753	0.8640	0.9813	0.9710	0.9846
	A3	0.8616	0.6041	0.5205	0.9682	0.9878	0.8902	0.8858	0.8934	0.9818	0.9764	0.9878
	A4	0.8676	0.7096	0.5024	0.9727	0.9881	0.9099	0.8914	0.8852	0.9879	0.9892	0.9892
	A5	0.8878	0.6241	0.5827	0.9364	0.9911	0.9213	0.9103	0.9056	0.9945	1.0000	1.0000
	A6	0.9252	0.7896	0.5261	0.9514	0.9843	0.9211	0.9204	0.9474	0.9919	0.9935	0.9935
	A7	0.9303	0.7779	0.5527	0.9337	0.9855	0.9245	0.9299	0.9807	0.9983	0.9997	0.9997
	A8	0.9409	0.0000	0.5533	0.9514	0.9773	0.9081	0.9074	0.9684	1.0000	0.9920	1.0000
	A9	0.9972	1.0000	0.7489	0.9491	0.9785	0.9449	0.9366	0.9796	0.9598	0.9523	1.0000
	A10	1.0000	0.8351	1.0000	0.9568	0.9851	1.0000	1.0000	1.0000	0.0000	0.0000	1.0000
	Adj Wj	0.1067	0.1439	0.1508	0.0747	0.0421	0.0946	0.0934	0.1098	0.0922	0.0917	

Table 7 CCM (Complete Compensatory Model)

	u1(ai)	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	SUM
CCM (Complete Compensatory Model)	A1	0.0390	0.0705	0.0614	0.0747	0.0421	0.0000	0.0000	0.0095	0.0836	0.0794	0.4601
	A2	0.0351	0.0000	0.0189	0.0608	0.0078	0.0093	0.0077	0.0000	0.0922	0.0888	0.3205
	A3	0.0000	0.0566	0.0058	0.0412	0.0207	0.0222	0.0154	0.0251	0.0922	0.0902	0.3694
	A4	0.0048	0.0802	0.0000	0.0455	0.0206	0.0353	0.0190	0.0177	0.0918	0.0917	0.4067
	A5	0.0202	0.0581	0.0243	0.0031	0.0256	0.0419	0.0314	0.0336	0.0906	0.0917	0.4206
	A6	0.0500	0.0978	0.0073	0.0204	0.0133	0.0425	0.0392	0.0687	0.0917	0.0917	0.5227
	A7	0.0530	0.0933	0.0153	0.0000	0.0152	0.0440	0.0450	0.0943	0.0918	0.0917	0.5436
	A8	0.0611	0.0000	0.0154	0.0200	0.0000	0.0330	0.0295	0.0843	0.0922	0.0895	0.4250
	A9	0.1046	0.1439	0.0747	0.0174	0.0022	0.0577	0.0497	0.0933	0.0809	0.0786	0.7029
	A10	0.1067	0.1062	0.1508	0.0261	0.0145	0.0946	0.0934	0.1098	0.0000	0.0000	0.7023

Table 8 UCM (Uncompensatory Model)

	u2(ai)	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	MAX
UCM (Uncompensatory Model)	A1	0.0677	0.0733	0.0895	0.0000	0.0000	0.0946	0.0934	0.1004	0.0086	0.0123	0.1004
	A2	0.0717	0.0000	0.1319	0.0140	0.0343	0.0853	0.0857	0.1098	0.0000	0.0030	0.1319
	A3	0.1067	0.0872	0.1450	0.0336	0.0214	0.0723	0.0781	0.0847	0.0000	0.0015	0.1450
	A4	0.1019	0.0637	0.1508	0.0292	0.0215	0.0593	0.0744	0.0921	0.0004	0.0000	0.1508
	A5	0.0865	0.0858	0.1265	0.0717	0.0165	0.0527	0.0620	0.0762	0.0015	0.0000	0.1265

	A6	0.0567	0.0461	0.1435	0.0544	0.0288	0.0520	0.0543	0.0411	0.0005	0.0000	0.1435
	A7	0.0537	0.0506	0.1356	0.0747	0.0269	0.0506	0.0484	0.0155	0.0004	0.0000	0.1356
	A8	0.0456	0.0000	0.1354	0.0548	0.0421	0.0616	0.0640	0.0255	0.0000	0.0022	0.1354
	A9	0.0021	0.0000	0.0761	0.0573	0.0399	0.0369	0.0438	0.0165	0.0113	0.0131	0.0761
	A10	0.0000	0.0376	0.0000	0.0486	0.0275	0.0000	0.0000	0.0000	0.0000	0.0000	0.0486

Table 9 ICM (Incomplete Compensatory Model)

	u3(ai)	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**MAX**
ICM (Incomplete Compensatory Model)	A1	0.9902	0.9457	0.9486	1.0000	1.0000	0.9857	0.9865	0.9855	0.9971	0.9958	0.8454
	A2	0.9910	0.0000	0.9187	1.0000	0.9999	0.9886	0.9891	0.9858	0.9997	0.9987	0.0000
	A3	0.9855	0.9317	0.9079	0.9985	1.0000	0.9902	0.9899	0.9890	0.9994	0.9989	0.8056
	A4	0.9861	0.9533	0.9028	0.9987	1.0000	0.9921	0.9903	0.9879	0.9999	1.0000	0.8226
	A5	0.9874	0.9344	0.9218	0.9951	0.9996	0.9923	0.9913	0.9892	0.9995	1.0000	0.8227
	A6	0.9924	0.9675	0.9086	0.9968	0.9996	0.9929	0.9929	0.9948	0.9999	1.0000	0.8523
	A7	0.9923	0.9645	0.9145	0.9949	0.9994	0.9926	0.9933	0.9979	0.9999	1.0000	0.8562
	A8	0.9935	0.0000	0.9146	0.9963	0.9990	0.9909	0.9910	0.9965	1.0000	0.9993	0.0000
	A9	0.9997	1.0000	0.9573	0.9961	0.9991	0.9947	0.9939	0.9977	0.9962	0.9955	0.9317
	A10	1.0000	0.9744	1.0000	0.9967	0.9994	1.0000	1.0000	1.0000	0.0000	0.0000	0.8454

Table 10 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	0.4601	5	0.6279	0.1004	3	0.5161	0.8454	4	0.8103	0.6714	0.6714		**4**
2014	A2	0.3205	10	0.3301	0.1319	5	0.7124	0.0000	8	0.2121	0.3329	0.3329		**10**
2015	A3	0.3694	9	0.3976	0.1450	9	0.9313	0.8056	7	0.6736	0.5338	0.5338		**8**
2016	A4	0.4067	8	0.4608	0.1508	10	1.0000	0.8226	6	0.7175	0.5917	0.5917		**7**
2017	A5	0.4206	7	0.5089	0.1265	4	0.6570	0.8227	5	0.7549	0.5975	0.5975		**6**
2018	A6	0.5227	4	0.7221	0.1435	8	0.8789	0.8523	3	0.8593	0.7789	0.7789		**3**
2019	A7	0.5436	3	0.7868	0.1356	7	0.8055	0.8562	2	0.9095	0.8255	0.8255		**2**
2020	A8	0.4250	6	0.5548	0.1354	6	0.7635	0.0000	8	0.2121	0.4729	0.4729		**9**
2021	A9	0.7029	1	1.0000	0.0761	2	0.3838	0.9317	1	1.0000	0.9384	0.9384		**1**
2022	A10	0.7023	2	0.9508	0.0486	1	0.2386	0.0000	8	0.2121	0.6580	0.6580		**5**

	MAX	0.7029			0.1508			0.9317				

In the specific case, therefore, the top five years in terms of the economic performance of the Serbian economy according to the LMAW-DNMA method are in order: 2021, 2019, 2018, 2013, and 2022. In the period 2013 - 2022, the worst economic performance of the Serbian economy was achieved in 2014. All in all, it can be concluded based on the given empirical analysis that the economic performance of the Serbian economy has improved significantly in recent times. Adequate management of analyzed 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 digitalization 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 classical methodology, the multi-criteria decision-making method in the evaluation of the economic performance of the Serbian economy, 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 Serbian economy.

4.Conclusion

Empirical research of the problem treated in this paper using the LMAW-DNMA method showed that the top five years in terms of the economic performance of the Serbian economy are in order: 2021, 2019, 2018, 2013, and 2022. In the period 2013 - 2022, the worst economic performances of the Serbian economy were achieved in 2014. Overall, the economic performance of the Serbian economy has improved significantly recently. Adequate management of analyzed 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 Serbian economy also include economic climate, foreign direct investments, digitization of the entire company's operations, energy crisis, and so on. To some extent, the negative effects of the COVID-19 coronavirus pandemic on the economic performance of the Serbian economy have been mitigated by the application of digitization. The economy of Serbia can achieve the target economic performance by adequately controlling the critical factors of business success (price, costs, time, quality, innovation, and growth).

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