Primljeno/Submitted: 03.03.2023.
Prihvaćeno/Accepted: 11.06.2023.

Pregledni rad
Review paper
JEL Classification: *C61, L32*

PERFORMANCE ANALYSIS OF COMPANIES IN SERBIA BASED ON THE LMAW-DNMA METHOD

ANALIZA PERFORMANSI PREDUZEĆA U SRBIJI NA BAZI LMAW-DNMA METODA

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ABSTRACT

Recently, the importance of applying multi-criteria decision-making methods in the economy has been increasing. With their help, more realistic results are achieved in the function of improvement in the future by applying relevant measures. Based on that, this paper analyzes the performance of companies in Serbia based on the LMAW-DNMA method. According to the results of the DNMA method, the top five companies in Serbia include: TELEKOM SRBIJA AD BELGRADE, DELTA HOLDING DOO BELGRADE, MK GROUP DOO BELGRADE, JP SRBIJAGAS NOVI SAD and HEMOFARM AD VRŠAC. The best performance was recorded at the company TELEKOM SRBIJA AD, BELGRADE. The company with the worst performance is YURA CORPORATION DOO RAČA. This positioning of companies in Serbia according to performance was influenced by numerous factors. These are: general economic conditions, inflation, interest rate, exchange rate, employment, living standards of the population, the Covid-19 pandemic, and the energy crisis. Likewise, the efficiency of human resource, asset, capital, sales and profit management. The application of new concepts of cost management (for example, calculation of costs by basic activities) and digitization of the entire business play a significant role in this. Effective control of these and other factors can significantly influence the achievement of the target performance of companies in Serbia.

Key words: performance, companies, Serbia, LMAW-DNMA method

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SAŽETAK

U poslednje vreme sve je veći značaj primene metoda višekriterijumskog odlučivanja u ekonomiji. Pomoću njih se dolazi do realnijih rezultata u funkciji unapređenja u budućnosti primenom relevantnih mera. Polazeći od toga, u ovom radu se analiziraju performanse preduzeća u Srbiji na bazi LMAW-DNMA metoda. Prema rezultatima DNMA metodi u top pet preduzeća u Srbiji spadaju: TELEKOM SRBIJA A.D., BEOGRAD, DELTA HOLDING DOO BEOGRAD, MK GROUP DOO BEOGRAD, JP SRBIJAGAS NOVI SAD i HEMOFARM AD VRŠAC. Njabolje performanse su zabeležene kod preduzeća TELEKOM SRBIJA A.D., BEOGRAD. Sa najlošijim performansama je preduzeće YURA CORPORATION DOO RAČA. Na ovakvo pozicioniranje preduzeća u Srbiji prema performansama uticali su brojni faktori. To su: opšti uslovi privređivanja, inflacija, kamatna stopa, devizni kurs, zaposlenost, životni standard stanovništva, pandemija korona virusa Covid-19, i energetska kriza. Isto tako, i efikasnost upravljanja ljudskim resursima, aktivom, kapitalom, prodajom i profitom. U tome značajnu ulogu ima primena novih koncepata upravljanja troškovima (na primer, obračun troškova po baznim aktivnostima) i digitalizacija celokupnog poslovanja. Efikasnom kontrolom ovih i drugih faktora može se znatno uticati na ostvarenje ciljnih performansi preduzeća u Srbiji.

Key words: performanse, preduzeća, Srbija, LMAW-DNMA metoda

INTRODUCTION

The issue of company performance analysis is very challenging, complex and significant. Various methodologies are used: ratio analysis, statistical analysis, DEA analysis and multi-criteria decision-making methods. When analyzing the efficiency of companies, DEA models are used to a significant extent (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; Mandić et al., 2017; Martić, & Savić, 2001; Cooper et al., 1999; Amin, & Hajjami, 2021; Chen et al., 2018, 2020, 2021a,b, Đurić et al., 2020; Lukić 2022a,b,c; Radonjić, 2020; Stević et al., 2022; Stojanović et al., 2022; Rasoulzadeh et al., 2021). This is also the case with the analysis of the efficiency of companies in Serbia (Lukic et al., 2017, 2020; Lukic, 2018, 2021, 2022a,b, 2023; Lukic & Kozarevic, 2019; Lukic & Hadrovic Zekic, 2019; Vojteški Kljenak & Lukić, 2022) . DEA models provide a realistic picture of which companies are efficient and which are not and which measures should be taken in order to increase efficiency. Likewise, in recent times, multi-criteria decision-making methods have been increasingly applied when analyzing the company's performance, for the reason that they lead to more realistic results compared to classical methods (such as ratio analysis) as a basis for improvement in the future by applying relevant measures (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) . Having that in mind, the subject of research in this paper is the analysis of the performance of companies in Serbia based on the LMAW-DNMA method. The aim and purpose of this is to look at the performance of companies in Serbia as realistically as possible in order to improve them in the future by applying relevant measures. The primary research hypothesis in this work is reflected in the fact that knowing the real situation regarding the company's performance is a prerequisite for improvement in the future by applying relevant measures. In addition to ratio analysis, statistical analysis and DEA approach, multi-criteria decision-making methods, including the LMAW-DNMA method, play a significant role in this. Empirical data needed for the research of the treated problem in this paper were collected from the Agency for Economic Registers of the Republic of Serbia. In terms of international comparability, there are no restrictions because they are "manufactured" in accordance with the relevant international standards.

1. METHODOLOGY

In further presentations, we will point out the theoretical and methodological characteristics of the LMAW and DNMA methods (Demir, 2022).

LMAW method

The LMAW 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 $C = \{C_1, C_2, \dots, C_n\}$ 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 $e(1 \leq e \leq k)$ 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 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 it n_{Cn}^e represents the value of the real vector derived from the previous equation.

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

DNMA method

DNMA is a newer method for identifying alternatives (Demir, 2022). Two different normalized (linear and vector) techniques are used, as well as three different coupling functions (full compensation - CCM, non-compensation - UCM and incomplete compensation - ICM). The steps of 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:

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

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

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

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 (σ_j) 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 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:

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

Step 3: Calculating the aggregation model

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

The CCM (Complete Compensation 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 (non-compensatory 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 Compensation 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 principle of distance:

$$DN_i = w_1 \sqrt{\varphi \cdot \left(\frac{u_1(a_i)}{\max_i u_1(a_i)} \right)^2 + (1-\varphi) \cdot \left(\frac{m - r_1(a_i) + 1}{m} \right)^2} - w_2 \sqrt{\varphi \cdot \left(\frac{u_2(a_i)}{\max_i u_2(a_i)} \right)^2 + (1-\varphi) \cdot \left(\frac{r_2(a_i)}{m} \right)^2} + w_3 \sqrt{\varphi \cdot \left(\frac{u_3(a_i)}{\max_i u_3(a_i)} \right)^2 + (1-\varphi) \cdot \left(\frac{m - r_3(a_i) + 1}{m} \right)^2} \quad (12)$$

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 $w_1 + w_2 + w_3 = 1$. 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.

2. RESULTS AND DISCUSSION

For the purpose of analyzing the performance of companies in Serbia, the following criteria were chosen: C1 - number of employees, C2 - business assets, C3 - capital, C4 - business income and C5 - net profit/net loss. They were chosen because they are good measures of company performance. Alternatives are observed companies in Serbia. According to what criteria were the companies selected? The selection of companies was made according to the realized business income in 2021. They have different ownership structures. However, the ownership structure of the company does not affect the results of multi-criteria decision-making methods. This means, in other words, that the results obtained in this paper are valid. Criteria, alternatives and initial data are shown in Table 1 for 2021.

Table 1. Initial data

		Sector	(I) Number of employees	(I) Business assets	(I) Capital	(O) Business income	(O)Net gain / Net loss
			C1	C2	C3	C4	C5
A1	JP EPS BELGRADE	D-supply of electricity, gas, steam and air conditioning	24.013	959.978	602.051	319.834	- 15.492
A2	NIS AD NOVI SAD	B-mining	11.544	411.025	262.836	310.238	20.957
A3	TELEKOM SRBIJA AD, BELGRADE	J-information and communications	12.333	490.964	185.581	144.701	6.709
A4	JP SRBIJAGAS NOVI SAD	D-supply of electricity, gas, steam and air conditioning	2.471	287.578	129.753	122.489	5.802
A5	DELHAIZE S	G-wholesale and retail trade; repair of motor vehicles and motorcycles	11.637	83.293	42.881	118.912	2.989
A6	NELT CO. DOO BELGRADE	G-wholesale and retail trade; repair of motor vehicles and motorcycles	3.121	37.637	18.721	87.126	248
A7	DELTA HOLDING DOO BELGRADE	M-professional, scientific, innovative and technical activities	3.311	149.188	83.718	76.424	2.497
A8	MERCATA VT DOO	G-wholesale and retail trade; repair of motor vehicles and motorcycles	1.078	12.763	1.093	75.391	958
A9	PHOENIX PHARMA DOO BELGRADE	G-wholesale and retail trade; repair of motor vehicles and motorcycles	2.749	39.024	10.837	74.941	1.772

		Sector	(I) Number of employees	(I) Business assets	(I) Capital	(O) Business income	(O)Net gain / Net loss
			C1	C2	C3	C4	C5
A10	COCA-COLA HBC - SERBIA DOO ZEMUN	C-processing industry	1.623	56.832	43.084	64.769	6.783
A11	MY KIOSK GROUP DOO	K-financial activities and insurance activities	3.589	12.247	2.622	64.365	596
A12	TARKETT DOO BACA PALANKA	C-processing industry	3.215	38.174	19.813	58.565	2.493
A13	MK GROUP DOO BELGRADE	K-financial activities and insurance activities	2.151	94.429	46.830	57.675	17.461
A14	KNEZ PETROL COMPANY DOO BELGRADE	M-professional, scientific, innovative and technical activities	1.183	11.849	3.417	52.652	3.447
A15	HEMOFARM AD VRŠAC	C-processing industry	3.922	68.380	47.524	49.284	5.091
A16	MILŠED DOO BELGRADE	H-transport and storage	2.758	27.749	3.547	45.553	1.084
A17	FCA SERBIA DOO KRAGUJEVAC	C-processing industry	2.072	49.521	31.195	41.512	**-** 3.866
A18	EMSAD BELGRADE	D-supply of electricity, gas, steam and air conditioning	1.656	105.336	69.530	39.043	2.362
A19	KOEFIK DOO BELGRADE	G-wholesale and retail trade; repair of motor vehicles and motorcycles	2.983	34.703	8.502	38.062	152
A20	YURA CORPORATION DOO RACA	C-processing industry	6.913	27.713	4.458	37.188	**-** 1.092

Note: Data are expressed in millions of dinars. The number of employees is expressed in whole numbers. I - input. O - output

Source: Annual report on the operations of economic units in the economy in 2021. Agency for Economic Registers of the Republic of Serbia

The weighting coefficients of the criteria were determined using the LMAW method. Tables 2-5 show the calculations and results of the LMAW method. (In this paper, all calculations and results are the authors).

Table 2. Prioritization scale

Prioritization Scale		
Linguistic Variables	**Abbreviation**	**Prioritization**
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

Table 3. Evaluation of criteria

KIND	1	1	1	1	1
	C1	**C2**	**C3**	**C4**	**C5**
E1	**H**	**AH**	**H**	**E**	**MH**
E2	**VH**	**VH**	**MH**	**H**	**H**
E3	**E**	**MH**	**VH**	**AH**	**AH**
E4	**MH**	**E**	**E**	**VH**	**AH**
Υ_{AIP}	0.5				

	C1	**C2**	**C3**	**C4**	**C5**	**LN(Πη)**
R1	8	10	8	6	7	10.199
R2	9	9	7	8	8	10.499
R3	6	7	9	10	10	10.540
R4	7	6	6	9	10	10.029

Source: author

Table 4. Weight coefficients of criteria and aggregated fuzzy vectors

Weight Coefficients Vector	**C1**	**C2**	**C3**	**C4**	**C5**
W1j	0.204	0.226	0.204	0.176	0.191
W2j	0.209	0.209	0.185	0.198	0.198
W3j	0.170	0.185	0.208	0.218	0.218
W4j	0.194	0.179	0.179	0.219	0.230
Aggregated Fuzzy Vectors	**C1**	**C2**	**C3**	**C4**	**C5**
W1j	0.010	0.011	0.010	0.009	0.010
W2j	0.010	0.010	0.009	0.010	0.011
W3j	0.009	0.009	0.010	0.011	0.011
W4j	0.009	0.009	0.009	0.011	0.012
SUM	0.038	0.040	0.038	0.041	0.044
Aggregated Weight Coefficient Vectors	0.1941	0.1993	0.1940	0.2026	0.2090

Source: author

In the specific case, therefore, the most important criterion is C5 - net gain/net loss. This means, in other words, that, among other things, more efficient profit management can achieve the target performance of companies in Serbia. Tables 5 - 11 show the calculations and results of the DNMA method.

Table 5. Initial Matrix

INITIAL MATRIX	KIND	1	1	1	1	1
	Weight	0.1941	0.1993	0.1940	0.2026	0.2090
		C1	**C2**	**C3**	**C4**	**C5**
	A1	24.013	959.978	602.051	319.834	**-15.492**
	A2	11.544	411.025	262.836	310.238	20.957
	A3	12.333	490.964	185.581	144.701	6.709
	A4	2.471	287.578	129.753	122.489	5.802
	A5	11.637	83.293	42.881	118.912	2.989
	A6	3.121	37.637	18.721	87.126	248
	A7	3.311	149.188	83.718	76.424	2.497
	A8	1.078	12.763	1.093	75.391	958
	A9	2.749	39.024	10.837	74.941	1.772
	A10	1.623	56.832	43.084	64.769	6.783
	A11	3.589	12.247	2.622	64.365	596
	A12	3.215	38.174	19.813	58.565	2.493
	A13	2.151	94.429	46.83	57.675	17.461
	A14	1.183	11.849	3.417	52.652	3.447
	A15	3.922	68.38	47.524	49.284	5.091
	A16	2.758	27.749	3.547	45.553	1.084
	A17	2.072	49.521	31.195	4.512	**-3.866**
	A18	1.656	105.336	69.53	39.043	2.362
	A19	2.983	34.703	8.502	38.062	152
	A20	6.913	27.713	4.458	37.188	**-1.092**
MAX		24.0130	959.9780	602.0510	319.8340	958.0000
MIN		1.0780	11.8490	1.0930	37.1880	-15.4920

Source: author

Table 6. Linear Normalization Matrix

Linear Normalization MATRIX		C1	C2	C3	C4	C5	MAX
	A1	1.0000	1.0000	1.0000	1.0000	0.0000	1.0000
	A2	0.4563	0.4210	0.4355	0.9660	0.0374	0.9660
	A3	0.4907	0.5053	0.3070	0.3804	0.0228	0.5053
	A4	0.0607	0.2908	0.2141	0.3018	0.0219	0.3018
	A5	0.4604	0.0754	0.0695	0.2891	0.0190	0.4604
	A6	0.0891	0.0272	0.0293	0.1767	0.2707	0.2707
	A7	0.0974	0.1449	0.1375	0.1388	0.0185	0.1449
	A8	0.0000	0.0010	0.0000	0.1352	1.0000	1.0000
	A9	0.0729	0.0287	0.0162	0.1336	0.0177	0.1336
	A10	0.0238	0.0474	0.0699	0.0976	0.0229	0.0976
	A11	0.1095	0.0004	0.0025	0.0962	0.6281	0.6281
	A12	0.0932	0.0278	0.0312	0.0756	0.0185	0.0932
	A13	0.0468	0.0871	0.0761	0.0725	0.0339	0.0871
	A14	0.0046	0.0000	0.0039	0.0547	0.0195	0.0547
	A15	0.1240	0.0596	0.0773	0.0428	0.0211	0.1240
	A16	0.0733	0.0168	0.0041	0.0296	0.0170	0.0733
	A17	0.0433	0.0397	0.0501	0.0153	0.0000	0.0501
	A18	0.0252	0.0986	0.1139	0.0066	0.0183	0.1139
	A19	0.0831	0.0241	0.0123	0.0031	0.1721	0.1721
	A20	0.2544	0.0167	0.0056	0.0000	0.0000	0.2544

Source: author

Table 7. Vector Normalization Matrix

Vector Normalization MATRIX		C1	C2	C3	C4	C5	MAX
	A1	1.0000	1.0000	1.0000	1.0000	0.0000	1.0000
	A2	0.7001	0.6459	0.6357	0.9849	0.3790	0.9849
	A3	0.7190	0.6974	0.5528	0.7245	0.3695	0.7245
	A4	0.4818	0.5662	0.4928	0.6896	0.3689	0.6896
	A5	0.7023	0.4345	0.3996	0.6839	0.3670	0.7023
	A6	0.4974	0.4050	0.3736	0.6339	0.5294	0.6339
	A7	0.5020	0.4770	0.4434	0.6171	0.3667	0.6171
	A8	0.4483	0.3890	0.3547	0.6155	1.0000	1.0000
	A9	0.4885	0.4059	0.3651	0.6148	0.3662	0.6148
	A10	0.4614	0.4174	0.3998	0.5988	0.3696	0.5988
	A11	0.5087	0.3886	0.3563	0.5981	0.7601	0.7601
	A12	0.4997	0.4053	0.3748	0.5890	0.3667	0.5890
	A13	0.4741	0.4416	0.4038	0.5876	0.3766	0.5876
	A14	0.4508	0.3884	0.3572	0.5797	0.3674	0.5797
	A15	0.5167	0.4248	0.4045	0.5744	0.3684	0.5744
	A16	0.4887	0.3986	0.3573	0.5685	0.3658	0.5685
	A17	0.4722	0.4127	0.3870	0.5622	0.0000	0.5622
	A18	0.4622	0.4487	0.4282	0.5583	0.3666	0.5583
	A19	0.4941	0.4031	0.3626	0.5567	0.4658	0.5567
	A20	0.5887	0.3986	0.3583	0.5554	0.0000	0.5887
	Adj Wj	0.1938	0.1994	0.1927	0.2056	0.2086	

Source: author

Table 8. CCM (Complete Compensatory Model)

CCM (Complete Compensatory Model)	u1(ai)	C1	C2	C3	C4	C5	SUM
	A1	0.1938	0.1994	0.1927	0.2056	0.0000	0.7914
	A2	0.0915	0.0869	0.0869	0.2056	0.0081	0.4789
	A3	0.1882	0.1994	0.1171	0.1547	0.0094	0.6687
	A4	0.0390	0.1921	0.1367	0.2056	0.0151	0.5885
	A5	0.1938	0.0326	0.0291	0.1291	0.0086	0.3932
	A6	0.0638	0.0200	0.0209	0.1342	0.2086	0.4475
	A7	0.1302	0.1994	0.1829	0.1970	0.0266	0.7361
	A8	0.0000	0.0002	0.0000	0.0278	0.2086	0.2366
	A9	0.1057	0.0428	0.0234	0.2056	0.0277	0.4051
	A10	0.0472	0.0969	0.1380	0.2056	0.0489	0.5366
	A11	0.0338	0.0001	0.0008	0.0315	0.2086	0.2748
	A12	0.1938	0.0594	0.0644	0.1669	0.0414	0.5258
	A13	0.1041	0.1994	0.1684	0.1711	0.0811	0.7240
	A14	0.0162	0.0000	0.0136	0.2056	0.0742	0.3096
	A15	0.1938	0.0959	0.1200	0.0709	0.0356	0.5162
	A16	0.1938	0.0456	0.0107	0.0831	0.0485	0.3817
	A17	0.1677	0.1581	0.1927	0.0628	0.0000	0.5812
	A18	0.0429	0.1726	0.1927	0.0118	0.0336	0.4536
	A19	0.0935	0.0279	0.0138	0.0037	0.2086	0.3476
	A20	0.1938	0.0131	0.0042	0.0000	0.0000	0.2111

Source: author

Table 9. UCM (Uncompensatory Model)

UCM (Uncompensatory Model)	u2(ai)	C1	C2	C3	C4	C5	MAX
	A1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	A2	0.1022	0.1125	0.1058	0.0000	0.2006	0.2006
	A3	0.0056	0.0000	0.0756	0.0508	0.1992	0.1992
	A4	0.1548	0.0073	0.0560	0.0000	0.1935	0.1935
	A5	0.0000	0.1667	0.1636	0.0765	0.2000	0.2000
	A6	0.1300	0.1793	0.1718	0.0714	0.0000	0.1793
	A7	0.0635	0.0000	0.0098	0.0086	0.1820	0.1820
	A8	0.1938	0.1992	0.1927	0.1778	0.0000	0.1992
	A9	0.0881	0.1566	0.1693	0.0000	0.1809	0.1809
	A10	0.1466	0.1024	0.0547	0.0000	0.1597	0.1597
	A11	0.1600	0.1992	0.1919	0.1741	0.0000	0.1992
	A12	0.0000	0.1399	0.1283	0.0387	0.1673	0.1673
	A13	0.0897	0.0000	0.0243	0.0345	0.1276	0.1276
	A14	0.1775	0.1994	0.1791	0.0000	0.1345	0.1994
	A15	0.0000	0.1035	0.0726	0.1346	0.1731	0.1731
	A16	0.0000	0.1537	0.1819	0.1225	0.1601	0.1819
	A17	0.0261	0.0412	0.0000	0.1428	0.0000	0.1428
	A18	0.1509	0.0267	0.0000	0.1937	0.1750	0.1937
	A19	0.1002	0.1714	0.1789	0.2019	0.0000	0.2019
	A20	0.0000	0.1862	0.1884	0.2056	0.0000	0.2056

Source: author

Table 10. ICM (Incomplete Compensatory Model)

ICM (Incomplete Compensatory Model)	u3(ai)	C1	C2	C3	C4	C5	MAX
	A1	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000
	A2	0.9360	0.9193	0.9191	1.0000	0.8193	0.6480
	A3	0.9985	0.9924	0.9492	1.0000	0.8689	0.8174
	A4	0.9329	0.9615	0.9373	1.0000	0.8776	0.7379
	A5	1.0000	0.9087	0.8970	0.9946	0.8734	0.7080
	A6	0.9541	0.9146	0.9031	1.0000	0.9631	0.7590
	A7	0.9608	0.9499	0.9383	1.0000	0.8971	0.7683
	A8	0.8560	0.8284	0.8190	0.9050	1.0000	0.5256
	A9	0.9564	0.9206	0.9045	1.0000	0.8976	0.7148
	A10	0.9508	0.9306	0.9251	1.0000	0.9042	0.7401
	A11	0.9251	0.8748	0.8642	0.9519	1.0000	0.6658
	A12	0.9686	0.9282	0.9166	1.0000	0.9059	0.7465
	A13	0.9593	0.9447	0.9303	1.0000	0.9114	0.7683
	A14	0.9524	0.9233	0.9109	1.0000	0.9092	0.7283
	A15	0.9797	0.9416	0.9347	1.0000	0.9115	0.7860
	A16	0.9711	0.9317	0.9144	1.0000	0.9121	0.7546
	A17	0.9668	0.9402	0.9306	1.0000	0.0000	0.0000
	A18	0.9641	0.9574	0.9502	1.0000	0.9160	0.8033
	A19	0.9771	0.9377	0.9207	1.0000	0.9635	0.8128

ICM (Incomplete Compensatory Model)	u3(ai)	C1	C2	C3	C4	C5	MAX
	A20	1.0000	0.9252	0.9088	0.9881	0.0000	0.0000

Source: author

Table 11. Ranking of alternatives according to the DNMA method

											w1	**w2 w3**	
											0.6	**0.1 0.3**	
			CCM	**φ**		**UCM**	**φ**		**ICM**	**φ**	**Utility Values**		**Rank**
		u1(ai)	**Rank**	**0.5**	**u2(ai)**	**Rank**	**0.5**	**u3(ai)**	**Rank**	**0.5**			**Order**
JP EPS BELGRADE	**A1**	0.7914	1	1.0000	0.0000	1	0.0354	0.0000	18	0.1061	0.6354	0.6354	**9**
NIS AD NOVI SAD	**A2**	0.4789	10	0.5783	0.2006	18	0.9386	0.6480	16	0.5878	0.6171	0.6171	**11**
TELEKOM SRBIJA AD, BELGRADE	**A3**	0.6687	4	0.8475	0.1992	15	0.8666	0.8174	1	1.0000	0.8952	0.8952	**1**
JP SRBIJAGAS NOVI SAD	**A4**	0.5885	5	0.7723	0.1935	11	0.7710	0.7379	11	0.7297	0.7594	0.7594	**4**
DELHAIZE S	**A5**	0.3932	14	0.4298	0.2000	17	0.9137	0.7080	14	0.6606	0.5474	0.5474	**15**
NELT CO. DOO BELGRADE	**A6**	0.4475	12	0.5110	0.1793	7	0.6646	0.7590	7	0.8223	0.6198	0.6198	**10**
DELTA HOLDING DOO BELGRADE	**A7**	0.7361	2	0.9401	0.1820	10	0.7191	0.7683	6	0.8503	0.8911	0.8911	**2**
MERCATA VT DOO	**A8**	0.2366	19	0.2229	0.1992	13	0.8250	0.5256	17	0.4762	0.3591	0.3591	**19**
PHOENIX PHARMA DOO BELGRADE	**A9**	0.4051	13	0.4594	0.1809	8	0.6837	0.7148	13	0.6800	0.5480	0.5480	**14**
COCA-COLA HBC - SERBIA DOO ZEMUN	**A10**	0.5366	7	0.6891	0.1597	4	0.5673	0.7401	10	0.7491	0.6949	0.6949	**6**
MY KIOSK GROUP DOO	**A11**	0.2748	18	0.2675	0.1992	14	0.8454	0.6658	15	0.6138	0.4292	0.4292	**18**
TARKETT DOO BACA PALANKA	**A12**	0.5258	8	0.6573	0.1673	5	0.6020	0.7465	9	0.7727	0.6864	0.6864	**7**
MK GROUP DOO BELGRADE	**A13**	0.7240	3	0.9074	0.1276	2	0.4445	0.7683	5	0.8728	0.8507	0.8507	**3**
KNEZ PETROL COMPANY DOO BELGRADE	**A14**	0.3096	17	0.3107	0.1994	16	0.8890	0.7283	12	0.7058	0.4871	0.4871	**17**
HEMOFARM AD VRŠAC	**A15**	0.5162	9	0.6267	0.1731	6	0.6320	0.7860	4	0.9075	0.7115	0.7115	**5**
MILŠED DOO BELGRADE	**A16**	0.3817	15	0.4017	0.1819	9	0.7021	0.7546	8	0.7984	0.5507	0.5507	**13**
FCA SERBIA DOO KRAGUJEVAC	**A17**	0.5812	6	0.7423	0.1428	3	0.5025	0.0000	18	0.1061	0.5274	0.5274	**16**
EMSAD BELGRADE	**A18**	0.4536	11	0.5379	0.1937	12	0.7900	0.8033	3	0.9423	0.6844	0.6844	**8**
KOEFIK DOO BELGRADE	**A19**	0.3476	16	0.3574	0.2019	19	0.9661	0.8128	2	0.9724	0.6028	0.6028	**12**
YURA CORPORATION	**A20**	0.2111	20	0.1919	0.2056	20	1.0000	0.0000	18	0.1061	0.2470	0.2470	**20**

											w1	**w2**	**w3**	
											0.6	**0.1**	**0.3**	
			CCM	**φ**		**UCM**	**φ**		**ICM**	**φ**	**Utility Values**			**Rank**
DOO RACA														
	MAX	0.7914			0.2056			0.8174						

Source: author

Therefore, according to the results of the DNMA method, the top five companies in Serbia in terms of performance are: TELEKOM SRBIJA AD, BELGRADE, DELTA HOLDING DOO BELGRADE, MK GROUP DOO BELGRADE, JP SRBIJAGAS NOVI SAD and HEMOFARM AD VRŠAC. The best performance was recorded at the company TELEKOM SRBIJA AD, BELGRADE. The company with the worst performance is YURA CORPORATION DOO RAČA. Factors for positioning companies in Serbia according to performance are numerous factors: general economic conditions, inflation, interest rate, exchange rate, employment, standard of living of the population, the Covid-19 pandemic, the energy crisis, and the efficiency of managing human resources, assets, capital, sales and profit. The application of new cost management concepts (calculation of costs by basic activities, target costs and profit, kaizen concept, etc.) and digitization of the entire business play a significant role in this. Effective control of these and other factors can significantly influence the achievement of the target performance of companies in Serbia.

CONCLUSION

Based on the results of empirical research on the performance of companies in Serbia, the following can be concluded: according to the results of the DNMA method, the top five companies in Serbia include: TELEKOM SRBIJA AD, BELGRADE, DELTA HOLDING DOO BELGRADE, MK GROUP DOO BELGRADE, JP SRBIJAGAS NOVI SAD and HEMOFARM AD VRŠAC. The best performance was recorded at the company TELEKOM SRBIJA AD, BELGRADE. The company with the worst performance is YURA CORPORATION DOO RAČA. There are numerous determinants of the performance of companies in Serbia. These are: general economic conditions, inflation, interest rate, exchange rate, employment, living standards of the population, the Covid-19 pandemic, the energy crisis, the efficiency of managing human resources, assets, capital, sales and profits, and the digitization of the entire business. The application of new concepts of cost management (for example, calculation of costs by basic activities) plays a significant role in this. Effective control of these and other factors can significantly influence the achievement of the target performance of companies in Serbia.

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