Univerzitet u Istočnom Sarajevu, Ekonomski fakultet Brčko
University of East Sarajevo, Faculty of Economics Brcko

Zbornik radova Ekonomskog fakulteta Brčko
Proceedings of Faculty of Economics Brcko

http://zbornik.efb.ues.rs.ba

Časopis Ekonomskog fakulteta Brčko
Volumen 17, Sveska 1, 2023, str. 52-61
Journal of Faculty of Economics Brcko
Volume 17, Issue 1, 2023, pp. 52-61

Klasifikacija
Pregledni naučni članak
Classification
Review article

UDK: 330.142.211:005.914.3(497.11)
DOI: 10.7251/ZREFB2317052L

ANALYSIS OF TRADE PERFORMANCE IN SERBIA BASED ON INTEGRATED METHODS OF MULTI-CRITERIA DECISION-MAKING

Radojko Lukić[a,1]

[a] Faculty of Economics and Business, University of Belgrade, Serbia

ARTICLE INFO

Received 10/20/2023
Sent to revision 11/20/2023
Accepted 11/28/2023
Available online 12/27/2023

Keywords:
Serbian trade
AHP method
LMAW method
MEREC method
DIBR-TOPSIS method

ABSTRACT

Research into the dynamics of trade performance positioning is a very challenging, continuously current, significant, and complex issue, especially in the conditions of integrated application of multi-criteria decision-making methods. Based on that, this paper investigates the dynamics of the performance positioning of trade in Serbia for the period 2013 - 2022 using different methods for determining the weighting coefficients of the criteria (AHP, LMAW, MEREC, DIBR), and the TOPSIS method. The goal of this, among other things, is to assess the impact of evaluation criteria on the dynamics of the performance positioning of trade in Serbia by using the TOPSIS method. In the specific case, therefore, the influence of the different evaluations of the criteria on the results of the ranking of the alternatives according to the TOPSIS method is negligible. In the trade of Serbia, the best results according to all used multi-criteria decision-making methods (AHP-TOPSIS, LMAW-TOPSIS, MEREC-TOPSIS, and DIBR-TOPSIS) were achieved in 2022, and the worst in 2014. They continuously improved from year to year in the observed period results of trade in Serbia. Effective management of key macro and micro factors contributed to this. Taken as a whole, the performance of Serbian trade continuously improved. The factors that influenced the improvement of the dynamics of the performance positioning of trade in Serbia are geopolitical situation, economy, inflation, interest rate, employment, the standard of living of the population, trade policy and strategy, foreign direct investments, new business models (multichannel sales - store and electronic, private label, sale of organic products, etc.), concept of sustainable development, energy crisis, management of human resources, asset, capital, sales and profit, digitization of the entire business, and others. The target dynamics of the performance positioning of trade in Serbia can be achieved by effective control of human resources, assets (investments), capital, sales, profits, labor productivity, and financial indebtedness.

Introduction

Research on the performance positioning of trade is very challenging, continuously current, significant, and complex. It indicates what measures should be taken to improve the performance positioning of trade in the future. In addition to financial analysis, statistical analysis, and DEA models, as well as multi-criteria decision-making methods, play a significant role in this. This paper investigates the dynamics of the performance positioning of trade in Serbia using different methods for determining weight coefficients of criteria (AHP, LMAW, MEREC, and DIBR) and the TOPSIS method. The goal and purpose of this is to see as realistically as possible the impact of evaluation criteria on the dynamics of the performance positioning of trade in Serbia based on the TOPSIS method and, in the context of this, to propose adequate measures for improvement in the future. As far as the literature is concerned, it is very rich in the world when it comes to the analysis of financial and business performance, efficiency, and positioning of companies from all economic sectors, which means trade as well. This is also the case with literature in Serbia (Lukic et al., 2020; Lukic, 2020). In this work, as far as we know, for the first time in the literature, the impact of the evaluation of criteria on the dynamics of the performance positioning of trade in Serbia is investigated by

[1] radojko.lukic@ekof.bg.ac.rs

the comparative use of different methods for determining the weighting coefficients of the criteria (AHP, LMAW, MEREC, DIBR), and the TOPSIS method, in function of improvement in the future by applying relevant measures. In this, among other things, the scientific and professional contribution of this work to theory, methodology, and practice is manifested. The research hypothesis is based on the fact that only a continuous analysis of the dynamics of the performance positioning of trade in Serbia, based on modern methodology, provides a realistic basis for improvement in the future by applying adequate measures.

1. Methodology

In further presentations of the issues treated in this paper, we will outline the characteristics of the multi-criteria decision-making methods. Given that the weighting coefficients of criterion when applying the TOPSIS method are determined using the AHP method, we will briefly refer to its theoretical and methodological characteristics. The **Analytical Hierarchy Process (AHP) method** proceeds through the following steps (Satyr, 2008):

Step 1: Forming a matrix of comparison pairs

$$A = [a_{ij}] = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \quad (1)$$

Step 2: Normalization of the matrix of comparison pairs

$$a_{ij}^* = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}}, i,j = 1, \dots, n \quad (2)$$

Step 3: Determination of relative importance, i.e. vector weights

$$w_i = \frac{\sum_{i=1}^{n} a_{ij}^*}{n}, i,j = 1, \dots, n \quad (3)$$

Consistency index - CI (consistency index) is a measure of the deviation of *n* from λ_{max} and can be represented by the following formula:

$$CI = \frac{\lambda_{max} - n}{n} \quad (4)$$

If CI < 0.1 of the estimated value of coefficients a_{ij} are consistent, and the deviation of λ_{max} from *n* is negligible. This means, in other words, that the AHP method accepts an inconsistency of less than 10%. Using the consistency index, the consistency ratio CR = CI/RI can be calculated, where RI is the random index.

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, 2021b).

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}^erepresents 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 equation:

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

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:

$$n_{Cn}^e = \frac{\gamma_{Cn}^e}{\gamma_{AIP}} \quad (5)$$

So the relational vector $R^e = (n_{C1}^e, n_{C2}^e, \dots, n_{Cn}^e)$is obtained. Where it n_{Cn}^erepresents the value of the relation 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 $w = (w_1, w_2, \ldots, w_n)^T$ is calculated by the expert $e(1 \le e \le k)$using the following equation:

$$w_j^e = \frac{\log_A(n_{Cn}^e)}{\log_A\left(\prod_{j=1}^{n} n_{Cn}^e\right)}, A > 1 \quad (6)$$

where w_j^eit represents the weighting coefficients obtained according to expert evaluations e^{th} and the n_{Cn}^eelements 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 $w = (w_1, w_2, \ldots, w_n)^T$:

$$W_j = \left(\frac{1}{k.(k-1)} \cdot \sum_{x=1}^{k} \left(w_j^{(x)}\right)^p \cdot \sum_{\substack{y=1 \\ y \ne x}}^{k} \left(w_{ij}^{(y)}\right)^q \right)^{\frac{1}{p+q}} \quad (7)$$

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

As is known, the weight of criteria in multi-criteria decision-making (MCDM) problems is an important element that significantly affects the results. Consequently, several methods were developed for determining the weights of the criteria (AHP, DEMATEL, CRITIC, Entropy, and Standard Deviation). Weighting methods can be objective, subjective, and integrated in nature. This paper discusses the method based on the removal effects of criteria (**MEREC** - Method based on the Removal Effects of Criteria) for determining their weights in decision problems with multiple criteria (Ayçin et al., 2021: Popović et al., 2022; Ecer and Aycin, 2022; Mishra et al., 2022; Nguyen et al., 2022; Rani et al., 2022; Toslak et al., 2022). The MEREC method is in the category of objective criteria weighting methods, which uses the effect of removing each criterion on the performance of alternatives to determine the weight of the criteria (Shanmugasundar et al., 2022). Higher weights are assigned to criteria that have greater effects on the performance of alternatives. First, in the MEREC method, measures for the performance of the alternatives are defined. In doing so, a simple logarithmic measure is used with equal weights to calculate the performance of the alternative. To identify the effects of removing each criterion, the measure of absolute deviation is used, which reflects the differences between the overall performance of the alternative and its effect in removing the criteria. The following steps are used to calculate the objective weights of the criteria using the MEREC method (Keshavarz-Ghorabaee et al., 2021).

Step 1: Constructing the decision matrix. The decision matrix shows the scores or values of each alternative about each criterion. The elements of this matrix are denoted by x_{ij} and should be greater than zero ($x_{ij} > 0$). If the values are negative, they should be transformed into positive values using the appropriate technique. Suppose there are *n* alternatives and *m* criteria, the form of the decision matrix is as follows:

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1j} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2j} & \cdots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{i1} & x_{i2} & \cdots & x_{ij} & \cdots & x_{im} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nj} & \cdots & x_{nm} \end{bmatrix} \quad (8)$$

Step 2: Normalization of the decision matrix (*N*). In this step, a simple linear normalization is used to scale the elements of the decision matrix. The elements of the normalized matrix are marked with n_{ij}^x. If $\mathcal{B}$it shows a set of useful criteria and $\mathcal{H}$ represents a set of non-useful criteria, the following normalization equation can be used:

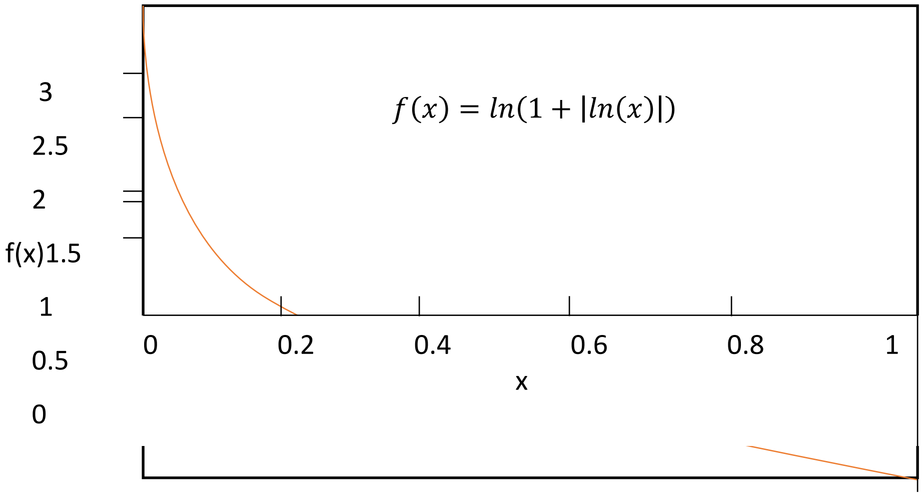
$$n_{ij}^x = \begin{cases} \dfrac{\min_k x_{kj}}{x_{ij}} & if \quad j \in \mathcal{B} \\ \dfrac{x_{ij}}{\max_k x_{kj}} & if \quad j \in \mathcal{H} \end{cases} \quad (9)$$

It should be noted here that the normalization process is similar to but different from the process in methods such as WASPAS. The difference is in switching between useful and non-useful criteria formulas. Unlike other studies, here all criteria are transformed into normalized criteria types (Keshavarz-Ghorabaee et al., 2021).

Step 3: Calculate the total performance of the alternatives (S_i). In this phase, a logarithmic measure with equal criteria weights is applied to obtain the overall performance of the alternatives. This measure is based on the non-linear function shown in Figure 1. According to the normalized value obtained in the previous phase, it can be ensured that smaller values n_{ij}^x give higher performance values (S_i). The following equation is used for these calculations:

$$S_i = ln\left(1 + \left(\frac{1}{m}\sum_j \left|ln(n_{ij}^x)\right|\right)\right) \quad (10)$$

Figure 1: Weights of Comparative Analysis



Step 4: Calculate the performance of alternatives with each criterion removed. In this phase, logarithmic measures are used in the same way as in the previous step. The difference between this step and step 3 is that the performance of the alternatives is determined by removing each criterion separately. Thus, *m* performance sets are associated with *m* criteria. Denote by $S_{ij}^{'}$ the total performance of the *i* -th alternative in connection with the removal of the *j* -th criterion. In this step, the following equation is used for the calculation:

$$S_{ij}^{'} = ln\left(1 + \left(\frac{1}{m}\sum_{k,k\neq j} \left|ln(n_{ik}^x)\right|\right)\right) \quad (11)$$

Step 5: Calculate the sum of absolute deviations. the jth criterion is calculated based on the values obtained in steps 3 and 4. Let's denote by E_j the effect of removing the *j*-th criterion. The calculation of the value of E_j is performed using the following equation:

$$E_j = \sum_i \left|S_{ij}^{'} - S_i\right| \quad (12)$$

Step 6: Determining the final criteria weight. In this step, the actual weight of the criterion is calculated using the removal effect (E_j) in step 5. Let us denote w_j the weight of the *j*th criterion. The following equation is used to calculate w_j:

$$W_j = \frac{E_j}{\sum_k E_k} \quad (13)$$

The **DIBR** (Defining Interrelationships Between Ranked criteria) method is based on defining the relationship between ranked criteria, i.e. adjacent criteria. It consists of five steps (Pamucara et al., 2021a; Tešić et al., 2022):

Step 1. Ranking of criteria according to importance. On a defined set of *n* criteria, $C = \{C_1, C_2, \dots, C_n\}$ the criteria are ranked according to their importance as $C_1 > C_2 > C_3 > \cdots > C_n$.

Step 2. Comparison of criteria and definition of mutual relations. By comparing the criteria, the values were obtained $\lambda_{12}, \lambda_{13}, \dots, \lambda_{1-n,n}$, and λ_n Thus, for example, when comparing criteria *C 1* and *C 2,* the value, etc. was obtained. λ_{12}All compared values must satisfy the condition $\lambda_{n-1,n}, \lambda_{1n} \in [0,1]$. Based on the defined conditions and relationships, the following relationships between the criteria were derived:

$$\mathcal{W}_1 : \mathcal{W}_2 = (1-\lambda_{12}) : \lambda_{12} \quad (14)$$

$$\mathcal{W}_2 : \mathcal{W}_3 = (1-\lambda_{23}) : \lambda_{23} \quad (15)$$

...

$$\mathcal{W}_{n-1} : \mathcal{W}_n = (1-\lambda_{n-1.n}) : \lambda_{n-1,n} \quad (16)$$

$$\mathcal{W}_1 : \mathcal{W}_n = \left(1-\lambda_{1,n}\right) : \lambda_{1,n} \quad (17)$$

Ratios (14-17) and values $\lambda_{n-1,n}$can be viewed as ratios of criteria to which the decision maker assigns total importance in the interval of 100% for the two observed criteria.

Step 3. Defining the equations for calculating weight criteria.Based on the relationship from step 2, the expressions for determining the weighting coefficients of the criteria $\mathcal{W}_1, \mathcal{W}_2, \dots, \mathcal{W}_n$are derived:

$$\mathcal{W}_2 = \frac{\lambda_{12}}{(1-\lambda_{12})}\mathcal{W}_1 \quad (18)$$

$$\mathcal{W}_3 = \frac{\lambda_{23}}{(1-\lambda_{23})}\mathcal{W}_2 = \frac{\lambda_{12}\lambda_{23}}{(1-\lambda_{12})(1-\lambda_{23})}\mathcal{W}_1 \quad (19)$$

$$\mathcal{W}_n = \frac{\lambda_{n-1,n}}{\left(1-\lambda_{n-1,n}\right)}\mathcal{W}_{n-1} = \frac{\lambda_{12}\lambda_{23}. \dots . \lambda_{n-1,n}}{(1-\lambda_{12})(1-\lambda_{n-1.n}). \dots . \left(1-\lambda_{n-1,n}\right)}\mathcal{W}_1 = \frac{\prod_{i=1}^{n-1}\lambda_{i,i+1}}{\prod_{i=1}^{n-1}\left(1-\lambda_{i,i+1}\right)}\mathcal{W}_1 \quad (20)$$

Step 4. Calculation of the weight coefficient of the most influential criterion. Based on equations (18) - (20) and conditions $\sum_{j=1}^{n}\mathcal{W}_j = 1$, the following mathematical relationship is defined

$$\mathcal{W}_1\left(1+\frac{\lambda_{12}}{(1-\lambda_{12})}+\frac{\lambda_{12}\lambda_{23}}{(1-\lambda_{12})(1-\lambda_{23})}+\dots+\frac{\prod_{i=1}^{n-1}\lambda_{i,i+1}}{\prod_{i=1}^{n-1}\left(1-\lambda_{i,i+1}\right)}\right) = 1 \quad (21)$$

From the previous expression (21), the final expression for defining the weight coefficient of the most influential criterion is derived:

$$\mathcal{W}_1 = \frac{1}{1+\frac{\lambda_{12}}{(1-\lambda_{12})}, \frac{\lambda_{12}\lambda_{23}}{(1-\lambda_{12})(1-\lambda_{23})}+\dots+\frac{\prod_{i=1}^{n-1}\lambda_{i,i+1}}{\prod_{i=1}^{n-1}\lambda_{i,i+1}}} \quad (22)$$

Based on the obtained value $\mathcal{W}_1$and the use of expressions (18) - (20), the weight coefficients of the other criteria $\mathcal{W}_2, \mathcal{W}_3, \dots, \mathcal{W}_n$are obtained.

Step 5. Defining the degree of satisfaction of the subjective relationships between the criteria.Based on the expression (17), the value of the weight coefficient of the criterion $\mathcal{W}_n$is defined

$$\mathcal{W}_n = \frac{\lambda_{1n}}{(1-\lambda_{1n})}\mathcal{W}_1 \quad (23)$$

Expression (17) is a relation for controlling expression (20), which is intended to check the satisfaction of the decision marker's preference, and from which the value $\lambda'_{1,n}$ is defined, expression (24):

$$\lambda'_{1,n} = \frac{w_n}{w_1 + w_n} \quad (24)$$

If the values λ_{1n} $\lambda'_{1,n}$ are approximately equal, it can be concluded that the decision makers' preference is satisfied. If they differ, it is necessary to first check the ratio for λ_{1n}. If the decision-maker considers that the relationship is λ_{1n}well defined, the relationships between the criteria should be redefined and the weighting coefficients of the criteria should be calculated. If this is not the case, it is necessary to redefine the relationship for λ_{1n}It is necessary that the deviation of the value $\lambda_{1n}$and λ'_{1n} be a maximum of 10%. If this is not the case, it is necessary to redefine the relations between the criteria to satisfy this condition.

The **TOPSIS** method (*Technique for Order Preference by Similarity to Ideal Solution*) is very successfully used in evaluating the financial performance of companies. It is a multi-criteria decision-making technique that was first developed and applied by Hwang and Yoon (1981)(Hwang, 1981, 1995). According to this method, alternatives are defined by their distances from the ideal solution. The goal is to choose the optimal alternative that is closer to the optimal solution, that is, the farthest from the negative ideal solution (Young et al., 1994). A positive ideal solution maximizes utility, i.e. minimizes costs (relative to the given problem). Conversely, a negative ideal solution maximizes costs, i.e. minimizes utility. The TOPSIS method consists of six steps (Üçüncü *et al.*, 2018):

Step 1: Creating the initial matrix. In the displayed initial matrix A_{ij}, "*m* " indicates the number of alternatives, and " *n* " indicates the number of criteria:

$$A_{ij} = \begin{vmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{vmatrix}$$

Step 2: Formation of the weighted normalized decision matrix. The normalized decision matrix (R_{ij}; i=1,…,m; j=1,…,n) is determined by the following equation with matrix elements A_{ij}:

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^{m} a_{ij}^2}} \ (25)$$

$$t = 1,2,3, \dots, m \ j = 1,2,3, \dots, n$$

$$R_{ij} = \begin{vmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{vmatrix}$$

In equation (12), the weight measure " *j* " is represented by W_{ij}. The weight-normalized decision matrix (V_{ij}; *i=1,…,m; j=1,…,n*) was determined using the following equation with the elements of the normalized matrix:

$$V_{ij} = W_{ij} * r_{ij} \ (26)$$

$$i = 1,2,3, \dots, m \ j = 1,2,3, \dots, n$$

Step 3: Determination of positive and negative ideal solutions. The value of the positive-ideal solution (A^+) and the negative-ideal solution (A^-) is determined from the value of the weight-normalized matrix (V_{ij}). A^+ is a better and A^- *is* a worse performance score. The value of the positive-ideal solution (A^+) and the negative-ideal solution (A^-) is determined as follows:

$$A^+ = \{v_i^+, \dots, v_n^+\} = \left\{\left(\max_i v_{ij}, j \in j\right)\left(\min_i v_{ij}, j \ \in j'\right)\right\} \ i = 1,2, \dots, m \ (27$$

$$A^- = \{v_i^-, \dots, v_n^-\} = \left\{\left(\min_i v_{ij}, j \in j\right)\left(\max_i v_{ij}, j \in j'\right)\right\} \ i = 1,2, \dots, m \ (28)$$

where *j is* related to the benefit criterion, and *j'* is related to the cost criterion.

Step 4: Determination of special measures (ie the distance of the alternatives from the ideal and negative-ideal solution). The distance from the positive-ideal solution (S_i^+) and the negative-ideal solution (S_i^-) for each alternative according to the given criterion is determined using the following equation:

$$S_i^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^+)^2} \ (29)$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2} \ (30)$$

$$i = 1,2,3, \dots, m \ j = \ 1,2,3, \dots, n$$

Step 5: Determination of the coefficient of relative closeness to the ideal solution. Separate measures of the positive-ideal solution (S_i^+) and the negative-ideal solution (S_i^-) were used to determine the relative closeness to the ideal solution (C_i^+) for each decision point. C_i^+ represents the relative closeness to the ideal solution and takes a value in the range $0 \leq C_i + \leq 1$. " C_i^+ " = 1 shows the relative closeness to the positive-ideal solution. " C_i^+ " = 0 shows relative closeness to the negative-ideal solution. The relative closeness to the ideal solution (C_i^+ ; i=1,…,m; *j=1,…,n*) was determined using the following equation:

$$C_i^+ = \frac{S_i^-}{S_i^- + S_i^+} \ (31$$

$$i = 1,2,3, \dots, m$$

Step 6: Sorting alternatives according to relative superiority. Determining the relative superiority of the results (*score)* represents the achieved company performance. High scores correspond to better performance. The results can be used to determine the company's ranking within the industry (Üçüncü *et al* ., 2018).

2. Results and discussion

In this paper, the criteria were chosen by the nature of trade operations. Initial data are shown in Table 1. (In this paper, all calculations and results are the author's own.)

Table 1: Initial data

DMU	(I) Number of employees (C1)	(I) Assets (C2)	(I) Capital (C3)	(O) Sales (C4)	(O) Net profit (C5(	Assets per employee, in thousands of dinars (C6)	Sales per employee, in thousands of dinars (C7)	Net profit per employee in thousands of dinars (C8)	Asset turnover ratio (sales/assets) (C9)	Financial indebtedness (assets/equity) (%) (C10)
2013 (A1)	193210	2160474	746992	2891518	89730	11182	14965.67	464.417	1.338372	289.22
2014 (A2)	191621	2157564	761305	2594602	86955	11259.54	13540.28	453.7864	1.202561	283.40
2015 (A3)	159621	2197931	805009	2731999	95265	13769.69	17115.54	596.82	1.242987	273.03
2016 (A4)	206092	2324843	859749	3009651	105238	11280.61	14603.43	510,636	1.294561	270.41
2017 (A5)	208020	2375290	920992	3172393	122727	11418.57	15250.42	589.9769	1.335581	257.91
2018 (A6)	219373	2524897	1007972	3361094	121816	11509.61	15321.37	555.2917	1.331181	250.49
2019 (A7)	222049	2682931	1073056	3608329	139409	12082.61	16250.15	627.8299	1.344921	250.03
2020 (A8)	227618	2837599	1183026	3664505	171010	12466.5	16099.36	751.3026	1.29141	239.86
2021 (A9)	234727	3166529	1318126	4754169	170703	13490.26	20254.04	727.2406	1.501382	240.23
2022 (A10)	234011	3490398	1426553	5511864	214917	14915.53	23553.87	918.4055	1.579151	244.67
Mean	209634.2000	2591845.6000	1010278.0000	3530012.4000	131777.0000	12337.4920	16695.4130	619.5707	1.3462	259.9250
Median	213696.5000	2450093.5000	964482.0000	3266743.5000	122271.5000	11796.1100	15710.3650	593.3985	1.3334	254.2000
Std. Deviation	23349.91852	454467.72510	237092.79420	930782.88700	42190.70378	1301.78941	3013.51715	144.24732	.11338	17.96649
Minimum	159621.00	2157564.00	746992.00	2594602.00	86955.00	11182.00	13540.28	453.79	1.20	239.86
Maximum	234727.00	3490398.00	1426553.00	5511864.00	214917.00	14915.53	23553.87	918.41	1.58	289.22
Mean	209634.2000	2591845.6000	1010278.0000	3530012.4000	131777.0000	12337.4920	16695.4130	619.5707	1.3462	259.9250

Note: The author's ratio analysis. DMU - units. I-input. O-output
Source: Agency for Economic Registers of the Republic of Serbia

Labor productivity (sales per employee) has been continuously increasing in the trade of Serbia recently. During the observed period, it ranged from 13,540.2 to 23,553.87 thousand dinars. The increase in labor productivity had a positive effect on the overall performance of trade in Serbia. Table 2 shows the correlation matrix of the initial data.

Table 2: Correlations

Correlations											
		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	Pearson Correlation	1	.808**	.833**	.769**	.805**	.201	.475	.625	.693*	-.804**
	Sig. (2-tailed)		.005	.003	.009	.005	.579	.165	.053	.026	.005
C2	Pearson Correlation	.808**	1	.991**	.985**	.980**	.737*	.887**	.934**	.881**	-.824**
	Sig. (2-tailed)	.005		.000	.000	.000	.015	.001	.000	.001	.003

C3	Pearson Correlation	.833**	.991**	1	.959**	.982**	.704*	.843**	.932**	.839**	-.890**
	Sig. (2-tailed)	.003	.000		.000	.000	.023	.002	.000	.002	.001
C4	Pearson Correlation	.769**	.985**	.959**	1	.948**	.746*	.927**	.904**	.947**	-.745*
	Sig. (2-tailed)	.009	.000	.000		.000	.013	.000	.000	.000	.013
C5	Pearson Correlation	.805**	.980**	.982**	.948**	1	.711*	.842**	.965**	.822**	-.854**
	Sig. (2-tailed)	.005	.000	.000	.000		.021	.002	.000	.004	.002
C6	Pearson Correlation	.201	.737*	.704*	.746*	.711*	1	.920**	.846**	.652*	-.494
	Sig. (2-tailed)	.579	.015	.023	.013	.021		.000	.002	.041	.147
C7	Pearson Correlation	.475	.887**	.843**	.927**	.842**	.920**	1	.892**	.894**	-.582
	Sig. (2-tailed)	.165	.001	.002	.000	.002	.000		.001	.000	.077
C8	Pearson Correlation	.625	.934**	.932**	.904**	.965**	.846**	.892**	1	.770**	-.798**
	Sig. (2-tailed)	.053	.000	.000	.000	.000	.002	.001		.009	.006
C9	Pearson Correlation	.693*	.881**	.839**	.947**	.822**	.652*	.894**	.770**	1	-.591
	Sig. (2-tailed)	.026	.001	.002	.000	.004	.041	.000	.009		.072
C10	Pearson Correlation	-.804**	-.824**	-.890**	-.745*	-.854**	-.494	-.582	-.798**	-.591	1
	Sig. (2-tailed)	.005	.003	.001	.013	.002	.147	.077	.006	.072	
**. Correlation is significant at the 0.01 level (2-tailed).											
*. Correlation is significant at the 0.05 level (2-tailed).											

There is a strong correlation between sales per employee and other statistical variables (except the number of employees) at the level of statistical significance. There is a negative correlation between C7 and C10, and it is slightly higher than statistical significance. With the increase in labor productivity, the financial indebtedness of trade in Serbia decreases, and vice versa. Labor productivity is one of the most important determinants of trade performance in Serbia. By improving productivity, and applying adequate measures, such as training, rewarding, flexible employment, promotion, health, and social insurance, it is possible to influence the achievement of the target results of trade in Serbia. The Friedman test shows that there is a significant difference between the analyzed statistical variables (Asymp. Sig. .000). The weight coefficients of the criteria were determined using the AHP, LMAW, MEREC, and DIBR methods. They are shown in Table 3.

Table 3: Weight coefficients of criteria

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10		Consistency Ratio. It should be less than 10%
AHP	0.125	0.1442	0.1666	0.0879	0.0905	0.0699	0.0783	0.0774	0.0774	0.0829	1	0.0417
LMAO	0.1016	0.1043	0.1015	0.1059	0.1093	0.0984	0.1074	0.1061	0.0926	0.0714	1	
MEASURE	0.1293	0.0771	0.1287	0.1293	0.1733	0.043	0.0912	0.1346	0.0513	0.0422	1	
DIBR	0.1644	0.1518	0.1193	0.1058	0.0976	0.0938	0.0832	0.0681	0.0604	0.0557	1	2.67

The significance of the criteria is as follows: according to the AHP method, the most significant criterium is C3; according to the LMAW method, the most important criterion is C5; According to the MEREC method, the most important criterion is C5; and according to the DIBR method, the most important criterion is C1. Therefore, trade in Serbia can achieve the target performance through adequate management of human resources, capital, and profit. Table 8 shows the ranking of alternatives according to AHP, LMAW, MEREC, DIBR and TOPSIS methods.

Table 4: Ranking of alternatives according to AHP, LMAW, MEREC, DIBR and TOPSIS methods

Year	Code	AHP-TOPSIS	AHP-TOPSIS	LMAW-TOPSIS	LMAW-TOPSIS	MEREC-TOPSIS	MEREC-TOPSIS	DIBR-TOPSIS	DIBR-TOPSIS
		Ci	Ranking	Ci	Ranking	Ci	Ranking	Ci	Ranking
2013	A1	0.133	**9**	0.127	**9**	0.102	**9**	0.148	**9**
2014	A2	0.111	**10**	0.093	**10**	0.080	**10**	0.126	**10**
2015	A3	0.156	**8**	0.196	**7**	0.154	**8**	0.159	**8**
2016	A4	0.198	**7**	0.177	**8**	0.176	**7**	0.220	**7**
2017	A5	0.271	**6**	0.263	**6**	0.277	**6**	0.284	**6**
2018	A6	0.335	**5**	0.293	**5**	0.300	**5**	0.343	**5**
2019	A7	0.433	**4**	0.398	**4**	0.412	**4**	0.435	**4**
2020	A8	0.563	**3**	0.531	**3**	0.577	**3**	0.552	**3**
2021	A9	0.733	**2**	0.692	**2**	0.688	**2**	0.730	**2**
2022	A10	0.932	**1**	0.941	**1**	0.971	**1**	0.953	**1**

In the specific case, therefore, the influence of the different evaluations of the criteria on the results of the ranking of the alternatives according to the TOPSIS method is negligible. In the trade of Serbia, the best results according to all used multi-criteria decision-making methods (AHP-TOPSIS, LMAW-TOPSIS, MEREC-TOPSIS, and DIBR-TOPSIS) were achieved in 2022, and the worst in 2014. They continuously improved from year to year in the observed period. results of trade in Serbia. Effective management of key macro and micro factors contributed to this. The comparative use of different methods of multi-criteria decision-making, in addition to the classical methodology, provides a realistic basis for looking at the performance of trade in Serbia in the function of improvement by effective control of influencing factors through the application of appropriate measures. For these reasons, they are recommended.

Conclusion

In the specific case, therefore, the influence of the different evaluations of the criteria on the results of the ranking of the alternatives according to the TOPSIS method is negligible. In the trade of Serbia, the best results according to all used multi-criteria decision-making methods (AHP-TOPSIS, LMAW-TOPSIS, MEREC-TOPSIS, and DIBR-TOPSIS) were achieved in 2022, and the worst in 2014. They continuously improved from year to year in the observed period results of trade in Serbia. This was contributed by the effective management of key macro and micro factors (geopolitical situation, economy, inflation, interest rate, employment, living standards of the population, trade policy and strategy, foreign direct investments, new business models (multichannel sales -store and electronic, private brand, sale of organic products, etc.), concept of sustainable development, energy crisis, management of human resources, assets, capital, sales and profit, digitization of the entire business, and others). The target dynamics of the performance positioning of trade in Serbia can be achieved by effective control of human resources, assets (investments), capital, sales, profits, labor productivity, and financial indebtedness.

Literature

1. 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.
2. 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, DOI 10.15388/22-INFOR494
3. Hwang, C. L.& K. P.Yoon (1995). *Multiple Attribute Decision Making: An Introduction*. Paperback / Sage Publications.
4. Hwang, C.L.&Yoon, K.S. (1981). *Multiple attribute decision making: methods and applications*. Berlin: Springer.
5. Keshavarz-Ghorabaee, M., Amiri, M., Zavadskas, E.K., Turskis, Z., Antucheviciene, J. (2021). Determination of Objective Weights Using a New Method Based on the Removal Effects of Criteria (MEREC). *Symmetr*y, 13, 525. https://doi.org/10.3390/sym13040525
6. Lukic, R., Vojteski Kljenak, D., & Anđelić, S. (2020). Analyzing financial performances and Efficiency of the retail food in Serbia by using the AHP - TOPSIS method. *Economics of Agriculture* , Year 67, No. 1, 2020, (pp. 55-68), Belgrade.

7. Lukic, R. (2020). Analysis of the efficiency of trade in oil derivatives in Serbia by applying the fuzzy AHP-TOPSIS method. *Business Excellence and Management* , 10 (3), 80-98.
8. 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.
9. 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. *Appl. Sci*., 12, 3720. https://doi.org/10.3390/ app12083720
10. Pamucar, D., Deveci, M., Gokasar, I., Işık, M., & Zizovic, M. (2021a). Circular economy concepts in urban mobility alternatives using integrated DIBR method and fuzzy Dombi CoCoSo model. *Journal of Cleaner Production*, 323, 129096. http://dx.doi.org/10.1016/j. jclepro.2021.129096.
11. Pamučar, D., Žižović, M., Biswas, S., & Božanić, D. (2021b) 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
12. 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.
13. 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. *Int J Intell Syst*., 37, 2612- 2647. doi:10.1002/int.22787
14. Shanmugasundar, G., Sapkota, G., Čep, R., Kalita, K. (2022). Application of MEREC in Multi-Criteria Selection of Optimal Spray-Painting Robot. *Processes*, 10, 1172. https://doi.org/10.3390/ pr10061172
15. Saaty, T. L. (2008). Decision Making With The Analytic Hierarchy Process. *Int J Serv Sci* , 1(1), 83-98.
16. Tešić, D.Z., Božanić, D.I., Pamučarc, D.S., Dind, J. (2022). DIBR – FUZZY MARCOS model for selecting a location for a heavy mechanized bridge. Vojnotehnički glasnik, 70(2), 314-339. DOI: 10.5937/vojtehg70-35944
17. 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.
18. Üçüncü, T., Akyüz, K. C., Akyüz, İ., Bayram, B. Ç.&Ve Ersen, N. (2018), Evaluation of Financial Performance of Paper Companies Traded at BIST with TOPSIS Method,*Kastamonu Unıversıty Journal of ForestryFaculty*, 18(1), 92–98.
19. Young, J. L., Ting, Y. L. &Hwang, C. L. (1994),TOPSIS for MODM,*European Journal of Operational Research*, North-Holland, 76, 486–500.