Evaluation of trade performance dynamics in Serbia using ARAT and Rough MABAC methods

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Abstract: Recently, there has been an increasing amount of literature dedicated to the importance and specifics of applying multi-criteria decision-making methods in trade. These methods, given that they are based on a mathematical approach, provide realistic results of the analysis of the treated problem. Based on that, this study investigates the dynamics of trade performance in Serbia based on the ARAT (Interval and Iterative Preference/Priority Scale), and the Rough MABAC (Multi-Attributive Border Approximation Area Comparison) method. The results of the study show that in 2023, the best performance of trade in Serbia was achieved. The worst performance of trade in Serbia was achieved in 2018. The ranking of trade performance in Serbia is as follows: 2023, 2022, 2021, 2020, 2019 and 2018. The performance of trade in Serbia has continuously improved. Effective management of human resources, investments, capital, sales, and profit contributed to this. Certainly, the positive influence of other relevant factors (foreign direct investments, new business models - multichannel sales: store and electronic, private brand, sale of organic products, the concept of sustainable development - economic, social, and environmental dimensions, the idea of social responsibility) must not be neglected. , digitization of the entire business, etc.). To achieve the target profit in Serbian trade, adequate adaptation to dynamic complex changes in the business environment and macroeconomic trends (geopolitical situation, energy crisis, inflation, exchange rate, interest rates, etc.) is important. In all this, digitizing the entire trade business plays a significant role.

Keywords: performance Serbian trade, ARAT, Rough MABAC
JEL classification: L81, M31, M41, O32

1. Introduction

Applying multi-criteria decision-making methods provides more realistic information about trade performance compared to classical analysis. This is because multicriteria analysis is based on a mathematical approach. Based on that, the subject of research in this study is a multi-category analysis of trade performance in Serbia. The goal and purpose of this study is to realistically assess the dynamics of trade performance in Serbia using the ARAT (Interval and Iterative Preference/Priority Scale) and Rough MABAC (Multi-Attributive Border Approximation Area Comparison) methods to improve them in the future by applying relevant measures (Pamučar et al., 2018; Puška et al., 2023; Shang et al., 2023,

Chattopadhyay et al., 2022). In other words, the research goals in this study are to look as realistically as possible at the performance of Serbian trade by individual analyzed years in the period 2018 - 2023 using the ARAT and Rough MABAC methods. And on that basis, to propose appropriate measures in the function of improvement. This reflects the scientific and professional contribution of this study. Especially since there is not a single article of this type in the literature. Knowing the real performance situation is a fundamental assumption for improvement. This reflects the primary research hypothesis in this study. To research the treated problem in this study, very high-quality original empirical data created by relevant international standards are available. This facilitates, without any limitations, an international comparison of the results of this study.

2. Literature Review

In contemporary literature, there is an increasing number of works dedicated to the application of multi-criteria decision-making methods in the evaluation of trade performance (Ersoy, 2017). This is also the case with literature in Serbia (Lukić, 2021a,b, 2022). The literature can be grouped into two categories: literature dedicated to the development of multi-criteria decision-making methods (Aytekin, 2020; Shang, 2023) and literature dedicated to the application of multi-criteria decision-making methods to a specific case, in this study using the example of the analysis of the dynamics of trade performance in Serbia. In this study, the emphasis is on the application of methods to a specific case. Multi-criteria decision-making (MCDM) methods are used very effectively in the analysis of energy, environment, and sustainability (Aytekin, 2022; Chakraborty et al., 2020; Ersoy, 2017). Considerable attention is paid to the analysis of the performance of food companies based on multi-criteria decision-making methods (Aytekin, 2021). The DIBR II (Defining Interrelationships Between Ranked Criteria II) - Rough MABAC method was applied in the ranking of methods and techniques of lean organization systems management in the process of technical maintenance (Božanić et al., 2023). The Rough MABAC-DoE (a design of experiments) method is used in the selection of suppliers in the iron and steel industry (Chattopadhyay et al., 2022). The traditional MABAC method was used in the evaluation of the performance of trade and banks in Serbia (Lukić, 2021a,b, 2022). The MABAC method was effectively used in the analysis of the efficiency of the logistics process (Pamučar & Ćirović, 2015). The MABAC method was applied to the case of evaluation of university web pages (Pamučar et al., 2028).
The selection of green suppliers in agribusiness was carried out using Integrating Fuzzy Rough Sets with LMAW (Logarithm Methodology of Additive Weight) and MABAC (Puška et al., 2023).
The traditional MABAC method and the Rough MABAC method have been applied in the literature in the analysis of different cases. In the literature, it is particularly emphasized that the key problem related to optimization is the selection of criteria and determining their weight. The choice of criteria depends on the character of the analyzed optimization problem. For example, in connection with the selection of suppliers, the following criteria are relevant: C1 Costs. These criteria will enable reducing costs and ensuring favorable resources. C2 Quality. These criteria will enable ensuring good resources to maintain product quality. C3 Production innovation. These criteria will enable providing innovative resources to improve products. C4 Delivery. These criteria will enable ensuring timely resource delivery. C5 Technological capacities. These criteria will enable providing an adequate quantity of resources. C6 Environmental management standards. These criteria will enable implementing systems for environmental protection. C7 Pollution control. These criteria will enable reducing all negative effects on the environment. C8 Environmental product design. These criteria will enable sourcing resources that help reduce environmental impact. C9 Eco-friendly materials. These criteria will enable sourcing resources that use environmentally friendly materials. C10 Resource consumption reduction. These criteria will enable enabling resource consumption reduction (Puška et al., 2023). In this study, the

criteria were chosen according to the same principle, i.e. according to the character of the analyzed optimization problem. Numerous methods of subjective and objective nature have been developed in the literature for determining the weight of criteria. This includes the ARAT method used in this study to determine the weight coefficients of the analyzed criteria in the context of optimization of the treated problem. All relevant literature cited in this study and others serve as a theoretical, methodological, and empirical basis for the most comprehensive research of the problem treated in this study. It makes it possible to gain a better idea of the topicality, significance, complexity, and challenge of the issue analyzed in this study.

3. Research methodology

The applied research methodology in the analysis of the treated problem in this study is the ARAT and Rough MABAC method, the characteristics of which are shown below. The first method is used to determine the significance of the criteria. Another method is used to rank the alternatives.

ARAT (Interval and Iterative Preference/Priority Scale) is a more recent multi-criteria decision-making method. It is used to determine the weighting coefficients of the criteria. Aytekin (2020) developed the Interval and Interactive Preference/Priority Scale (ARAT) method to represent the preferences of decision-makers. Also, ARAT provides an appropriate format for solving the problem of scaling criteria in multi-criteria decision-making problems according to the preferences of decision-makers or experts and determining the level of importance of criteria. ARAT ensures that the decision maker's preferences for each criterion are determined interactively. Preferences are shaded from 0 to 10 on a theoretically infinitely divisible scale. In the first phase, the values on this scale range from 0 to 10, with 0 being the most negative and 10 being the most positive value. Therefore, the veto value in ARAT is zero, which indicates that it is a relative criterion or the alternative is not considered in the problem. A score of 10 indicates a strong preference, while a score of five indicates a moderate preference. Interactions are used to complete the finalization of priority importance values. The following are the steps for implementing the ARAT method in the process of determining the weight coefficients of the criteria (Aytekin, 2022, 2021).

Step 1: Defining the criteria: The criteria that will be used in the solution are defined by the decision problem ($j=1,...,$ n).

Step 2: Assign initial importance values of the criteria: The importance levels of each criterion in the decision problem are represented by the importance values (l_j) assigned by the decision maker. The ARAT scale with values ranging from 0 to 10 is used for this purpose.

Step 3: Evaluation of criteria by grouping according to their previous significance levels: First, in this step, criteria with the same significance level are grouped. The decision maker is then again asked to determine the fractional significance values and to review the previously assigned significance values. The significant values determined in the previous step can be revised by the decision-maker. The decision maker, on the other hand, can declare that the significant values determined in the previous step are satisfactory for all criteria. The finalization of the significance of the criterion values is completed in this scenario. Otherwise, until the decision maker is satisfied, the process of defining significant values continues in stages.

Step 4: Determining Criterion Weights: The following equation is used to obtain criteria weights, where l_j indicates the exact significant value determined for criterion j. While the weight values range from 0 to 1, the significance levels of the criteria increase as their weights approach unity.

$$w_{j_s} = \frac{l_j}{\sum_{j=1}^{n} l_j} \quad (1)$$

MABAC (Multi-Attributive Border Approximation Area Comparison) is a newly developed and widely accepted multi-criteria decision-making method (Pamučar and Čirović, 2015) that primarily ranks a set of alternatives based on their distance from the border approximation area for each criterion. However, it has been modified over time to develop purposeful hybrid models. In this study, MABAC is interpolated with rough numbers that are further fed into a DoE (design of experiments) model (Chattopadhyay et al., 2022; Božanić et al., 2024) to provide a generalized metamodel for evaluating and ranking a set of alternatives (e.g., supplier). Considering a decision problem that has *n* alternatives $(A_1, A_2, \dots, A_i, \dots, A_n)$and *m* criteria $\left(C_1, C_2, \dots, C_j, \dots, C_m\right)$, the procedural steps of the Rough MABAC method are listed below (Chakraborty et al., 2020; Božanić et al., 2024):

Step 1: The decision matrix *X* is constructed using rough numbers while taking into account the judgment of a team of experts/decision-makers when evaluating the relative performance of alternatives (for example suppliers) in terms of evaluation criteria:

$$X = \begin{matrix} A_1 \\ A_2 \\ M \\ A_n \end{matrix} \begin{bmatrix} RN(x_{11}) & RN(x_{12}) & \wedge & RN(x_{1m}) \\ RN(x_{21}) & RN(x_{22}) & \wedge & RN(x_{2m}) \\ M & M & M & M \\ RN(x_{n1}) & RN(x_{n2}) & K & RN(x_{nm}) \end{bmatrix} \quad (2)$$

$$= \begin{matrix} A_1 \\ A_2 \\ M \\ A_n \end{matrix} \begin{bmatrix} [x_{11}^-, x_{11}^+] & [x_{12}^-, x_{12}^+] & \wedge & [x_{1m}^-, x_{1m}^+] \\ [x_{21}^-, x_{21}^+] & [x_{22}^-, x_{22}^+] & \wedge & [x_{2m}^-, x_{2m}^+] \\ M & M & M & M \\ [x_{n1}^-, x_{n1}^+] & [x_{n2}^-, x_{n2}^+] & K & [x_{nm}^-, x_{bm}^+] \end{bmatrix}$$

where$RN\left(x_{ij}\right) = \left[x_{ij}^-, x_{ij}^+\right]$.

Step 2: Depending on the type of criteria, the initial decision matrix *X* is normalized to obtain the corresponding normalized decision matrix $N = \left[n_{ij}^-, n_{ij}^+\right]_{n\,x\,m}$.

$$RN\left(n_{ij}\right) = \begin{Bmatrix} \left[\frac{x_{ij}^- - x_{ij}^+}{x_j^+ - x_j^-}, \frac{x_{ij}^+ - x_{ij}^-}{x_j^+ - x_j^-}\right]; if\ j\ \in B, \\ \left[\frac{x_{ij}^+ - x_j^+}{x_j^- - x_j^+}, \frac{x_{ij}^- - x_j^+}{x_j^- - x_j^+}\right]; if\ j \in C, \end{Bmatrix} \quad (3)$$

Where $x_j^+ = \max_i\left(x_{ij}^+\right), x_j^- = \min_i\left(x_{ij}^-\right)$, *B* is the set of utility criteria and *C* is the set of cost criteria.

Step 3: Determine the weight assigned to each criterion $W = \left(w_1, w_2, \dots, w_j, \dots, w_m\right)$so that $\sum_{j=1}^{m} w_j = 1$. The Weight-normalized decision matrix $Y = \left[y_{ij}^-, y_{ij}^+\right]_{n\,x\,m\mathcal{M}}$is now calculated using equation (4):

$$y_{ij}^{-} = \left(n_{ij}^{-} + 1\right)w_j; y_{ij}^{+} = \left(n_{ij}^{+} + 1\right)w_j, i = 1,2,\dots,n, j = 1,2,\dots,m \quad (4)$$

Step 4: The Boundary Approximation Area (BAA) matrix is derived based on the geometric aggregation of the rough numbers.

$$Q = [RN(q_1)\ RN(q_2)\ \wedge\ RN(q_m)]$$

$$q_j^{-} = \left(\prod_{i=1}^{n} y_{ij}^{-}\right)^{1/n}, j = 1,2,\dots,m \quad (5)$$

$$q_j^{+} = \left(\prod_{i=1}^{n} y_{ij}^{+}\right)^{1/n}, j = 1,2,\dots,m$$

Step 5: The Euclidean distance of the alternative from the BAA is estimated based on the difference between the boundary approximation area and the weighted normalized matrix, and is presented$K = \left[RN\left(k_{ij}\right)\right]_{n\,x\,m}$.

$$k_{ij} = D\left(y_{ij}, q_j\right) = \sqrt{\frac{1}{2}\left(\left(y_{ij}^{-} - q_j^{-}\right)^2 + \left(y_{ij}^{+} - q_j^{+}\right)^2\right)}\ if\ RN\left(y_{ij}\right) > RN\left(q_j\right) \quad (6)$$

$$k_{ij} = -D\left(y_{ij}, q_j\right) = -\sqrt{\frac{1}{2}\left(\left(y_{ij}^{-} - q_j^{-}\right)^2 + \left(y_{ij}^{+} - q_j^{+}\right)^2\right)}\ if\ RN\left(y_{ij}\right) < RN\left(q_j\right)$$

Step 6: The considered alternatives are finally ranked in descending order according to *the Si* value.

$$S_i = \sum_{j=1}^{m} k_{ij}\ \ (i = 1,2,\wedge,n) \quad (7)$$

4. Results and discussion

In Serbia, the Agency for Business Registers publishes regular annual financial reports every year. Original data from those sources were used in this study. They are of high quality because they are based on relevant international standards. This significantly alleviates the problem of international comparison of the results of this study.

Criteria are selected according to the nature of the problem. In the specific case, the evaluation and ranking of trade performance dynamics in Serbia using the ARAT and Rough MABAC methods is based on the following criteria: C1 - number of employees, C2 - assets, C3 - capital, C4 - sales and C5 - net profit. The selected criteria correspond to the character of the trade. The alternatives are the years: A1 - 2018, A2 - 2019, A3 - 2020, A4 - 2021, A5 - 2022 and A6 - 2023. The original empirical data used are shown in Table 1.

Table 1. Initial data

		(I) Number of employees	(I) Assets	(I) Capital	(O) Sales	(A) Net profit
		C1	C2	C3	C4	C5
A1	2018	219373	2524897	1007972	3361094	121816
A2	2019	222049	2682931	1073056	3608329	139409
A3	2020	227618	2837599	1183026	3664505	171010
A4	2021	234727	3166529	1318126	4754169	170703
A5	2022	234011	3490398	1426553	5511864	214917
A6	2023	239429	3882976	1600734	5737589	234843

Note: The number of employees is expressed in whole numbers. Other variables in millions of dinars. I - input. O-output. The data are given for the period 2018 - 2023

Source: Agency for Economic Registers of the Republic of Serbia, 2023.

The weight coefficients of the criteria were determined using the ARAT method (Table 2). Decision makers are professional persons with a good knowledge of the nature of trade operations. They had an excellent knowledge of the theories and practices of trade. They have many years of practical experience in analyzing trade performance based on financial reports. (In this study, all calculations and results are by the authors.)

Table 2. Weight coefficients of criteria

Empirical	Final Importance Value	Weights of Criteria
C1	6.1	0.1586
C2	8.85	0.2301
C3	8.71	0.2265
C4	8.5	0.2210
C5	6.3	0.1638
		1

Note: Author's calculation, 2024.

In this particular case, the most important criterion is C2 - assets. Then criterion C 3 – capital. The ranking of the criteria is as follows: C2>C3>C4>C5>C1. The target profit in Serbian trade can, therefore, be achieved with efficient management of total investments and financial capital. In this target, effective management is also needed with the other analyzed variables (number of employees, sales, and net profit). The ranking of alternatives was performed using the Rough MABAC method.
Table 3 shows the initial decision matrix.

Table 3. Initial decision matrix

Initial decision matrix										
	0.1586	0.1586	0.2301	0.2301	0.2265	0.2265	0.221	0.221	0.1638	0.1638
	max	max	max	max	max	max	max	max	max	max
	C1		C2		C3		C4		C5	
A1	219373	219373	2524897	2524897	1007972	1007972	3361094	3361094	121816	121816
A2	222049	222049	2682931	2682931	1073056	1073056	3608329	3608329	139409	139409
A3	227618	227618	2837599	2837599	1183026	1183026	3664505	3664505	171010	171010
A4	234727	234727	3166529	3166529	1318126	1318126	4754169	4754169	170703	170703
A5	234011	234011	3490398	3490398	1426553	1426553	5511864	5511864	214917	214917
A6	239429	239429	3882976	3882976	1600734	1600734	5737589	5737589	234843	234843

Note: Author's calculation, 2024.

The Appendices shows other Tables 1, 2, 3, 4 and 5 in connection with the calculation process using the Rough MABAC method.

Table 4 shows the results of the Rough MABAC method.

Table 4. Rank

						Rank				
A1	2018	-0.098	-0.098	-0.09763	-0.195	6		[-0.098,-0.098]	-0.195	6
A2	2019		0.024	0.023661	-0.074	5		[0.024,0.024]	-0.074	5
A3	2020	0.187	0.187	0.186947	0.089	4		[0.187,0.187]	0.089	4
A4	2021	0.451	0.451	0.451405	0.354	3		[0.451,0.451]	0.354	3
A5	2022	0.677	0.677	0.676584	0.579	2		[0.677,0.677]	0.579	2
A6	2023	0.902	0.902	0.902367	0.805	1		[0.902,0.902]	0.805	1
		-0.098								
			0.902							

Note: Author's calculation, 2024.

In 2023, according to the results of the ARAT - Rough MABAC method, the best trade performance in Serbia was achieved. The worst performance of trade in Serbia was achieved in 2018. The ranking of the performance of trade in Serbia is as follows: 2023, 2022, 2021, 2020, 2019 and 2018. Therefore, the performance of trade in Serbia has continuously improved. This was influenced by effective management of human resources, investments, capital, sales, and profits. In any case, the positive influence of other relevant factors must not be ignored, such as foreign direct investments, new business models - multichannel sales: store and electronic, private brand, sale of organic products, concept of sustainable development - economic, social and environmental dimension, the idea of social responsibility, digitization of the entire business, etc. Adequate adaptation to dynamic changes in the complex business environment (geopolitical situation, energy crisis, inflation, exchange rate, interest rates, etc.) is certainly a function of achieving the target profit in Serbian trade. The mentioned other relevant factors that must not be ignored were identified based on the author's long-term study of trade performance in Serbia.

To obtain as realistic results as possible, it is recommended that, in addition to classic analysis, multi-criteria decision-making methods are used as much as possible in the evaluation of trade performance in Serbia. This is shown by the results of this study. Knowing about the real performance situation is in the function of improving the performance of trade in Serbia by applying adequate measures (for example, it has been confirmed in practice that the application of the concept of cost accounting by activities contributes to increasing profits).

As far as we know, there are no similar studies in the literature. This limits international comparison. Considering the importance, it is suggested that similar research be carried out for other countries, especially in the region.

5. Conclusion

Recently, more and more, in addition to classical analysis, to obtain the most accurate results about the treated problem, multi-criteria analysis is applied. In this study, the ARAT and Rough MABAC methods were applied in the evaluation of trade performance, in the example of Serbia. The following results were determined: the best performances were achieved in the trade of Serbia in 2023, and the worst in 2018. The ranking of the performance of trade in Serbia by year is as follows: 2023, 2022, 2021, 2020, 2019, and 2018. The performance of trade in Serbia has continuously improved. The factors that

influenced it were: efficient management of human resources, investments, capital, sales, and profits. In this context, the positive influence of other relevant factors must not be lost sight of. We will point out only some of them. These are foreign direct investments, new business models - multichannel sales: store and electronic, private brand, sale of organic products, the concept of sustainable development - economic, social, and environmental dimensions, concept of social responsibility, digitization of the entire business, etc. Adequate adaptation to dynamic changes in a very complex business environment and macroeconomic trends (geopolitical situation, energy crisis, inflation, exchange rate, interest rates, etc.) is significant in the function of achieving the target profit in Serbian trade. The application of modern cost management concepts (for example, calculation by base activities), customers, product categories, and others also contributes to the achievement of the target profit of trade in Serbia.

References:

Aytekin, A. (2022). Energy, Environment, and Sustainability: A Multi-criteria Evaluation of Countries, *Strategic Planning for Energy and the Environment*, 41(3), 281–316. https://doi.org/10.13052/spee1048-5236.4133

Aytekin, A. (2021). Chapter I Efficiency and performance analyses of food companies via IDOCRIW, REF-II, and OCRA methods, *Business Studies and New Approaches*, 7.

Aytekin, A. (2020). Çok kriterili karar problemine uzaklık ve referens temelli çözüt üçorı. (Doctor Thesis). Anadolu University. Eskişehir.

Božanić, D., Epler, I., Puška, A., Biswas, S., Marinković, D., & Koprivica, S. (2023). Application of the DIBR II–Rough MABAC decision-making model for ranking methods and techniques of lean organization systems management in the process of technical maintenance, *Facta Universitatis, Series: Mechanical Engineering*, 22(1), 101-124.https://doi.org/10.22190/FUME230614026B

Chattopadhyay, R., Das, P.P., and Chakraborty, S. (2022). Development of a Rough-MABAC-DoE-based metamodel for supplier selection in the iron and steel industry, *Operational Research in Engineering Sciences: Theory and Applications*, 5(1), 20-40. DOI: https://doi.org/10.31181/oresta190222046c

Chakraborty, S., Dandge, S.S., & Agarwal, S. (2020). Non-traditional machining processes selection and evaluation: A rough multi-attributive border approximation area comparison approach, *Computers & Industrial Engineering*, 139, 106201. https://doi.org/10.1016/j.cie.2019.106201

Ersoy, N. (2017). Performance measurement in the retail industry by using multi-criteria decision-making methods, *Ege Academic Review*, 17(4), 539–551. https://doi.org/10.21121/eab.2017431302

Lukic, R. (2021a). Application of MABAC Method in Evaluation of Sector Efficiency in Serbia. *Review of International Comparative Management*, 22(3), 400-417. DOI: 10.24818/RMCI.2021.3.400

Lukic, R. (2021b). Analysis Of Trade Efficiency In Serbia Based On The MABAC Method, Ekonomski pogledi - *Economic Outlook*, 23(2), 1-18.

Lukić, R. (2022). Evaluation of the efficiency of banks in Serbia using the MABAC method. *Bankarstvo - Banking*, 2, 35-60. DOI: 10.5937/bankarstvo2202010L

Pamučar, D., & Ćirović, G. (2015). The selection of transport and handling resources in logistics centers using multi-attributive border approximation area comparison (MABAC), *Expert Systems with Applications*, 42(6), 3016-3028. https://doi.org/10.1016/j.eswa.2014.11.05

Pamučar,D., Stević, Ž., & Kazimieras Zavadskas, E.(2018). Integration of interval rough AHP and interval rough MABAC methods for evaluating university web pages. *Applied Soft Computing*, 67, 2018, 141-163. https://doi.org/10.1016/j.asoc.2018.02.057

Puška, A., Štilić, A., Nedeljković, M, Božanić, D., &Biswas, S.(2023). Integrating Fuzzy Rough Sets with LMAW and MABAC for Green Supplier Selection in Agribusiness. *Axioms*, 12(8),746. https://doi.org/10.3390/axioms12080746

Shang, B., Chen, Z., Ma, Q., & Tan, Y. (2023). A comprehensive mortise and tenon structure selection method based on Pugh's controlled convergence and rough Z-number MABAC method. *PLoS ONE,* 18(5), e0283704. https://doi.org/10.1371/journal.pone.0283704

Appendices

Table 1. Quantified initial decision matrix

Quantified initial decision matrix										
w	0.1586	0.1586	0.2301	0.2301	0.2265	0.2265	0.221	0.221	0.1638	0.1638
	max	max	max	max	max	max	max	max	max	max
	C1		C2		C3		C4		C5	
A1	219373.000	219373.000	2524897	2524897	1007972.000	1007972.000	3361094	3361094	121816.000	121816.000
A2	222049.000	222049.000	2682931	2682931	1073056.000	1073056.000	3608329	3608329	139409.000	139409.000
A3	227618.000	227618.000	2837599	2837599	1183026.000	1183026.000	3664505	3664505	171010.000	171010.000
A4	234727.000	234727.000	3166529	3166529	1318126.000	1318126.000	4754169	4754169	170703.000	170703.000
A5	234011.000	234011.000	3490398	3490398	1426553.000	1426553.000	5511864	5511864	214917.000	214917.000
A6	239429.000	239429.000	3882976	3882976	1600734.000	1600734.000	5737589	5737589	234843.000	234843.000
min	219373.000	219373.000	2524897.000	2524897.000	1007972.000	1007972.000	3361094.000	3361094.000	121816.000	121816.000
max	239429.000	239429.000	3882976.000	3882976.000	1600734.000	1600734.000	5737589.000	5737589.000	234843.000	234843.000

Note: Author's calculation, 2024.

Table 2. Normalized matrix

Normalized matrix										
	0.1586	0.1586	0.2301	0.2301	0.2265	0.2265	0.221	0.221	0.1638	0.1638
	max	max	max	max	max	max	max	max	max	max
	C1		C2		C3		C4		C5	
A1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A2	0.133	0.133	0.116	0.116	0.110	0.110	0.104	0.104	0.156	0.156
A3	0.411	0.411	0.230	0.230	0.295	0.295	0.128	0.128	0.435	0.435
A4	0.766	0.766	0.472	0.472	0.523	0.523	0.586	0.586	0.433	0.433
A5	0.730	0.730	0.711	0.711	0.706	0.706	0.905	0.905	0.824	0.824
A6	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

Note: Author's calculation, 2024.

Table 3. Weighted matrix

Weighted matrix										
	0.1586	0.1586	0.2301	0.2301	0.2265	0.2265	0.221	0.221	0.1638	0.1638
	max	max	max	max	max	max	max	max	max	max
	C1		C2		C3		C4		C5	
A1	0.159	0.159	0.230	0.230	0.227	0.227	0.221	0.221	0.164	0.164
A2	0.180	0.180	0.257	0.257	0.251	0.251	0.244	0.244	0.189	0.189
A3	0.224	0.224	0.283	0.283	0.293	0.293	0.249	0.249	0.235	0.235
A4	0.280	0.280	0.339	0.339	0.345	0.345	0.351	0.351	0.235	0.235
A5	0.274	0.274	0.394	0.394	0.386	0.386	0.421	0.421	0.299	0.299
A6	0.317	0.317	0.460	0.460	0.453	0.453	0.442	0.442	0.328	0.328

Note: Author's calculation, 2024.

Table 4. GAO

GAO										
	0.1586	0.1586	0.2301	0.2301	0.2265	0.2265	0.221	0.221	0.1638	0.1638
	max	max	max	max	max	max	max	max	max	max
	C1		C2		C3		C4		C5	
GAO	0.173	0.173	0.253	0.253	0.252	0.252	0.245	0.245	0.176	0.176

Note: Author's calculation, 2024.

Table 5. Distance from GAO

Distance from GAO										
	0.1586	0.1586	0.2301	0.2301	0.2265	0.2265	0.221	0.221	0.1638	0.1638
	max	max	max	max	max	max	max	max	max	max
	C1		C2		C3		C4		C5	
A1	-0.015	-0.015	-0.022	-0.022	-0.025	-0.025	-0.024	-0.024	-0.012	-0.012
A2	0.007	0.007	0.004	0.004	0.000	0.000	-0.001	-0.001	0.014	0.014
A3	0.051	0.051	0.031	0.031	0.042	0.042	0.005	0.005	0.059	0.059
A4	0.107	0.107	0.086	0.086	0.093	0.093	0.106	0.106	0.059	0.059
A5	0.101	0.101	0.141	0.141	0.135	0.135	0.176	0.176	0.123	0.123
A6	0.144	0.144	0.208	0.208	0.201	0.201	0.197	0.197	0.152	0.152

Note: Author's calculation, 2024.

Ocjena dinamike trgovinske performanse primjenom ARAT i grube MABAC metode

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Sažetak: U posljednje vrijeme sve je više literature posvećene važnosti i specifičnostima primjene višekriterijskih metoda odlučivanja u trgovini. Ove metode, s obzirom da se temelje na matematičkom pristupu, daju realne rezultate analize tretiranog problema. Na temelju toga, ova studija istražuje dinamiku trgovinskih performansi u Srbiji na temelju ARAT (Intervalna i iterativna skala preferencija/prioriteta), te Rough MABAC (Multi-Attributive Border Approximation Area Comparison) metoda. Rezultati istraživanja pokazuju da je u 2023. godini ostvaren najbolji učinak trgovine u Srbiji. Najlošiji učinak trgovine u Srbiji ostvaren je 2018. godine. Poredak učinka trgovine u Srbiji je sljedeći: 2023., 2022., 2021., 2020., 2019. i 2018. Učinak trgovine u Srbiji kontinuirano se poboljšava. Tome je pridonijelo učinkovito upravljanje ljudskim resursima, investicijama, kapitalom, prodajom i dobiti. Svakako, pozitivan utjecaj drugih relevantnih čimbenika (izravna strana ulaganja, novi poslovni modeli – višekanalna prodaja: prodajna i elektronička, privatni brend, prodaja organskih proizvoda, koncept održivog razvoja – ekonomska, socijalna i ekološka dimenzija, koncept društvene odgovornost i sl.). Za postizanje ciljane dobiti u srpskoj trgovini važno je adekvatno prilagođavanje dinamičkim kompleksnim promjenama u poslovnom okruženju i makroekonomskim kretanjima (geopolitička situacija, energetska kriza, inflacija, tečaj, kamatne stope i dr.). U svemu tome značajnu ulogu ima digitalizacija cjelokupnog poslovanja u trgovini.

Ključne riječi: performanse, srpska trgovina, ARAT, grubi MABAC
JEL klasifikacija: L81, M31, M41, O32