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
zbornik.efb.ues.rs.ba

Časopis Ekonomskog fakulteta Brčko
Volumen 18, Sveska 1, 2024, str. 57-65
Journal of Faculty of Economics Brcko
Volume 18, Issue 1, 2024, pp. 57-65

Klasifikacija
Prethodno saopštenje
Classification
Preliminary communication

UDK: 339.13.017:331.105.44(497.11)
DOI: 10.7251/ZREFB2418057L

COMPARATIVE ANALYSIS OF TRADE PERFORMANCE IN SERBIA AND SELECTIVE COUNTRIES IN THE REGION BASED ON THE AROMAN METHOD

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ARTICLE INFO

Received 12/2/2024
Sent to revision 12/3/2024
Accepted 12/23/2024
Available online 12/30/2024

Keywords:
Performance
Positioning
trade of Serbia
trade of selective countries in the region (Croatia, Slovenia and Bosnia and Herzegovina)
AROMAN method

ABSTRACT

It is necessary to know the actual trade performance of Serbia and neighboring countries to improve it in the future by applying relevant measures. This enables the application of various multi-criteria decision-making methods, individually or integrated. In this study, starting from that, the performance of trade in Serbia and selective countries in the region as alternatives (Croatia, Slovenia, and Bosnia and Herzegovina) is comparatively analyzed based on relevant criteria using the AROMAN (Alternative Ranking Order Method Accounting for Two-Step Normalization) method. According to the selected criteria (number of companies, number of employees, net sales revenue, and added value), Serbia is in second place, while Bosnia and Herzegovina is in fourth place in the region. To further improve business in Serbia, it is necessary to manage the number and size of companies as efficiently as possible human resources, sales, and added value. Other factors, such as inflation, interest rates, exchange rate, employment, living standards of the population, foreign direct investments, etc., influenced the presented performance positioning of Serbian trade. The digitization of the entire business and the implementation of new business models are also important for improving the performance of trade in Serbia.

Introduction

In commerce, as in other sectors, various methods of multi-criteria decision-making are used more and more to analyze the performance of different alternatives (for example, country, region, company, store, suppliers, etc.) about the selected criteria (for example, the number of companies, number of employees, net turnover, added value, etc.) (Ersoy, 2017; Lukic, 2022a,b,2023a,b,c). Because they give a more realistic performance picture of trade, bearing in mind that they use several criteria at the same time, the importance of which is determined by a mathematical approach. Bearing this in mind, this study comparatively analyzes the performance of trade in Serbia and selective countries in the region (Croatia, Slovenia, and Bosnia and Herzegovina) using the AROMAN method. The goal of this research is to improve the performance of trade in Serbia, as well as selective countries in the region, by applying relevant measures (for example, more efficient management of the number and size of companies, human capital, sales, added value, etc.). The main research hypothesis in this study is based on the fact that knowledge of the positioning of trade, in the specific case of Serbia and selective countries in the region, indicates the need to undertake certain measures to improve it in the future. This is made possible by multi-criteria decision-making methods, in this particular case the application of the AROMAN (Alternative Ranking Order Method Accounting for Two-Step Normalization) method, in assessing the trade positioning of Serbia, that is, Croatia, Slovenia, and Bosnia and Herzegovina.

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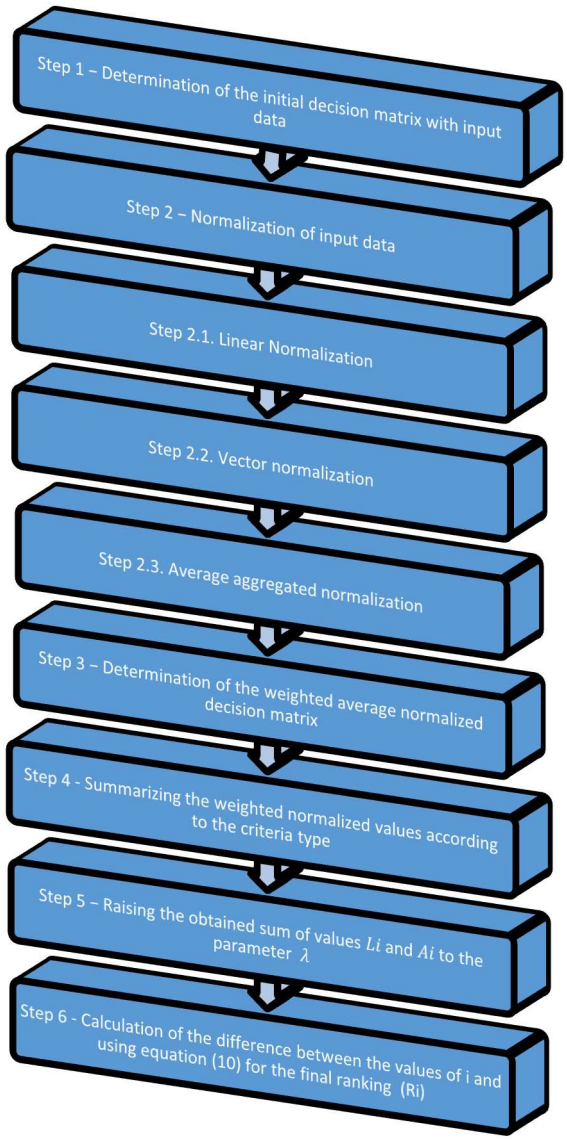
Generally speaking, lately, there has been an increasingly rich literature dedicated to the effects of applying different methods of multi-criteria decision-making in the evaluation of trade performance in the world and Serbia. In this study, it serves as a theoretical, methodological, and empirical basis for solving the problem treated in this study as effectively as possible.

1. Methodology

The analysis of the treated problem in this study is based on the application of the AROMAN method, the characteristics of which are shown below.

The AROMAN method (Alternative Ranking Order Method Accounting for Two-Step Normalization) is one of the newer methods of multicriteria analysis developed by Bošković et al. (2023). This method combines the normalized data from the two-step normalization and the average aggregated matrix from the normalized data is obtained. The AROMAN method can be described in the following steps (Dobrodolac et al., 2024; Nikoloić et al., 2023; Čubranić-Dobrodolac et al., 2023; Rani et al., 2023) (Diagram 1):

Diagram 1: Steps of the AROMAN method



Source: Author's diagram

Step 1 – Determination of the initial decision matrix with input data.

Before starting the decision-making process, it is necessary to define the initial decision-making matrix with input data. Depending on the problem, input data is usually collected beforehand in terms of alternatives and criteria. Therefore, suppose we have a decision matrix X_{mxn} with input data $x_{11}, \dots, x_{2j}, \dots, x_{mn}$:

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1j} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{21} & \cdots & x_{2j} & \cdots & x_{2n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mj} & \cdots & x_{mn} \end{bmatrix}; i = 1,2,\dots,m, j = 1,2,\dots,n. \quad (1)$$

Step 2 – Normalization of input data.

After defining the decision matrix with the input data, the second step is to normalize the input data. This means that the input data should be structured in intervals between 0 and 1. The two types of normalization are (equation (2) and equation (3)):

Step 2.1. Linear Normalization:

$$t_{ij} = \frac{x_{ij} - \min\limits_{i} x_{ij}}{\max\limits_{i} x_{ij} - \min\limits_{i} x_{ij}}; i = 1,2,\dots,m, j = 1,2,\dots,n. \quad (2)$$

Step 2.2. Vector normalization:

$$t_{ij}^{*} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}^{2}}; i? 1,2,\dots m, j = 1,2,\dots,n. \quad (3)$$

Step 2.3. Average aggregated normalization:

Aggregated average normalization is performed using equation (4):

$$t_{ij}^{norm} = \frac{\beta_{ij} + (1-\beta)t_{ij}^{*}}{2}; i = 1,2,\dots,m, j = 1,2,\dots,n. \quad (4)$$

Where t_{ij}^{norm}denotes the average aggregated normalization, $\beta$is a weighting factor varying in the range from 0 to 1. In our case $\beta = 0.5$.

Step 3 − Determination of the weighted average normalized decision matrix.

The weighted average normalized matrix is calculated based on equation (5):

$$\hat{t}_{ij} = W_{ij}.t_{ij}^{norm}; i = 1,2,\dots,m, j = 1,2,\dots,n. \quad (5)$$

Step 4 - Summarize the weighted normalized values according to the criteria type. This can be calculated using Equation (6) and Eqs. (7):

$$L_i = \sum_{j=1}^{n} \hat{t}_{ij}^{(min)}\ i = 1,2,\dots,m, j = 1,2,\dots,n, \quad (6)$$

$$A_i = \sum_{j=1}^{n} \hat{t}_{ij}^{(max)}\ i = 1,2,\dots,m, j = 1,2,\dots,n. \quad (7)$$

Step 5 − Raising the obtained sum of values Li and Ai to the parameter λ.

This step is calculated using Equation (8) and equation (9):

$$L_i^{\wedge} = L_i^{\lambda} = \left(\sum_{j=1}^{n} \hat{t}_{ij}^{(min)}\right)^{\lambda}; i = 1,2,\dots,m, j = 1,2,\dots,n, \quad (8)$$

$$A_i^{\wedge} = A_i^{1-\lambda} = \left(\sum_{j=1}^{n} \hat{t}_{ij}^{(max)}\right)^{1-\lambda}; i = 1,2,\dots,m, j = 1,2,\dots,n\,. \quad (9)$$

Where λ represents the strength of the criterion type coefficient. Since both types of criteria are included, the parameter $\lambda = 0.5$.

Step 6 - Calculation of the difference between the values of $L_i^{\wedge}$i $A_i^{\wedge}$and using equation (10) for the final ranking (R_i):

$$R_i = e^{(A_i - L_i)}; i = 1,2,\dots,m. \quad (10)$$

where R_i indicates the final ranking of alternatives.

2. Results and discussion

In this study, to research the treated problem, due to the nature of trade, the following criteria were used: C1 - number of companies, C2 - number of employees, C3 - net turnover, and C4 - added value. Criteria are nothing but performance factors, in the specific case of trade. Their adequate control can influence the achievement of the target added value. Alternatives are the trade of Serbia and selective countries in the region: A1 - Croatia, A2 - Slovenia, A3 - Bosnia and Herzegovina, and A4 - Serbia.

Table 1 and Figure 1 show the initial data in the form of a matrix for 2021. The original empirical data were collected from Eurostat statistics. (The number of companies and the number of employees are expressed in whole numbers. Net turnover and added value are expressed in millions of euros.) (In this study, all calculations and images are by the author.)

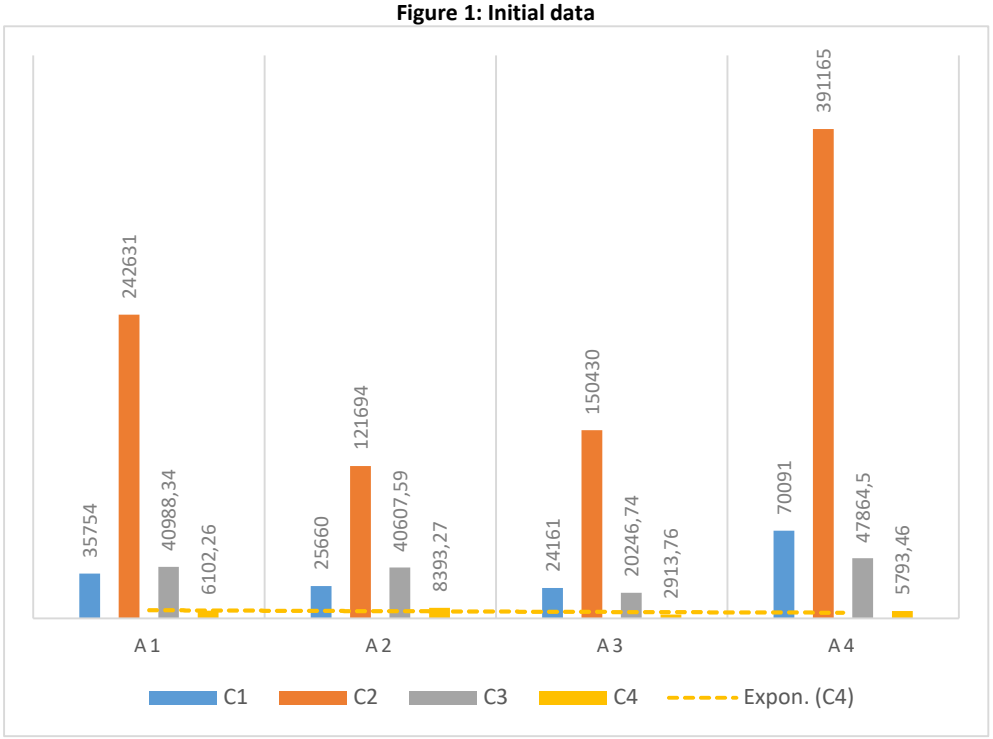
Table 1: Input-data matrix

	Input-data matrix				
		Number of companies,	Number of employees	Net turnover	Added value
		C1	C2	C3	C4
Croatia	A1	35754	242631	40988.34	6102.26

Slovenia	A2	25660	121694	40607.59	8393.27
Bosnia and Herzegovina	A3	24161	150430	20246.74	2913.76
Serbia	A4	70091	391165	47864.50	5793.46
	Mean	38916.5000	226480.0000	37426.7925	5800.6875
	Median	30707.0000	196530.5000	40797.9650	5947.8600
	Std. Deviation	21411.13751	121306.37840	11928.98480	2246.98558
	min	24161	121694	20246.74	2913.76
	max	70091	391165	47864.5	8393.27

Source: Eurostat

Figure 1: Initial data



Source: Author's picture

According to Eurostat statistics, the largest number of companies in trade is in Serbia, and the smallest is in Bosnia and Herzegovina. The number of zapoleni is the highest in the trade of Serbia, and the lowest in Slovenia. Net turnover is the largest in the trade of Serbia, and the smallest in Bosnia and Herzegovina. Slovenia's trade has the highest added value, and the lowest is in Bosnia and Herzegovina. In its way, this was reflected in their performance positioning shown below.

Net turnover per company (in millions of euros) is Croatia 1.146399, Slovenia 1.582525, Bosnia and Herzegovina 0.837993, and Serbia 0.682891. The highest net turnover per company is in the trade of Slovenia, and the lowest is in Serbia. The added value per company (in millions of euros) is Croatia 0.170673, Slovenia 0.327095, Bosnia and Herzegovina 0.120598, and Serbia 0.082656. The highest added value per company is in trade in Slovenia, and the lowest is in Serbia. The presented movements of net turnover per

company and additional value per company were reflected in their way on the positioning of the analyzed stores.

Net turnover per employee (in thousands of euros) is Croatia 168,9328, Slovenia 333,686, Bosnia and Herzegovina 134,5924, and Serbia 122,364. The highest labor productivity is in the shops of Slovenia, and the lowest is in Serbia. Added value per employee (in thousands of euros) amounts to Croatia 25.15037, Slovenia 68.97029, Bosnia and Herzegovina 19.36954, and Serbia 14.81078. Profitability is the highest in Slovenia's trade and the lowest in Serbia. We show the trend of labor productivity and profitability reflected in its way on the positioning of the trade of Serbia and the observed countries in the region.

According to the classic analysis, Slovenia's trade is best positioned in terms of performance.

In further presentations of the treated issues, we will look at the positioning of trade in Serbia and selective countries in the region (Croatia, Slovenia, and Bosnia and Herzegovina) based on the modern AROMA method. Table 2 shows the linear normalization (of the initial data).

Table 2: Linear Normalization

Linear Normalization				
	C1	C2	C3	C4
A1	0.2524	0.4488	0.7510	0.5819
A2	0.0326	0.0000	0.7372	1.0000
A3	0.0000	0.1066	0.0000	0.0000
A4	1.0000	1.0000	1.0000	0.5255

Source: Author's calculations

Table 3 shows the normalization vector.

Table 3: Vector Normalization

Vector Normalization				
	C1	C2	C3	C4
A1	0.4147	0.4859	0.5278	0.4987
A2	0.2976	0.2437	0.5229	0.6859
A3	0.2802	0.3013	0.2607	0.2381
A4	0.8130	0.7834	0.6164	0.4734

Source: Author's calculations

Table 4 and Figure 2 show the aggregated normalization.

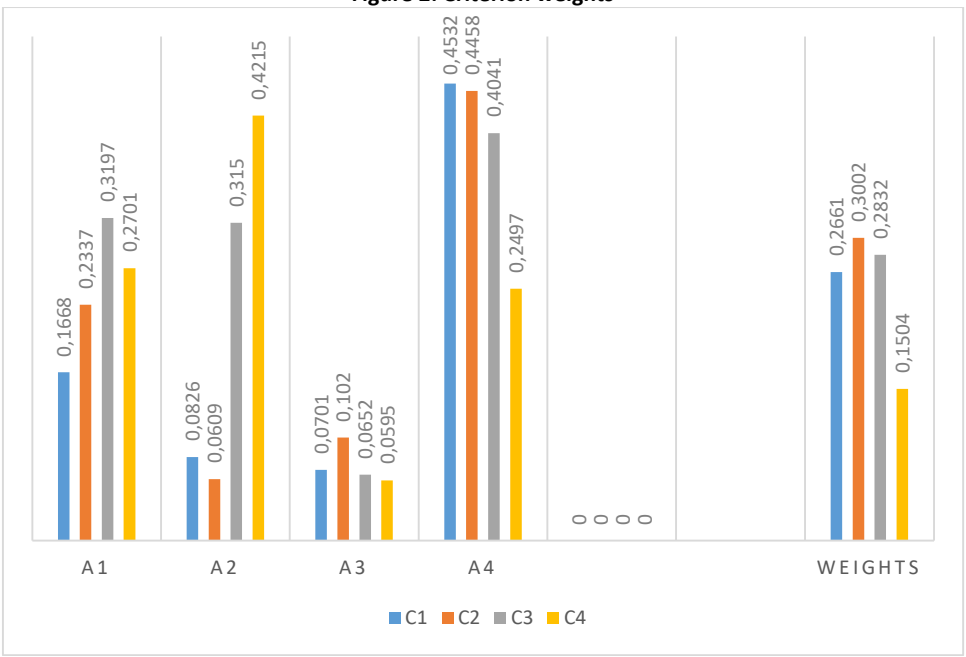
Table 4: Aggregated Normalization

					β
					0.5
Aggregated Normalization					
	C1	C2	C3	C4	
A1	0.1668	0.2337	0.3197	0.2701	
A2	0.0826	0.0609	0.3150	0.4215	
A3	0.0701	0.1020	0.0652	0.0595	
A4	0.4532	0.4458	0.4041	0.2497	
	max	max	max	max	
Weights	**0.2661**	**0.3002**	**0.2832**	**0.1504**	

Source: Author's calculations

In a specific case, the most important criterion is C2 - Number of employees. Followed by C3 - Net turnover. By increasing the efficiency of human resource management, it is possible to influence the achievement of the target added value of trade. Effective traffic management also plays a significant role in this. Therefore, the ranking of the criteria is C2 > C3 > C1 > C4.

Figure 2: Criterion weights



Source: Author's picture

The weight-aggregated normalization is shown in Table 5.

Table 5: Weighted Aggregated Normalization

								λ
Weighted Aggregated Normalization						Sum (Max)		0.5
	C1	C2	C3	C4				
A1	0.0444	0.0702	0.0906	0.0406		0.2458		
A2	0.0220	0.0183	0.0892	0.0634		0.1929		
A3	0.0186	0.0306	0.0185	0.0090		0.0767		
A4	0.1206	0.1339	0.1145	0.0376		0.4066		
	max	max	max	max				

Source: Author's calculations

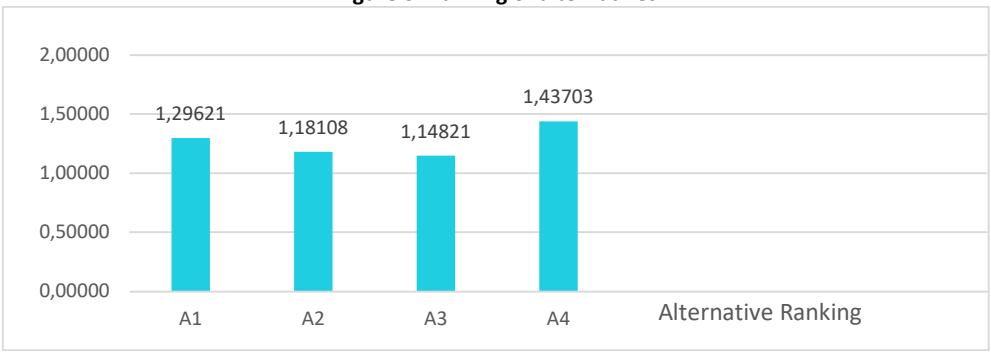
Table 6 and Figure 3 show the ranking of alternatives.

Table 6: Rank

					Rank
Croatia	A1	0.1934	0.4529	0.2594	**1.29621**
Slovenia	A2	0.1934	0.3599	0.1664	**1.18108**
Bosnia and Herzegovina	A3	0.1220	0.2602	0.1382	**1.14821**
Serbia	A4	0.2448	0.6074	0.3626	**1.43703**

Source: Author's calculations

Figure 3: Ranking of alternatives



Source: Author's picture

According to the given criteria and the results of the given multi-criteria decision-making method - AROMA, in terms of trade performance, Serbia is in first place. Croatia is in second place. The third place was taken by Slovenia. Bosnia and Herzegovina took fourth place. Serbian trade is the best positioned in the region. To further continuously improve the performance of trade, Serbia should manage the number and size of companies, shell capital, sales, and added value as efficiently as possible. The function of this is an adequate adaptation to macroeconomic trends in Serbia (gross domestic product growth rate, inflation, interest rate, employment rate, living standard of the population, exchange rate, foreign direct investments, etc.). It is important to implement new business models (multichannel sales - store and electronic, private brand, sale of organic products, etc.). Likewise, new concepts of managing costs, customers, product categories, assets, profits, etc. The digitization of the entire business has a significant role in all of this.
It is recommended that, in addition to classic analysis, as much as possible in the analysis of trade performance, different methods of multi-criteria decision-making are used in an integrated manner, using different criteria (with different weighting coefficients determined by the application of different methods developed for these purposes - sensitive analysis) and alternatives appropriate to the character of trade. In this way, a realistic performance picture of trade is obtained in the function of improvement in the future by applying relevant measures. At the same time, there are no restrictions regarding the availability of quality original empirical data and the international comparison of the obtained results.

Conclusion

The results of numerous empirical studies have shown that the application of various methods of multi-criteria decision-making gives a realistic performance picture of trade. The answer to the question of why is: because they use several criteria whose significance is determined mathematically. This is confirmed by the results of this study. In the specific case, the ranking of trade according to performance based on the AROMAN method is as follows: Serbia, Croatia, Slovenia, and Bosnia and Herzegovina. Serbia's trade is the best positioned in the region. To further continuously improve the performance of trade in Serbia, it is necessary to manage the number and size of companies, human capital, sales, and added value as efficiently as possible, then adequate adaptation to macroeconomic trends, application of new business models and concepts of cost management, customers, product categories, etc., as and the greatest digitization of the entire business.

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