

Comparative Analysis of Trade Performance between the European Union and Serbia using AHP-DNMA Method

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ABSTRACT

This study aims to conduct a comparative analysis of the key performance indicators of trade between the European Union (EU) and Serbia. The AHP-DNMA method is used here. The results are as follows: the trade of France is in the first place. Next: Germany, Spain, Italy, the Netherlands, etc. The trade of the leading countries of the European Union is well positioned for performance. The trade of Croatia is positioned in twenty-second place in terms of performance. Slovenia's trade is positioned in the twenty-third place in terms of performance. The trade performance of Croatia is better than that of Slovenia. According to performance results, she is in twentieth place. It is in a better performance position compared to the trade of Croatia and Slovenia. Adequate control of key factors is a function of achieving target performance.

KEYWORDS: *performance, factors, Serbian trade, AHP-DNMA method.*

JEL CLASSIFICATION: *L81, M31, M41, O32.*

1. INTRODUCTION

Examining the performance of each sector, which means trade, is challenging, current, significant, and complex. When it comes to trade, there is a specific analysis of performance, specific indicators are used, and particular factors act as a consequence of the nature of trade itself (Berman et al., 2018; Levy et al., 2019). The analysis of trade performance is done from different angles. In this study, we will analyse the performance factors of trade between the European Union and Serbia using the AHP and DNMA methods. Recently, in the analysis of trade performance, as in other sectors, in addition to classic financial analysis, strategic profit model, statistical analysis, DEA (Data Envelopment Analysis) models, multi-criteria decision-making methods, and artificial intelligence are increasingly used. Multi-criteria decision-making methods are increasingly used in the analysis of trade performance. They provide more accurate results compared to the classical methodology because they integrate the simultaneous action of several factors (Puška et al., 2022). It is very challenging to investigate the dynamics of efficiency and profitability of all economic sectors, especially trade, based on the strategic profit model, because it indicates the key determinants and measures that should be taken in the control process in the function of improvement. (Berman et al., 2018; Levi et al., 2019; Lovreta & Petković, 2021; Lukić, 2011). It is also important to analyse trade efficiency using DEA (Data Envelopment Analysis) models (Ersoy, 2017).

This study aims to analyze the key performance indicators (C1 - Number of enterprises, C2 - Number of persons employed, C3 - Turnover, C4 - Value added, C5 - Employee benefits expense, and C6 - Gross investment in tangible non-current assets) of trade between the European Union and Serbia as complex as possible. It is based on the primary hypothesis that the permanent analysis of key performance indicators is a prerequisite for the achievement of target performances.

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2. LITERATURE REVIEW

There is a very rich literature devoted to the development and application of DEA models (Andersen and Petersen, 1993; Banker et al., 1984; Chen et al., 2021, Chang & Wang, 2020; Dobrovič et al., 2021; Guo et al., 2020; Lee et al., 2011; Lin et al., 2020; Pendharkar, 2021; Podinovski & Bouzdine-Chameeva, 2021; Rostamzadeh et al., 2021; Tone, 2002). In the case of trade, the components of the strategic profit model (net profit, sales, assets, capital) can be used as input-output elements in DEA models. Because they fully correspond to the very nature of trade and are a good measure of its effect (Berman et al., 2018). In the relevant literature, an increasing number of works are devoted to the specifics of the analysis of the efficiency of trading companies according to the DEA model (Baviera-Puig et al., 2020; Fenives & Tarnoczi, 2020; Ko et al., 2017; Pachar et al., 2021; Shuangian et al., 2018). In the literature in Serbia, significant attention has recently been paid to the application of the DEA model in evaluating the efficiency of trading companies in Serbia (Lukić & Hadrović Zekić, 2019; Lukić et al., 2020; Lukić, 2021, 2022a, b, c, d). Recently, due to its importance, more and more attention is paid to the application of multi-criteria decision-making methods (Clausius, 1865; Ersoy, 2017; Ersoy & 2023; Lukić, 2023a, b, c, d, e, f, g, h, i, k, l, m; Wang & Lee, 2009; Zhang et al., 2014; in the analysis of the positioning of trading companies. All relevant literature in this study serves as a theoretical-methodological and empirical basis for measuring and analysing the trade performance of the European Union and Serbia using the DNMA method (Puška et al., 2022). The basic hypothesis of the research is based on the fact that knowing the real state of trade performance in the European Union and Serbia is a prerequisite for improvement in the future, taking appropriate measures in this direction. There is no doubt that the application of the DNMA method plays a significant role in this. Empirical data from Eurostat statistics were collected to investigate the problem addressed in this study. In this regard, it should be emphasised that there are no restrictions regarding the international comparability of the results because the empirical data were "produced" according to the relevant international standards.

3. METHODOLOGY

In this study, we will analyse key performance indicators using the AHP-DNMA method. In the following, we will present their basic characteristics. Given that the weight coefficients of the criteria when applying the DNMA method are determined using the AHP method, we will briefly refer to its theoretical-methodological and practical characteristics. The Analytical Hierarchy Process (AHP) method proceeds through the following steps, Figure 1 (Saaty, 2008):

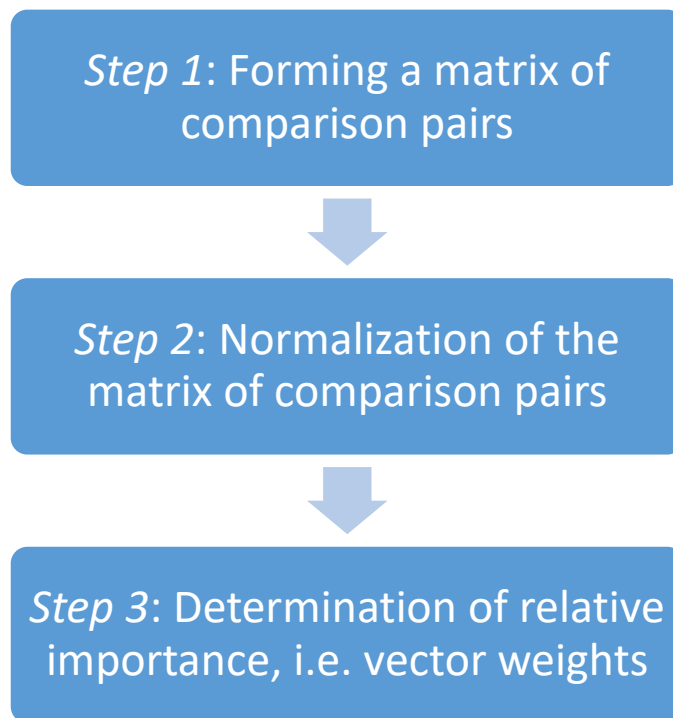


Figure 1. Process steps of the AHP method

Source: Author's diagram

Step 1: Forming a matrix of comparison pairs

$$A = [a_{ij}] = \begin{bmatrix} 1 & a_{12} & \dots & a_{1n} \\ 1/a_{12} & 1 & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ 1/a_{1n} & 1/a_{2n} & \dots & 1 \end{bmatrix} \tag{1}$$

Step 2: Normalization of the matrix of comparison pairs

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

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

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

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

$$CI = \frac{\lambda_{max} - n}{n} \tag{4}$$

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 **DNMA (Double Normalisation-based Multiple Aggregation) method** is a newer method for showing alternatives (Demir, 2022). Two different normalised (linear and vector) techniques are used, as well as three different coupling functions (Complete Compensatory Model - CCM, Uncompensatory Model - UCM, and Incomplete Compensatory Model - ICM). The steps to apply this method are as follows, Figure 2 (Liao & Wu, 2020; Ecer, 2020):

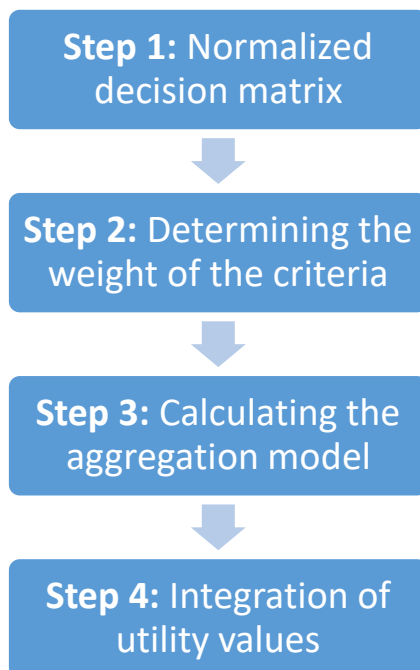


Figure 2. Stages of the DNMA method process

Source: Author's diagram

Step 1: Normalized decision matrix

The elements of the decision matrix are normalized with linear (\hat{x}_{ij}^{1N}) normalization using the following equation:

$$\hat{x}_{ij}^{1N} = 1 - \frac{|x^{ij} - r_j|}{\max\{\max_i x^{ij}, r_j\} - \min\{\min_i x^{ij}, r_j\}} \quad (5)$$

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

$$\hat{x}_{ij}^{2N} = 1 - \frac{|x^{ij} - r_j|}{\sqrt{\sum_{i=1}^m (x^{ij})^2 + (r_j)^2}} \quad (6)$$

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:

$$\sigma_j = \sqrt{\frac{\sum_{i=1}^m \left(\frac{x^{ij}}{\max_i x^{ij}} - \frac{1}{m} \sum_{i=1}^m \left(\frac{x^{ij}}{\max_i x^{ij}} \right) \right)^2}{m}} \tag{7}$$

Step 2.2: Values of the standard deviation calculated for the criteria se normalize with the following equation:

$$w_j^\sigma = \frac{\sigma_j}{\sum_{i=1}^n \sigma_j} \tag{8}$$

Step 2.3: Finally, the weights are adjusted with the following equation:

$$\hat{w}_j = \frac{\sqrt{w_j^\sigma \cdot w_j}}{\sum_{i=1}^n \sqrt{w_j^\sigma \cdot w_j}} \tag{9}$$

Step 3: Calculating the aggregation model

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

The CCM (Complete Compensatory Model) is calculated using the following equation:

$$u_1(a_i) = \sum_{j=1}^n \frac{\hat{w}_j \cdot \hat{x}_{ij}^{1N}}{\max_i \hat{x}_{ij}^{1N}} \tag{10}$$

The UCM (Uncompensatory Model) is calculated using the following equation:

$$u_2(a_i) = \max_j \hat{w}_j \left(\frac{1 - \hat{x}_{ij}^{1N}}{\max_i \hat{x}_{ij}^{1N}} \right) \tag{11}$$

The ICM (Incomplete Compensatory Model) is calculated using the following equation:

$$u_3(a_i) = \prod_{j=1}^n \left(\frac{\hat{x}_{ij}^{2N}}{\max_i \hat{x}_{ij}^{2N}} \right)^{\hat{w}_j} \tag{12}$$

Step 4: Integration of utility values

The calculated utility functions are integrated with the following equation using the Euclidean distance principle:

$$\begin{aligned}
 DN_i = & w_1 \sqrt{\varphi \left(\frac{u_1(a_i)}{\max_i u_1(a_i)} \right)^2 + (1 - \varphi) \left(\frac{m - r_1(a_i) + 1}{m} \right)^2} \\
 & - w_2 \sqrt{\varphi \left(\frac{u_2(a_i)}{\max_i u_2(a_i)} \right)^2 + (1 - \varphi) \left(\frac{r_2(a_i)}{m} \right)^2} \\
 & + w_3 \sqrt{\varphi \left(\frac{u_3(a_i)}{\max_i u_3(a_i)} \right)^2 + (1 - \varphi) \left(\frac{m - r_3(a_i) + 1}{m} \right)^2} \quad (13)
 \end{aligned}$$

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, $r_2(a_i)$ it shows the sequence number in the obtained order according to the increasing value (smaller value first) for the UCM function used. The label φ is the relative importance of the child value used and is in the range $[0,1]$. It is considered that it can be taken as $\varphi = 0.5$. The coefficients w_1, w_2, w_3 are obtained weights of the used functions CCM, UCM, and ICM, respectively. The sum should be equal to $w_1 + w_2 + w_3 = 1$. When determining the weights, if the decision maker attaches importance to a wider range of performance alternatives, he can set a higher value for w_1 . In case the decision maker is not willing to take risks, i.e., 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.

4. RESULTS AND DISCUSSION

When analysing trade performance, the key issue is the choice of criteria. The correct choice of criteria significantly affects the accuracy of the obtained empirical results. The criteria chosen in this study are the key performance indicators of trade according to Eurostat statistics. These are:

- C1 - Number of enterprises,
- C2 - Number of persons employed,
- C3 - Turnover,
- C4 - Value added,
- C5 - Employee benefits expense, and
- C6 - Gross investment in tangible non-current assets.

These criteria fully reflect the nature of trade. And they are nothing but performance factors. Their adequate control enables the achievement of target performances. The alternatives in this study are the member states of the European Union and Serbia. Table 1 shows the key performance indicators of trade between the European Union and Serbia for 2021.

Table 1. Key indicators, Wholesale and retail trade; repair of motor vehicles and motorcycles, EU, 2021

	Number of enterprises (thousands)	Number of persons employed (thousands)	Turnover (€ million)	Value added (€ million)	Employee benefits expense (€ million)	Gross investment in tangible non-current assets (€ million)
E U	5 860.8	29 490.9	9 855 923.8	1 507 694.9	813 220.4	162 000.0
Belgium	144.0	643.8	507055.3	59759.0	27501.4	12574.6
Bulgaria	132.7	506.0	81850.5	8105.9	3776.2	1402.1
Czechia	226.6	739.9	197555.3	22131.7	12038.7	3994.9
Denmark	40.7	469.5	215036.7	32711.6	21843.5	2352.7
Germany	537.8	6366.5	2292162.9	437073.7	211920.1	38491.9
Estonia	20.3	98.3	32381.7	3296.6	854.3	446.6
Ireland	48.4	383.0	193935.3	27740.5	13080.7	3175.1
Greece	223.9	801.0	123524.7	15803.6	9181.0	1553.6
Spain	729.3	3080.6	840794.3	127556.4	77791.9	13136.9
France	714.6	3658.3	1485733.3	224385.9	153077.2	28281.2
Croatia	35.8	242.6	40988.3	6102.3	3424.0	817.9
Italy	1033.9	3400.1	1082397.0	163140.4	77224.1	11567.2
Cyprus	17.0	73.5	14598.3	2498.6	1385.5	266.9
Latvia	24.6	147.0	34920.8	3737.4	1912.0	390.2
Lithuania	57.0	242.9	49523.3	6755.8	3295.9	987.0
Luxembourg	7.6	54.5	94938.5	6364.7	2763.7	526.9
Hungary	146.0	596.7	119571.3	14918.1	7014.0	2626.7
Malta	10.1	40.9	8527.3	1288.3	680.8	0.0
Netherlands	290.1	1598.7	829874.5	111987.7	53607.0	8743.4
Austria	93.2	709.4	279666.9	43928.1	27262.9	4998.1
Poland	543.2	2423.5	489430.2	61292.9	29130.4	8323.0
Portugal	215.7	798.5	155141.3	21696.9	13450.3	3469.6
Romania	270.5	1005.9	150955.8	24362.2	9234.2	5451.8
Slovenia	25.7	121.7	40607.6	5618.5	3031.8	641.2
Slovakia	100.6	324.9	65837.9	8393.3	4581.0	1595.4
Finland	55.6	271.1	128514.7	16501.7	11583.8	1840.3
Sweden	116.0	692.2	300400.3	50543.2	31574.3	4079.7
Serbia	70.0	391.1	47864.5	5793.4	3072.3	693.7

Source: Eurostat (online data code: sbs_ovw_act).

In this study, the weighting coefficients were calculated using the AHP method. Table 2 shows the weighting coefficients of the criteria.

Table 2. Weight coefficients of criteria

		1	2	3	4	5	6	WEIGHTS	
		C1	C2	C3	C4	C5	C6		
1	C1	1.00	1.00	1.50	2.00	1.00	1.00	0.1896	
2	C2	1.00	1.00	2.00	2.50	2.00	1.00	0.2368	
3	C3	0.67	0.50	1.00	2.00	1.00	1.00	0.1493	
4	C4	0.50	0.40	0.50	1.00	1.00	2.00	0.1296	
5	C5	1.00	0.50	1.00	1.00	1.00	2.00	0.1600	
6	C6	1.00	1.00	1.00	0.50	0.50	1.00	0.1347	
								1.0000	
								Consistency Ratio	0.0565

Source: Author's calculation

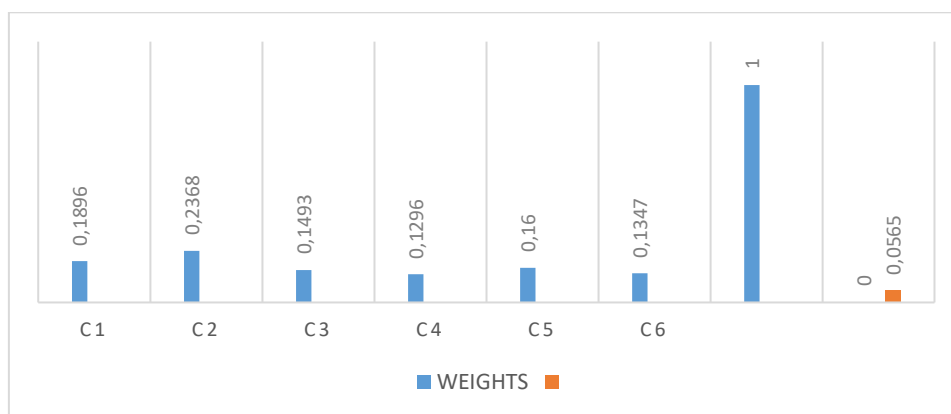


Figure 1. Ranking of criteria according to character

Source: Author's picture

So, in this particular case, the most important criterion is C2 - the number of employees. By improving the management of human resources (training, flexible employment, remuneration, career advancement, social, and health protection), it is possible, therefore, to a large extent to influence the achievement of the target performance of trade in the European Union and Serbia.

In this study, for analysis (selection and ranking) of the trade performance of the European Union and Serbia, the DNMA method was applied. The following tables (3-9) and Figure 2 show the calculations by stages and the final results obtained using this method. (All calculations and results are the author's.)

Table 3. Initial Matrix

INITIAL MATRIX	KIND	1	1	1	1	-1	1
	Weight	0.1896	0.2368	0.1493	0.1296	0.1600	0.1347
		C1	C2	C3	C4	C5	C6
A1		144	643.8	507055.3	59759	27501.4	12574.6
A2		132.7	506	81850.5	8105.9	3776.2	1402.1
A3		226.6	739.9	197555.3	22131.7	12038.7	3994.9
A4		40.7	469.5	215036.7	32711.6	21843.5	2352.7
A5		537.8	6366.5	2292162.9	437073.7	211920.1	38491.9
A6		20.3	98.3	32381.7	3296.6	854.3	446.6
A7		48.4	383	193935.3	27740.5	13080.7	3175.1
A8		223.9	801	123524.7	15803.6	9181	1553.6
A9		729.3	3080.6	840794.3	127556.4	77791.9	13136.9
A10		714.6	3658.3	1485733.3	224385.9	153077.2	28281.2
A11		35.8	242.6	40988.3	6102.3	3424	817.9
A12		1033.9	3400.1	1082397	163140.4	77224.1	11567.2
A13		17	73.5	14598.3	2498.6	1385.5	266.9
A14		24.6	147	34920.8	3737.4	1912	390.2
A15		57	242.9	49523.3	6755.8	3295.9	987
A16		7.6	54.5	94938.5	6364.7	2763.7	526.9
A17		146	596.7	119571.3	14918.1	7014	2626.7
A18		10.1	40.9	8527.3	1288.3	680.8	0
A19		290.1	1598.7	829874.5	111987.7	53607	8743.4
A20		93.2	709.4	279666.9	43928.1	27262.9	4998.1
A21		543.2	2423.5	489430.2	61292.9	29130.4	8323
A22		215.7	798.5	155141.3	21696.9	13450.3	3469.6
A23		270.5	1005.9	150955.8	24362.2	9234.2	5451.8

INITIAL MATRIX	KIND	1	1	1	1	-1	1
	Weight	0.1896	0.2368	0.1493	0.1296	0.1600	0.1347
		C1	C2	C3	C4	C5	C6
	A24	25.7	121.7	40607.6	5618.5	3031.8	641.2
	A25	100.6	324.9	65837.9	8393.3	4581	1595.4
	A26	55.6	271.1	128514.7	16501.7	11583.8	1840.3
	A27	116	692.2	300400.3	50543.2	31574.3	4079.7
	A28	70	391.1	47864.5	5793.4	3072.3	693.7
	MAX	1033.9000	6366.5000	2292162.9000	437073.7000	211920.1000	38491.9000
	MIN	7.6000	40.9000	8527.3000	1288.3000	680.8000	0.0000

Source: Author's calculation

Table 4. Linear Normalization Matrix

Linear Normalization MATRIX		C1	C2	C3	C4	C5	C6	MAX
	A1	0.1329	0.0953	0.2183	0.1342	0.8730	0.3267	0.8730
A2	0.1219	0.0735	0.0321	0.0156	0.9853	0.0364	0.9853	
A3	0.2134	0.1105	0.0828	0.0478	0.9462	0.1038	0.9462	
A4	0.0323	0.0678	0.0904	0.0721	0.8998	0.0611	0.8998	
A5	0.5166	1.0000	1.0000	1.0000	0.0000	1.0000	1.0000	
A6	0.0124	0.0091	0.0104	0.0046	0.9992	0.0116	0.9992	
A7	0.0398	0.0541	0.0812	0.0607	0.9413	0.0825	0.9413	
A8	0.2108	0.1202	0.0504	0.0333	0.9598	0.0404	0.9598	
A9	0.7032	0.4805	0.3644	0.2897	0.6350	0.3413	0.7032	
A10	0.6889	0.5719	0.6469	0.5119	0.2786	0.7347	0.7347	
A11	0.0275	0.0319	0.0142	0.0110	0.9870	0.0212	0.9870	
A12	1.0000	0.5310	0.4702	0.3714	0.6376	0.3005	1.0000	
A13	0.0092	0.0052	0.0027	0.0028	0.9967	0.0069	0.9967	
A14	0.0166	0.0168	0.0116	0.0056	0.9942	0.0101	0.9942	
A15	0.0481	0.0319	0.0180	0.0125	0.9876	0.0256	0.9876	
A16	0.0000	0.0021	0.0378	0.0116	0.9901	0.0137	0.9901	
A17	0.1349	0.0879	0.0486	0.0313	0.9700	0.0682	0.9700	
A18	0.0024	0.0000	0.0000	0.0000	1.0000	0.0000	1.0000	
A19	0.2753	0.2463	0.3597	0.2540	0.7494	0.2271	0.7494	
A20	0.0834	0.1057	0.1187	0.0978	0.8742	0.1298	0.8742	
A21	0.5219	0.3767	0.2106	0.1377	0.8653	0.2162	0.8653	
A22	0.2028	0.1198	0.0642	0.0468	0.9395	0.0901	0.9395	
A23	0.2562	0.1526	0.0624	0.0529	0.9595	0.1416	0.9595	
A24	0.0176	0.0128	0.0140	0.0099	0.9889	0.0167	0.9889	
A25	0.0906	0.0449	0.0251	0.0163	0.9815	0.0414	0.9815	
A26	0.0468	0.0364	0.0525	0.0349	0.9484	0.0478	0.9484	
A27	0.1056	0.1030	0.1278	0.1130	0.8538	0.1060	0.8538	
A28	0.0608	0.0554	0.0172	0.0103	0.9887	0.0180	0.9887	

Source: Author's calculation

Table 5. Vector Normalization Matrix

Vector Normalization MATRIX		C1	C2	C3	C4	C5	C6	MAX
	A1	0.5648	0.4974	0.5564	0.4686	0.9096	0.6140	0.9096
A2	0.5592	0.4853	0.4507	0.3959	0.9896	0.4476	0.9896	
A3	0.6052	0.5058	0.4795	0.4156	0.9617	0.4862	0.9617	
A4	0.5142	0.4821	0.4838	0.4305	0.9287	0.4618	0.9287	
A5	0.7574	1.0000	1.0000	1.0000	0.2879	1.0000	1.0000	
A6	0.5043	0.4495	0.4385	0.3891	0.9994	0.4334	0.9994	
A7	0.5180	0.4745	0.4786	0.4235	0.9582	0.4740	0.9582	
A8	0.6038	0.5112	0.4611	0.4067	0.9713	0.4499	0.9713	
A9	0.8510	0.7114	0.6393	0.5641	0.7401	0.6224	0.8510	
A10	0.8438	0.7622	0.7996	0.7005	0.4863	0.8479	0.8479	
A11	0.5119	0.4622	0.4406	0.3930	0.9908	0.4389	0.9908	
A12	1.0000	0.7395	0.6994	0.6142	0.7420	0.5990	1.0000	
A13	0.5027	0.4473	0.4340	0.3880	0.9976	0.4307	0.9976	
A14	0.5064	0.4538	0.4391	0.3897	0.9958	0.4326	0.9958	
A15	0.5222	0.4622	0.4427	0.3939	0.9912	0.4414	0.9912	
A16	0.4981	0.4457	0.4540	0.3934	0.9930	0.4346	0.9930	
A17	0.5657	0.4933	0.4601	0.4054	0.9787	0.4659	0.9787	
A18	0.4993	0.4445	0.4325	0.3862	1.0000	0.0000	1.0000	
A19	0.6362	0.5813	0.6366	0.5422	0.8216	0.5570	0.8216	
A20	0.5399	0.5032	0.4999	0.4463	0.9104	0.5012	0.9104	
A21	0.7600	0.6537	0.5520	0.4708	0.9041	0.5507	0.9041	
A22	0.5998	0.5110	0.4690	0.4150	0.9570	0.4784	0.9570	
A23	0.6266	0.5292	0.4679	0.4187	0.9712	0.5079	0.9712	
A24	0.5069	0.4516	0.4405	0.3923	0.9921	0.4363	0.9921	
A25	0.5435	0.4694	0.4468	0.3963	0.9869	0.4505	0.9869	
A26	0.5215	0.4647	0.4623	0.4077	0.9632	0.4542	0.9632	
A27	0.5511	0.5017	0.5051	0.4556	0.8959	0.4875	0.8959	
A28	0.5286	0.4752	0.4423	0.3926	0.9919	0.4371	0.9919	
Adj Wj	0.1875	0.1990	0.1582	0.1417	0.1642	0.1494		

Source: Author's calculation

Table 6. CCM (Complete Compensatory Model)

CCM (Complete Compensatory Model)	u1(ai)	C1	C2	C3	C4	C5	C6	SUM
A1	0.0286	0.0217	0.0395	0.0218	0.1642	0.0559	0.3317	
A2	0.0232	0.0149	0.0052	0.0022	0.1642	0.0055	0.2151	
A3	0.0423	0.0232	0.0138	0.0072	0.1642	0.0164	0.2671	
A4	0.0067	0.0150	0.0159	0.0114	0.1642	0.0101	0.2233	
A5	0.0969	0.1990	0.1582	0.1417	0.0000	0.1494	0.7452	
A6	0.0023	0.0018	0.0017	0.0007	0.1642	0.0017	0.1723	
A7	0.0079	0.0114	0.0136	0.0091	0.1642	0.0131	0.2194	
A8	0.0412	0.0249	0.0083	0.0049	0.1642	0.0063	0.2498	
A9	0.1875	0.1360	0.0820	0.0584	0.1482	0.0725	0.6847	
A10	0.1758	0.1549	0.1392	0.0987	0.0622	0.1494	0.7804	
A11	0.0052	0.0064	0.0023	0.0016	0.1642	0.0032	0.1829	
A12	0.1875	0.1057	0.0744	0.0526	0.1047	0.0449	0.5698	
A13	0.0017	0.0010	0.0004	0.0004	0.1642	0.0010	0.1688	
A14	0.0031	0.0034	0.0018	0.0008	0.1642	0.0015	0.1748	
A15	0.0091	0.0064	0.0029	0.0018	0.1642	0.0039	0.1883	
A16	0.0000	0.0004	0.0060	0.0017	0.1642	0.0021	0.1744	

CCM (Complete Compensatory Model)	u1(ai)	C1	C2	C3	C4	C5	C6	SUM
A1	0.0286	0.0217	0.0395	0.0218	0.1642	0.0559	0.3317	
A2	0.0232	0.0149	0.0052	0.0022	0.1642	0.0055	0.2151	
A3	0.0423	0.0232	0.0138	0.0072	0.1642	0.0164	0.2671	
A17	0.0261	0.0180	0.0079	0.0046	0.1642	0.0105	0.2313	
A18	0.0005	0.0000	0.0000	0.0000	0.1642	0.0000	0.1646	
A19	0.0689	0.0654	0.0759	0.0480	0.1642	0.0453	0.4677	
A20	0.0179	0.0241	0.0215	0.0159	0.1642	0.0222	0.2657	
A21	0.1131	0.0866	0.0385	0.0225	0.1642	0.0373	0.4623	
A22	0.0405	0.0254	0.0108	0.0071	0.1642	0.0143	0.2622	
A23	0.0501	0.0316	0.0103	0.0078	0.1642	0.0221	0.2860	
A24	0.0033	0.0026	0.0022	0.0014	0.1642	0.0025	0.1763	
A25	0.0173	0.0091	0.0040	0.0024	0.1642	0.0063	0.2033	
A26	0.0092	0.0076	0.0088	0.0052	0.1642	0.0075	0.2026	
A27	0.0232	0.0240	0.0237	0.0188	0.1642	0.0185	0.2723	
A28	0.0115	0.0111	0.0028	0.0015	0.1642	0.0027	0.1938	

Source: Author's calculation

Table 7. UCM (Uncompensatory Model)

UCM (Uncompensatory Model)	u2(ai)	C1	C2	C3	C4	C5	C6	MAX
A1	0.1590	0.1773	0.1186	0.1199	0.0000	0.0935	0.1773	
A2	0.1643	0.1842	0.1530	0.1395	0.0000	0.1439	0.1842	
A3	0.1453	0.1758	0.1443	0.1345	0.0000	0.1330	0.1758	
A4	0.1808	0.1841	0.1423	0.1304	0.0000	0.1392	0.1841	
A5	0.0907	0.0000	0.0000	0.0000	0.1642	0.0000	0.1642	
A6	0.1852	0.1972	0.1565	0.1411	0.0000	0.1477	0.1972	
A7	0.1796	0.1876	0.1445	0.1326	0.0000	0.1363	0.1876	
A8	0.1464	0.1741	0.1499	0.1368	0.0000	0.1431	0.1741	
A9	0.0000	0.0630	0.0762	0.0833	0.0159	0.0769	0.0833	
A10	0.0117	0.0441	0.0189	0.0430	0.1019	0.0000	0.1019	
A11	0.1823	0.1926	0.1559	0.1401	0.0000	0.1462	0.1926	
A12	0.0000	0.0933	0.0838	0.0891	0.0595	0.1045	0.1045	
A13	0.1858	0.1980	0.1577	0.1413	0.0000	0.1483	0.1980	
A14	0.1844	0.1957	0.1563	0.1409	0.0000	0.1479	0.1957	
A15	0.1784	0.1926	0.1553	0.1399	0.0000	0.1455	0.1926	
A16	0.1875	0.1986	0.1521	0.1400	0.0000	0.1473	0.1986	
A17	0.1615	0.1810	0.1502	0.1371	0.0000	0.1389	0.1810	
A18	0.1871	0.1990	0.1582	0.1417	0.0000	0.0000	0.1990	
A19	0.1187	0.1336	0.0823	0.0937	0.0000	0.1041	0.1336	
A20	0.1697	0.1750	0.1367	0.1258	0.0000	0.1272	0.1750	
A21	0.0744	0.1124	0.1197	0.1192	0.0000	0.1121	0.1197	
A22	0.1471	0.1737	0.1473	0.1346	0.0000	0.1351	0.1737	
A23	0.1375	0.1674	0.1479	0.1339	0.0000	0.1273	0.1674	
A24	0.1842	0.1965	0.1559	0.1403	0.0000	0.1469	0.1965	
A25	0.1702	0.1899	0.1541	0.1394	0.0000	0.1431	0.1899	
A26	0.1783	0.1914	0.1494	0.1365	0.0000	0.1419	0.1914	
A27	0.1643	0.1750	0.1345	0.1229	0.0000	0.1308	0.1750	
A28	0.1760	0.1879	0.1554	0.1402	0.0000	0.1467	0.1879	

Source: Author's calculation

Table 8. ICM (Incomplete Compensatory Model)

ICM (Incomplete Compensatory Model)	u3(ai)	C1	C2	C3	C4	C5	C6	MAX
	A1	0.9145	0.8868	0.9252	0.9103	1.0000	0.9430	0.6441
A2	0.8985	0.8678	0.8831	0.8782	1.0000	0.8882	0.5371	
A3	0.9168	0.8800	0.8958	0.8879	1.0000	0.9031	0.5795	
A4	0.8951	0.8777	0.9020	0.8968	1.0000	0.9009	0.5725	
A5	0.9492	1.0000	1.0000	1.0000	0.8151	1.0000	0.7737	
A6	0.8796	0.8530	0.8778	0.8749	1.0000	0.8827	0.5086	
A7	0.8911	0.8695	0.8960	0.8907	1.0000	0.9002	0.5566	
A8	0.9147	0.8801	0.8888	0.8839	1.0000	0.8914	0.5638	
A9	1.0000	0.9650	0.9558	0.9434	0.9773	0.9543	0.8115	
A10	0.9991	0.9790	0.9908	0.9733	0.9128	1.0000	0.8609	
A11	0.8835	0.8592	0.8797	0.8772	1.0000	0.8855	0.5187	
A12	1.0000	0.9417	0.9450	0.9333	0.9522	0.9263	0.7325	
A13	0.8794	0.8524	0.8767	0.8747	1.0000	0.8821	0.5070	
A14	0.8809	0.8552	0.8785	0.8755	1.0000	0.8829	0.5115	
A15	0.8868	0.8591	0.8803	0.8774	1.0000	0.8862	0.5215	
A16	0.8786	0.8526	0.8836	0.8770	1.0000	0.8839	0.5131	
A17	0.9023	0.8725	0.8875	0.8826	1.0000	0.8950	0.5520	
A18	0.8779	0.8509	0.8759	0.8739	1.0000	0.0000	0.0000	
A19	0.9532	0.9334	0.9605	0.9428	1.0000	0.9436	0.7602	
A20	0.9067	0.8887	0.9095	0.9039	1.0000	0.9147	0.6059	
A21	0.9680	0.9375	0.9249	0.9117	1.0000	0.9286	0.7106	
A22	0.9161	0.8826	0.8933	0.8883	1.0000	0.9016	0.5785	
A23	0.9211	0.8862	0.8909	0.8876	1.0000	0.9077	0.5859	
A24	0.8817	0.8550	0.8795	0.8768	1.0000	0.8845	0.5142	
A25	0.8942	0.8625	0.8822	0.8787	1.0000	0.8895	0.5318	
A26	0.8913	0.8649	0.8904	0.8853	1.0000	0.8938	0.5431	
A27	0.9129	0.8910	0.9133	0.9086	1.0000	0.9131	0.6164	
A28	0.8886	0.8637	0.8801	0.8769	1.0000	0.8848	0.5241	

Source: Author's calculation

Table 9. Results

											w1	w2	w3	
											0.6	0.1	0.3	
		CCM		φ	UCM		φ	ICM		φ	Utility Values		Rank Order	
		u1(ai)	Rank	0.5	u2(ai)	Rank	0.5	u3(ai)	Rank	0.5				
Belgium	A1	0.3317	7	0.6317	0.1773	13	0.7103	0.6441	7	0.7672	0.6802	0.6802	7	
Bulgaria	A2	0.2151	17	0.3603	0.1842	16	0.7690	0.5371	18	0.5213	0.4495	0.4495	17	
Czechia	A3	0.2671	10	0.5374	0.1758	12	0.6942	0.5795	11	0.6582	0.5893	0.5893	10	
Denmark	A4	0.2233	15	0.4073	0.1841	15	0.7557	0.5725	13	0.6200	0.5060	0.5060	14	
Germany	A5	0.7452	2	0.9596	0.1642	6	0.6025	0.7737	3	0.9138	0.9102	0.9102	2	
Estonia	A6	0.1723	26	0.1736	0.1972	25	0.9432	0.5086	26	0.4245	0.3258	0.3258	26	
Ireland	A7	0.2194	16	0.3838	0.1876	17	0.7928	0.5566	15	0.5779	0.4829	0.4829	16	
Greece	A8	0.2498	13	0.4631	0.1741	19	0.6590	0.5638	14	0.5983	0.5233	0.5233	13	
Spain	A9	0.6847	3	0.9033	0.0833	1	0.2971	0.8115	2	0.9535	0.8578	0.8578	3	
France	A10	0.7804	1	1.0000	0.1019	2	0.3656	0.8609	1	1.0000	0.9366	0.9366	1	
Croatia	A11	0.1829	22	0.2423	0.1926	22	0.8814	0.5187	22	0.4613	0.3719	0.3719	22	
Italy	A12	0.5698	4	0.8156	0.1045	3	0.3789	0.7325	5	0.8540	0.7834	0.7834	4	

											w1	w2	w3	
											0.6	0.1	0.3	
		CCM		ϕ	UCM		ϕ	ICM		ϕ	Utility Values			Rank Order
		u1(ai)	Rank	0.5	u2(ai)	Rank	0.5	u3(ai)	Rank	0.5				
Cyprus	A13	0.1688	27	0.1610	0.1980	26	0.9623	0.5070	27	0.4195	0.3187	0.3187		27
Latvia	A14	0.1748	24	0.2026	0.1957	23	0.9059	0.5115	25	0.4321	0.3418	0.3418		25
Lithuania	A15	0.1883	21	0.2644	0.1926	21	0.8657	0.5215	21	0.4736	0.3873	0.3873		21
Luxembourg	A16	0.1744	25	0.1875	0.1986	27	0.9812	0.5131	24	0.4399	0.3426	0.3426		24
Hungary	A17	0.2313	14	0.4329	0.1810	14	0.7338	0.5520	16	0.5598	0.5011	0.5011		15
Malta	A18	0.1646	28	0.1513	0.1990	28	1.0000	0.0000	28	0.0253	0.1983	0.1983		28
Netherlands	A19	0.4677	5	0.7395	0.1336	5	0.4913	0.7602	4	0.8880	0.7592	0.7592		5
Austria	A20	0.2657	11	0.5144	0.1750	10	0.6710	0.6059	9	0.7091	0.5884	0.5884		11
Poland	A21	0.4623	6	0.7161	0.1197	4	0.4369	0.7106	6	0.8234	0.7204	0.7204		6
Portugal	A22	0.2622	12	0.4907	0.1737	8	0.6492	0.5785	12	0.6404	0.5514	0.5514		12
Romania	A23	0.2860	8	0.5903	0.1674	7	0.6204	0.5859	10	0.6796	0.6201	0.6201		9
Slovenia	A24	0.1763	23	0.2202	0.1965	24	0.9244	0.5142	23	0.4487	0.3591	0.3591		23
Slovakia	A25	0.2033	18	0.3333	0.1899	19	0.8280	0.5318	19	0.5045	0.4341	0.4341		18
Finland	A26	0.2026	19	0.3122	0.1914	20	0.8470	0.5431	17	0.5393	0.4338	0.4338		19
Sweden	A27	0.2723	9	0.5621	0.1750	11	0.6811	0.6164	8	0.7332	0.6253	0.6253		8
Serbia	A28	0.1938	20	0.2872	0.1879	18	0.8076	0.5241	20	0.4868	0.3991	0.3991		20
	MAX	0.7804			0.1990			0.8609						

Source: Author's calculation

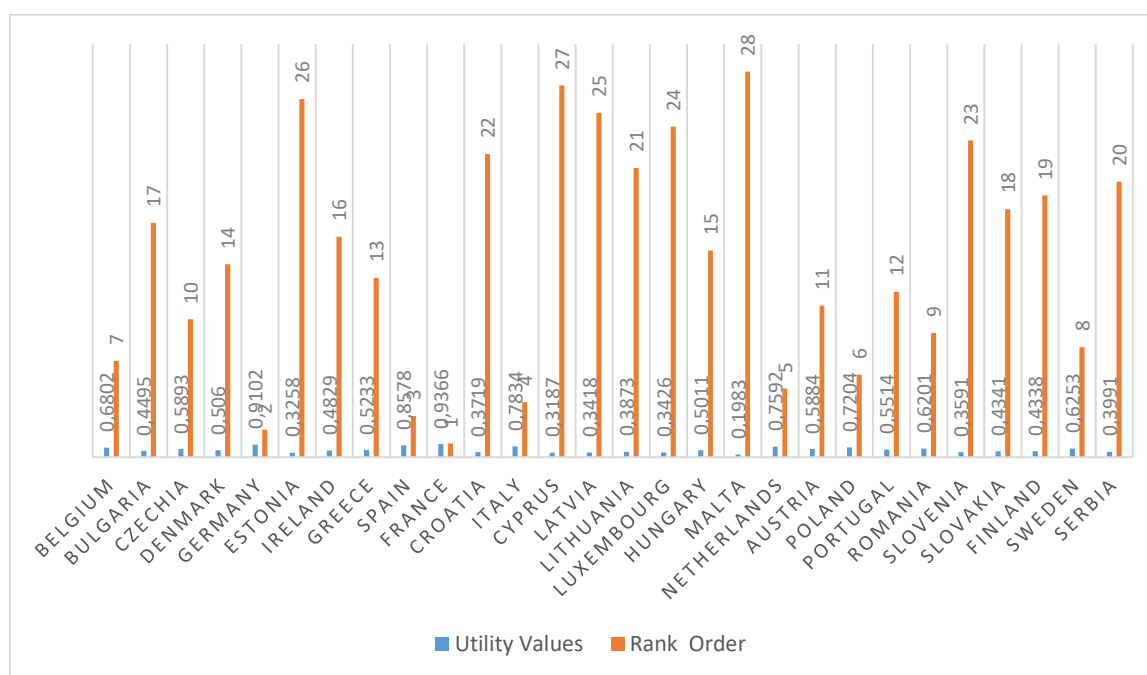


Figure 2. Ranking of the countries of the European Union and Serbia

Source: Author's picture

Analysis of the key performance indicators of trade between the European Union and Serbia using the AHP-DNMA method showed that, in terms of performance results, the trade of France is in first place. Next: Germany, Spain, Italy, the Netherlands, etc. Therefore, the trade of the leading countries of the European Union is well positioned for performance. In the specific case, of all the observed countries, Malta's trade is in the last performance place (twenty-eighth position). The trade of Croatia is positioned in twenty-second place in terms of performance. Slovenia's trade is positioned in the twenty-third place in terms of performance.

The trade performance of Croatia is better than that of Slovenia. As far as Serbia's trade is concerned, according to performance results, it is in the twentieth place. It is in a better performance position compared to the trade of Croatia and Slovenia. Determinants of the displayed performance positioning of the trade of the countries of the European Union and Serbia are the number of companies, the number of employees, turnover, added value, benefit costs of employees, and investments in tangible non-current assets. The target performance position of the trade of the countries of the European Union and Serbia can be achieved to a large extent by adequate control of the given statistical variables. This certainly applies to other relevant factors, including the digitisation of the entire business, as well as innovation and artificial intelligence.

In the literature, as far as we know, no similar studies are using different multi-criteria decision-making methods. This limits the possibility of comparing the results of this study with the results of other studies. Therefore, it is recommended that in the future, similar research be carried out using different multi-criteria decision-making methods. Based on this, it is possible to better understand the real performance of the trade of the countries of the European Union and Serbia in terms of improvement in the future by applying adequate measures.

5. CONCLUSIONS

In this study, the key performance indicators of the trade of the countries of the European Union and Serbia are comparatively analysed. They are taken as criteria in the AHP-DNMA model. By their nature, they are nothing more than key factors in the trade performance of the countries of the European Union and Serbia. Better control of them can influence the achievement of the target performance of trade in the land of the European Union and Serbia.

In terms of classical analysis, the application of the AHP-DNMA model enables an integrated analysis of the influence of key factors on the trade performance of the countries of the European Union and Serbia, based on a mathematical approach. Therefore, the final results are more realistic. The function of all this is to improve the trade performance of the countries of the European Union and Serbia through adequate control of key factors (the number of companies, the number of employees, turnover, added value, benefit costs of employees, and investments in tangible non-current assets). Given the above, it is recommended that, in addition to classical analysis, multi-criteria decision-making methods are increasingly applied in the analysis of the trade performance of the countries of the European Union and Serbia in the future.

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