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):

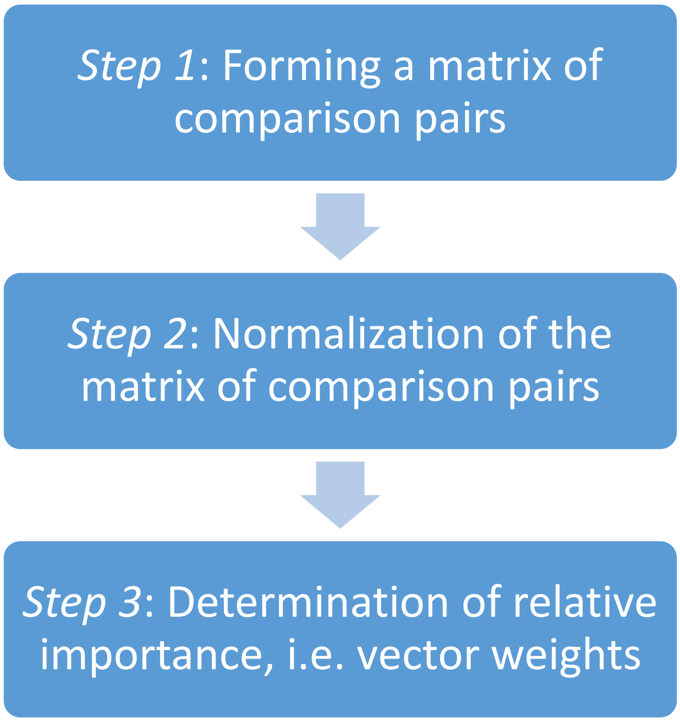

Figure 1. Process steps of the AHP method
Source: Author's diagram

Step 1: Forming a matrix of comparison pairs

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

Step 2: Normalization of the matrix of comparison pairs

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

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

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

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):

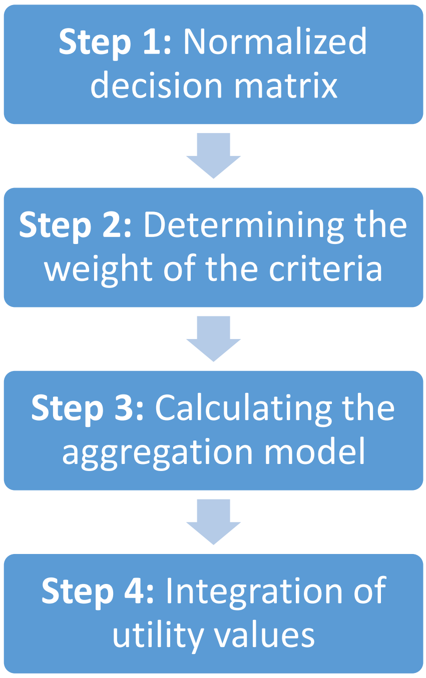

Figure 2. Stages of the DNMA method process
Source: Author's diagram

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

$$\hat{x}_{ij}^{1N} = 1 - \frac{\left|x^{ij} - r_j\right|}{max\left\{\max_i x^{ij}, r_j\right\} - min\left\{\min_i x^{ij}, r_j\right\}} \tag{5}$$

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

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

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 $\left(\sigma_j\right)$for the criterion $c_j$is determined with the following equation where *m* is the number of alternatives:

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

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

$$w_j^{\sigma} = \frac{\sigma_j}{\sum_{i=1}^{n}\sigma_j} \quad (8)$$

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

$$\hat{w}_j = \frac{\sqrt{w_j^{\sigma}.w_j}}{\sum_{i=1}^{n}\sqrt{w_j^{\sigma}.w_j}} \quad (9)$$

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:

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

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

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

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

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

Step 4: Integration of utility values
The calculated utility functions are integrated with the following equation using the Euclidean distance principle:

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

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 $\varphi$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

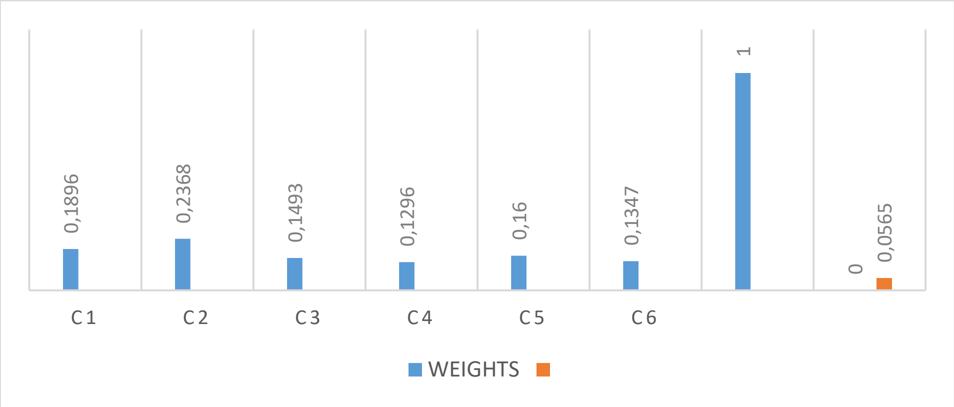

Figure 1. Ranking of criteria according to character
Source: Author's picture

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)

	u3(ai)	C1	C2	C3	C4	C5	C6	MAX
ICM (Incomplete Compensatory Model)	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	9	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

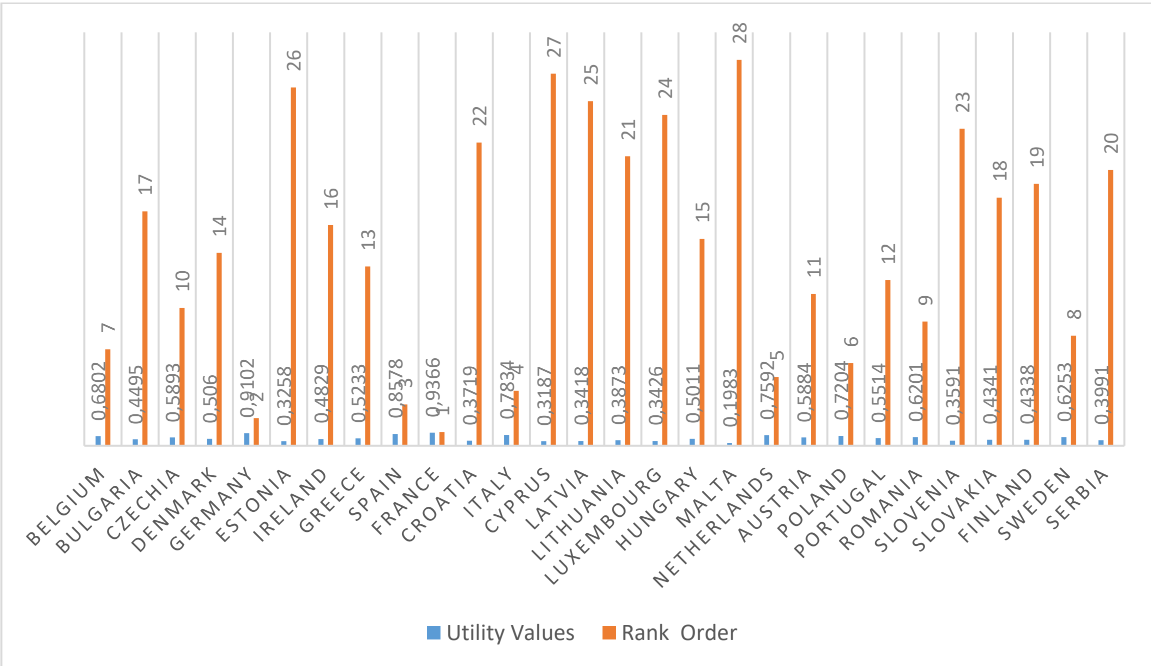

Figure 2. Ranking of the countries of the European Union and Serbia
Source: Author's picture

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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