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PREGLEDNI NAUČNI RAD / OVERVIEW SCIENTIFIC PAPER

APPLICATION OF THE COPRAS METHOD IN THE EVALUATION OF TRADE EFFICIENCY IN SERBIA

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Abstract: *The issue of the evaluation of trade efficiency based on multi-criteria analysis is very current, complex and significant. It provides a basis for improving, by applying adequate measures, the efficiency of trade in the future. With this in mind, this paper analyzes the efficiency of Serbian trade based on the COPRAS method. The obtained results of the empirical research of trade efficiency in Serbia using the COPRAS method show that it was best in 2020. Recently, the efficiency of trade in Serbia has been continuously increasing. This was positively influenced by numerous factors: economic climate, living standard, employment, inflow of foreign direct investment (global retail chains), modern concepts of cost and business management, digitalization of all business, electronic sales. The negative impact of the Covid-19 corona virus pandemic on trade efficiency in Serbia is negligible (compared to other economic activities, for example, Tourism and hospitality), and is partially offset by increased online sales.*

Key words: *efficiency; Serbian trade; accounting analysis; determinants; COPRAS method.*

JEL classification*: L81; M21; M41; M49.*

INTRODUCTION

The importance of the evaluation of trade efficiency based on multi-criteria analysis is growing. Stemming from that, the subject of this research is to analyze the trade efficiency in Serbia according to the COPRAS method. The goal and purpose here is to address this issue with the highest complexity possible both qualitatively and quantitatively. Gaining knowledge about the real situation in terms of trade efficiency in Serbia in this manner will serve as a starting point for improvement in the future, appropriate measures being included. This, among other things, reflects the scientific and professional contribution of this paper.

The basic hypothesis of the research of the treated problem in this paper is continuous analysis based on a multicriteria approach as a prerequisite for improvement (according to the established real situation), taking adequate measures, and applying trade efficiency in the future, especially in the case of Serbia. The COPRAS method plays and important role here.

The research methodology of the given hypothesis is based on the application of the COPRAS method. In order to make the analysis of the treated problem as complex as possible in this paper, statistical analysis is used to some extent.

For the purposes of researching the problem treated in this paper in accordance with the defined hypothesis and the application of the given methodology, empirical data was collected from the Business Registers Agency of the Republic of Serbia. They have been "manufactured" in accordance with the relevant international standards, so there are no restrictions in terms of international comparison.

LITERATURE OVERVIEW AND METHODOLOGY

Recently, more and more literature has been dedicated to the evaluation of trade efficiency based on multicriteria analysis (Saaty, 2008; Ersoy, 2017; Gaur, Agarwal, & Anshu, 2020; Lukic, 2019; Lukic, Hadrovic Zekic, & Crnjac Milic, 2020; Lukic, 2020; Lukic, Vojteski Kljenak, & Anđelić, 2020; Lukić, 2021; Berman, Evans, & Chatterjee, 2018; Levy, Weitz, & Grewal, 2019, Račić, Nikić & Nikić, 2021). In this context, the application of the COPRAS method also plays a significant role. In the literature of Serbia, there is, as far as we know, no complete work dedicated to the evaluation of trade efficiency in Serbia using the COPRAS method. This gap should be filled to some extent by this paper, and this, among other things, reflects his scientific and professional contribution.

The COPRAS (COmplex PRoportional ASsessment) method was developed by Zavadaskas et al. (Zavadskas, Kaklauskas, Turskis, & Tamošaitien, 2008). In this method, the influence of maximizing and minimizing criteria on the evaluation of the results is observed separately.

The choice of the best alternative is based on the simultaneous consideration of the ideal and anti-ideal solution (Burinskiene & Daskevic, 2014; Mardani, Jusoh, MD Nor, Khalifah, Zakwan, & Valipour, 2015; Çakir & Karabiyik, 2017; Alinezhad & Khalili, 2019; Sałabun, Wątróbski, & Shekhovtsov, 2020; Durmus & İnel, 2020; Baloyi & Meyer, 2020). The procedure of the COPRAS method takes place through several steps (Chatterjee, Athawale, & Chakraborty, 2011; Madic, Markovic, Petrovic, & Radovanovic, 2014).

The COPRAS Method

The research methodology of the given hypothesis is based on the application of the COPRAS method. The procedure of the COPRAS method takes place through several steps:

Step 1: Determining the initial decision matrix *X*.

$$X = [x_{ij}]_{mxn} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

Where x_{ij} is the estimated value of the *i* alternative in relation to the *j* criterion, *m* is the number of alternatives and *n* is the number of criteria.

Step 2: Normalizing the decision matrix using the following equation:

$$R = [r_{ij}]_{mxn} = {}^{x_{ij}}\Big/_{\sum_{i=1}^{m} x_{ij}} \quad (2)$$

Step 3: Determining of the weight-normalized decision matrix, D, using the following equation:

$$D = [y_{ij}]_{mxn} = r_{ij}.w_j, i = 1, \dots, m, j = 1, \dots, n \quad (3)$$

Where r_{ij} is the normalized performance value of the *i* alternative in relation to the *j* criterion, and *w* is the weight of the *j* criterion.

The sum of weight-normalized values of the criteria is equal to the weight:

$$\sum_{i=1}^{m} y_{ij} = w_j \quad (4)$$

Step 4: In this phase we determine the sum of weight-normalized values for beneficial (income) and non-benefit (cost) criteria by using the following equation:

$$S_{+i} = \sum_{j=1}^{n} y_{+ij}, S_{-i} = \sum_{j=1}^{n} y_{-ij} \quad (5)$$

Where y_{+ij} and y_{-ij} are, respectively, weight-normalized values of beneficial and non-benefit criteria.

Step 5: Determining the relative importance of the alternative Q_i, using the following equation:

$$Q_i = S_{+i} + \frac{S_{-min} \cdot \sum_{i=1}^{m} S_{-i}}{S_{-i} \cdot \sum_{i=1}^{m} \left({}^{S_{-min}}\Big/_{S_{-i}} \right)}, i = 1, \dots, m \quad (6)$$

Where S_{-min} is the minimum value of S_{-i}.

Step 6: Calculation of the quantitative utility, U_i, for the *i* alternative using the following equation:

$$U_i = \frac{Q_i}{Q_{max}} .100\% \qquad (7)$$

Where Q_{max} is the maximum relatively significant value.

As a consequence of equation 6, the utility values of competing alternatives range from 0% to 100%. Based on the list of utility rankings of alternatives, their competitiveness, ie. Position, is determined.

The higher the value of U_i, the higher the priority of the alternative.

The Analytic Hierarchy Process (AHP) Method

Considering the weights of the criteria in the application of the COPRAS method are determined using the AHP method, we will briefly look at its theoretical and methodological characteristics.

The Analytic Hierarchy Process (AHP) Method takes place through the following steps (Saaty, 2008):

Step 1: Forming a matrix of comparison pairs

$$A = [a_{ij}] = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \qquad (8)$$

Step 2: Normalizing the matrix of comparison pairs

$$a_{ij}^* = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}}, i, j = 1, \ldots, n \qquad (9)$$

Step 3: Determining the relative importance, ie. Vector weight

$$w_i = \frac{\sum_{i=1}^{n} a_{ij}^*}{n}, i, j = 1, \ldots, n \qquad (10)$$

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

$$CI = \frac{\lambda_{max} - n}{n} \qquad (11)$$

If CI < 0,1 the estimated values of the coefficients a_{ij} are consistent, and the deviation λ_{max} from *n* is negligible. This means, in other words, that the AHP method

accepts an inconsistency of less than 10%. The consistency ratio CR = CI / RI can be calculated using the consistency index, where RI is a random index.

EMPIRICAL EVIDENCE

While measuring trade efficiency is Serbia based on the COPRAS method, the following criteria was used: C1 – number of employees, C2 – employee earnings, C3 – assets, C4 – capital, C5 – sales and C6 – net profit. Alternative years observed: A1 – 2013, A2 – 2014, A3 – 2015, A4 – 2016, A5 – 2017, A6 – 2018, A7 – 2019. and A8 – 2020.

Table 1. Initial data for Serbian trade

	Number of Employees	Employee earnings	Assets	Capital	Sales	Net profit
2013	193210	151978	2160474	746992	2891518	89730
2014	191621	154833	2157564	761305	2594602	86955
2015	159621	164718	2197931	805009	2731999	95265
2016	206092	180367	2324843	859749	3009651	105238
2017	208020	194924	2375290	920992	3172393	122727
2018	219373	218410	2524897	1007972	3361094	121816
2019	222049	238022	2682931	1073056	3608329	139409
2020	227618	262322	2837599	1183026	3664505	171010

Note: data is shown in millions of RSD. Number of employees is shown as a whole number.

Source: The Serbian Business Registers Agency (SBRA), Annual Bulletin of Financial Statements for 2014, 2016, 2018. and 2020.

RESULTS AND DISCUSSION

The calculation was performed using the software program COPRAS Software - Excel, and the results obtained are shown in the tables below, as well as graphically.

Table 2. Statistics of the initial data

Statistics							
		1 Number of employees	2 Employee earnings	3 Assets	4 Capital	5 Sales	6 Net profit
N	Valid	8	8	8	8	8	8
	Missing	0	0	0	0	0	0
Std. Error of Mean		7765.75139	14344.42335	89632.96460	55471.58315	139264.95990	10115.84043
Median		207056.0000	187645.5000	2350066.5000	890370.5000	3091022.0000	113527.0000
Std. Deviation		21964.86187	40572.15608	253520.30840	156897.33040	393900.79000	28611.91747
Variance		482455156.900	1646099849.000	64272546750.000	24616772290.000	155157832400.000	818641821.100
Skewness		-1.119	.565	.717	.576	.141	.960
Std. Error of Skewness		.752	.752	.752	.752	.752	.752
Kurtosis		1.355	-1.028	-.773	-.869	-1.373	.519
Std. Error of Kurtosis		1.481	1.481	1.481	1.481	1.481	1.481
Range		67997.00	110344.00	680035.00	436034.00	1069903.00	84055.00
Minimum		159621.00	151978.00	2157564.00	746992.00	2594602.00	86955.00
Maximum		227618.00	262322.00	2837599.00	1183026.00	3664505.00	171010.00

Friedman Test

Ranks	
	Mean Rank
1 Number of employees	2.63
2 Employee earnings	2.38
3 Assets	5.00
4 Capital	4.00
5 Sales	6.00
6 Net profit	1.00

Test Statistics

N	8
Chi-Square	38.929
df	5
Asymp. Sig.	.000
a. Friedman Test	

Source: Author's calculation (using the SPSS software program)

All observed variables have lately been above average. This has had a positive effect on the efficiency of trade in Serbia. As Asimp. Sig. = 0.000 <0.05, the hypothesis that the differences between the variables (measurements) are equal to zero is rejected, ie. the differences between them are statistically significant.

Table 3. Correlation matrix of the initial data

Correlations							
		1	**2**	**3**	**4**	**5**	**6**
1 Number of Employees	Pearson Correlation	1	.802*	.813*	.793*	.852**	.769*
	Sig. (2-tailed)		.017	.014	.019	.007	.026
	N	8	8	8	8	8	8
2 Employee earnings	Pearson Correlation	.802*	1	.997**	.999**	.961**	.975**
	Sig. (2-tailed)	.017		.000	.000	.000	.000
	N	8	8	8	8	8	8
3 Assets	Pearson Correlation	.813*	.997**	1	.995**	.963**	.976**
	Sig. (2-tailed)	.014	.000		.000	.000	.000
	N	8	8	8	8	8	8
4 Capital	Pearson Correlation	.793*	.999**	.995**	1	.956**	.979**
	Sig. (2-tailed)	.019	.000	.000		.000	.000
	N	8	8	8	8	8	8
5 Sales	Pearson Correlation	.852**	.961**	.963**	.956**	1	.933**
	Sig. (2-tailed)	.007	.000	.000	.000		.001
	N	8	8	8	8	8	8
6 Net profit	Pearson Correlation	.769*	.975**	.976**	.979**	.933**	1
	Sig. (2-tailed)	.026	.000	.000	.000	.001	
	N	8	8	8	8	8	8

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Author's calculation (using the SPSS software program)

The correlation matrix shows that there is a positive strong correlation between the observed variables at the level of statistical significance.

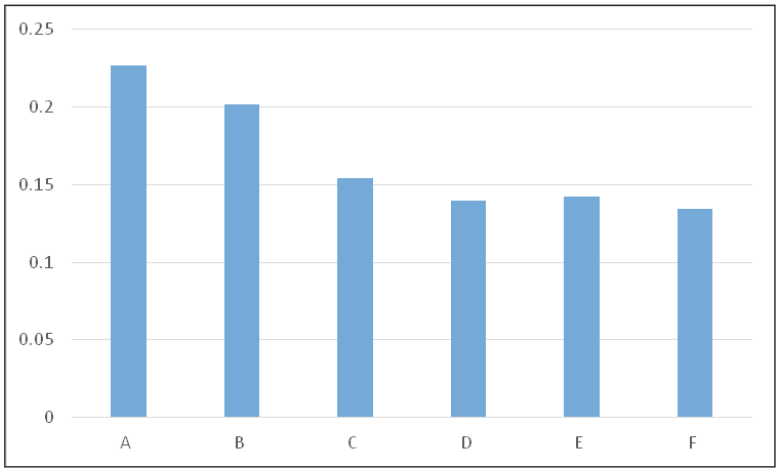
Weight coefficients were calculated using the AHP (Analytical Hierarchical Process) method (Saaty, 2008).

Table 4. Weight coefficients of the criteria

AHP With Arirthmetic Mean Method							
Initial Comparisons Matrix							
	A	**B**	**C**	**D**	**E**	**F**	
A – Number of Employees	1	2	3	1	1	1	
B – Employee earnings	0.5	1	1	2	1	3	
C - Assets	0.333333	1	1	1	2	1	
D - Capital	1	0.5	1	1	1	1	
E - Sales	1	1	0.5	1	1	1	
F – Net profit	1	0.333333	1	1	1	1	
SUM	4.83333	5.83333	7.5	7	7	8	
Normalized Matrix							
	A	**B**	**C**	**D**	**E**	**F**	**Weight of Criteria**
A – Number of Employees	0.2069	0.3429	0.4000	0.1429	0.1429	0.1250	0.2267
B – Employee earnings	0.1034	0.1714	0.1333	0.2857	0.1429	0.3750	0.2020
C - Assets	0.0690	0.1714	0.1333	0.1429	0.2857	0.1250	0.1545
D - Capital	0.2069	0.0857	0.1333	0.1429	0.1429	0.1250	0.1394
E - Sales	0.2069	0.1714	0.0667	0.1429	0.1429	0.1250	0.1426
F – Net profit	0.2069	0.0571	0.1333	0.1429	0.1429	0.1250	0.1347
						SUM	1
Consistency Ratio							
0.0762							
COMPARE WITH 0.1; IT SHOULD BE LESS THAN 0.1.							

Source: Author's calculation (using by AHP Software-Excel)

Graph 1. Weight coefficients of criteria



Source: Authors

In terms of the significance of the observed criteria, the Number of Employees is in the first place. It is followed by: Employee earnings, Assets, Sales, Capital and Net profit.

This means that efficient management of human capital (through training, flexible employment, adequate reward system, etc.) can, among other things, significantly increase the efficiency of trade in Serbia.

In order to achieve the target efficiency of trade in Serbia, it is also necessary to manage assets, capital, sales and profits as efficiently as possible (Berman, Evans, & Chatterjee, 2018; Levy, Weitz, & Grewal, 2019).

Table 5. Initial matrix

Initial Matrix						
Weights of criteria	0.2267	0.202	0.1545	0.1394	0.1426	0.1347
Kind of criteria	1	-1	1	1	1	1
	C1	C2	C3	C4	C5	C6
A1	193210	151978	2160474	746992	2891518	89730
A2	191621	154833	2157564	761305	2594602	86955
A3	159621	164718	2197931	805009	2731999	95265
A4	206092	180367	2324843	859749	3009651	105238
A5	208020	194924	2375290	920992	3172393	122727
A6	219373	218410	2524897	1007972	3361094	121816
A7	222049	238022	2682931	1073056	3608329	139409
A8	227618	262322	2837599	1183026	3664505	171010
SUM	1627604	1565574	19261529	7358101	25034091	932150

Source: Authors

Table 6. Normalized matrix

NormalizedMatrix						
Weights of criteria	0.2267	0.202	0.1545	0.1394	0.1426	0.1347
Kind of criteria	1	-1	1	1	1	1
	C1	C2	C3	C4	C5	C6
A1	0.1187	0.0971	0.1122	0.1015	0.1155	0.0963
A2	0.1177	0.0989	0.1120	0.1035	0.1036	0.0933
A3	0.0981	0.1052	0.1141	0.1094	0.1091	0.1022
A4	0.1266	0.1152	0.1207	0.1168	0.1202	0.1129
A5	0.1278	0.1245	0.1233	0.1252	0.1267	0.1317
A6	0.1348	0.1395	0.1311	0.1370	0.1343	0.1307
A7	0.1364	0.1520	0.1393	0.1458	0.1441	0.1496
A8	0.1398	0.1676	0.1473	0.1608	0.1464	0.1835

Source: Authors

Table 7. Weighted normalized decision matrix

Weighted Normalized Matrix						
Kind of criteria	1	-1	1	1	1	1
	C1	C2	C3	C4	C5	C6
A1	0.0269	0.0196	0.0173	0.0142	0.0165	0.0130
A2	0.0267	0.0200	0.0173	0.0144	0.0148	0.0126
A3	0.0222	0.0213	0.0176	0.0153	0.0156	0.0138
A4	0.0287	0.0233	0.0186	0.0163	0.0171	0.0152
A5	0.0290	0.0252	0.0191	0.0174	0.0181	0.0177
A6	0.0306	0.0282	0.0203	0.0191	0.0191	0.0176
A7	0.0309	0.0307	0.0215	0.0203	0.0206	0.0201
A8	0.0317	0.0338	0.0228	0.0224	0.0209	0.0247

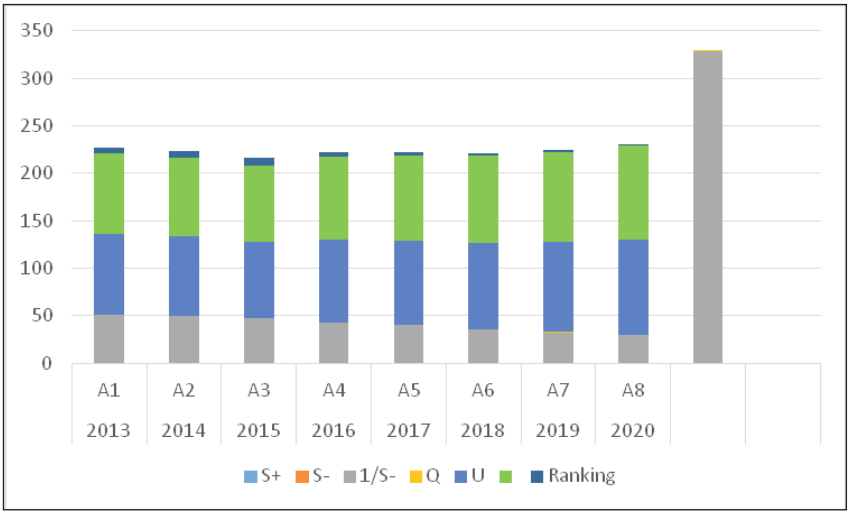
Source: Authors

Table 8. Raking alternatives

	Alternatives	S+	S-	1/S-	Q	U		Ranking
2013	A1	0.0878	0.0196	50.9966	0.1192	84.76	84.76	6
2014	A2	0.0858	0.0200	50.0563	0.1166	82.88	82.88	7
2015	A3	0.0844	0.0213	47.0523	0.1134	80.62	80.62	8
2016	A4	0.0960	0.0233	42.9700	0.1224	87.05	87.05	5
2017	A5	0.1013	0.0252	39.7610	0.1257	89.41	89.41	4
2018	A6	0.1067	0.0282	35.4854	0.1285	91.36	91.36	3
2019	A7	0.1135	0.0307	32.5616	0.1335	94.93	94.93	2
2020	A8	0.1225	0.0338	29.5452	0.1406	100.00	100.00	1
			0.2020	328.4284	0.1406			
			SUM	SUM	MAX			

Source: Authors

Graph 2. Ranking alternatives



Source: Authors

Based on the obtained results of the empirical research on the efficiency of trade in Serbia using the COPRAS method, it can be stated that it was at its best in 2020, followed by: 2019, 2018, 2017, 2016, 2013, 2014 and 2015.

The negative direct impact of the Covid-19 corona virus pandemic on the efficiency of trade in Serbia is negligible and is greatly mitigated with increased electronic sales. This is also indicated by the dynamics of monthly retail sales in the European Union and Serbia, as well as data on retail sales via the Internet in EU member states. Recently, as the results of empirical research using the COPRAS method show, the efficiency of trade in Serbia has been continuously increasing. This was positively influenced by numerous factors of macro and micro nature, such as: economic climate,

living standard, employment, inflow of foreign direct investment (global retail chains), modern concepts of cost, revenue and profit management, new business models, digitalization of business as a whole.

CONCLUSION

In terms of the significance of the observed criteria, the Number of employees is in the first place. It is followed by: Employee earnings, Assets, Sales, Capital and Net profit. This implies that, among other things, efficient management of human capital can significantly increase the efficiency of trade in Serbia. Based on the obtained results of the empirical research on the efficiency of trade in Serbia using the COPRAS method, it can be stated that it was at its best in 2020, followed by: 2019, 2018, 2017, 2016, 2013, 2014 and 2015. It is characteristic that, given the nature of the business, the negative impact of the Covid-19 corona virus pandemic on the efficiency of trade in Serbia was not significantly felt. It has been greatly mitigated with increased electronic sales. Generally speaking, the efficiency of trade in Serbia has been continuously increasing lately. This was positively influenced by numerous factors: economic climate, living standard, employment, inflow of foreign direct investment (global retail chains), modern business management concepts, digitalization of the entire business, electronic sales. Their efficient control can significantly influence the improvement of trade efficiency in Serbia. In order to achieve the targeted efficiency of trade in Serbia in the future, it is necessary to more efficiently manage human resources, assets, capital, sales and profits.

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