Application of MABAC Method in Evaluation of Sector Efficiency in Serbia

Radojko LUKIC[1]

Abstract

In recent times, as is well known, various methods of multi-criteria analysis are increasingly used in order to more accurately evaluate the efficiency of companies from all economic sectors. One of them is the MABAC method. Having this in mind, this paper analyzes the sectoral efficiency in Serbia on the basis of this method. The obtained results of the research of sectoral efficiency in Serbia on the basis of the MABAC method show to be in the first place in terms of efficiency of wholesale and retail trade, repair of motor vehicles and motorcycles. The following are: manufacturing, other activities, construction, electricity, gas, steam and air conditioning supply, information and communication, agriculture, forestry and fishing, transport and storage, mining, financial and insurance activities, accommodation and food services and water supply. The very nature of them significantly influences their positioning in terms of efficiency, especially in the conditions of the Covid-19 virus coronary virus. The impact of the Covid-19 coronary virus pandemic on the efficiency of wholesale and retail trade, repair of motor vehicles and motorcycles, for example, is negligible. It has been greatly mitigated with increased electronic sales. In contrast, transport and storage, banks and food and accommodation services have significantly felt the negative effect of the Covid-19 coronary virus pandemic on efficiency.

Keywords: efficiency, determinants, sector analysis, Serbia, MABAC method

JEL classification: L11, L13, L25, L81, M21
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1. Introduction

Recently, in order to more realistically evaluate the efficiency of companies, various methods of multi-criteria analysis have been developed (Mathew, 2018; Timiryanova, 2020; Okwu, 2020; Singh, 2020; Pachar, 2021; Brezović, 2021; Tsai, 2021). One of them is the MABAC method (Pamučar, 2015; Božanić, 2016; Boyanic, 2019, 2020; Işik, 2020; Nedeljković, 2021). In this paper, as a subject of research, a sectoral efficiency analysis in Serbia is performed on the basis of the MABAC method. The goal and purpose of that is to determine the most realistic situation as a basis and precondition for taking appropriate measures in the function of improving sectoral efficiency in Serbia in the future.

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In the world, an increasingly rich literature is dedicated to the analysis of company efficiency based on various methods of multi-criteria analysis (Ersoy, 2017). This is also the case with the literature in Serbia (Lukic, 2010, 2011a, b, 2018, 2019, b, 2020a, b, c, d, e, 2021 a, b). However, in the literature of Serbia, as far as we know, there is not a single complete work dedicated to the evaluation of sectoral efficiency using the MABAC method. This paper fills that gap to some extent. This, among other things, reflects his scientific and professional contribution.

The research hypothesis in this paper is that the continuous evaluation of sectoral efficiency (in the specific case of Serbia) in order to determine the most realistic situation is the starting point and precondition for improvement in the future by taking appropriate measures.

The application of various methods of multi-criteria analysis, including the MABAC method, plays a significant role in this. It provides an overview of the more realistic situation in terms of sectoral efficiency in Serbia. Based on that, appropriate measures can be taken in the function of improving the sectoral efficiency of Serbia in the future.

For the purposes of researching the problem treated in this paper (i.e. sectoral efficiency of Serbia), empirical data were obtained from the Business Registers Agency of the Republic of Serbia. The data is "produced" in accordance with relevant international standards. Given this, there are no restrictions on international comparability.

2. MABAC method

MABAC (Multi-Attributive Border Approximation area Comparison) is a newer method of multi-criteria decision making developed by Pamučar and Čirović (2015). The main feature of this method is in defining the distance of the criterion function of each observed alternative from the limit approximate value. The mathematical formulation of the MABAC method consists of the following steps (Pamučar, 2015):

Step 1: Forming the initial decision matrix (*X*).

In this phase, *m* alternatives are evaluated according to *n* criteria. Alternatives are represented by vectors $A_i = (x_{i1}, x_{i2}, ..., x_{in})$, where x_{ij} value of the *i*-th alternative according to the *j*-th criterion ($I = 1, 2, ..., m; j = 1, 2, ..., n$).

$$= \begin{matrix} A_1 \\ A_2 \\ \cdots \\ A_m \end{matrix} \begin{matrix} \begin{matrix} C_1 & C_2 & \cdots & C_n \end{matrix} \\ \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \end{matrix} \quad (1)$$

where *m* is the total number of alternatives, *n* is the total number of criteria.

Step 2: Normalize the elements of the initial matrix (*X*).

$$N = \begin{matrix} A_1 \\ A_2 \\ \cdots \\ A_m \end{matrix} \begin{matrix} \begin{matrix} C_1 & C_2 & \ldots & C_n \end{matrix} \\ \begin{bmatrix} n_{11} & n_{12} & \ldots & n_{1n} \\ n_{21} & n_{22} & \ldots & n_{2n} \\ \cdots & \cdots & \ldots & \cdots \\ n_{m1} & n_{m2} & \ldots & n_{mn} \end{bmatrix} \end{matrix} \quad (2)$$

The elements of the normalized matrix (*N*) are obtained using the following equations:

a) For beneficial (income) types of criteria (high value of criteria is preferred)

$$n_{ij} = \frac{x_{ij} - x_i^-}{x_i^+ - x_i^-} \qquad (3)$$

b) For cost types of criteria (lower value of criteria is preferred)

$$n_{ij} = \frac{x_{ij} - x_i^+}{x_i^- - x_i^+} \qquad (4)$$

where x_{ij}, x_i^+ and x_i^-, and the elements of the initial decision matrix (*X*), where they are x_i^+ and x_i^- defined as:

$x_i^+ = max(x_1, x_2, \ldots, x_m)$ and represent the maximum values of the observed criterion by alternatives.

$x_i^- = \min(x_1, x_2, \ldots, x_m)$ and represents the minimum values of the observed criterion by alternatives.

Step 3: Calculation of weight matrix elements (*V*).

The elements of the weight matrix (*V*) are calculated as follows:

$$V_{ij} = w_i g(n_{ij} + 1) \qquad (5)$$

where the n_{ij} elements of the normalized matrix (*N*) are the w_i weighting coefficients of the criteria.

Based on the previous equation, the following weight matrix V is obtained

$$V = \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1n} \\ v_{21} & v_{22} & \cdots & v_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ v_{m1} & v_{m2} & \ldots & v_{mn} \end{bmatrix}$$

$$= \begin{bmatrix} w_1 g(n_{11}+1) & w_2 g(n_{12}+1) & \ldots & w_n g(n_{1n}+1) \\ w_1 g(n_{21}+1) & w_2 g(n_{22}+1) & \ldots & w_n g(n_{2n}+1) \\ \cdots & \cdots & \cdots & \cdots \\ w_1 g(n_{m1}+1) & w_2 g(n_{m2}+1) & \ldots & w_n g(n_{mn}+1) \end{bmatrix} \quad (6)$$

where *n* is the total number of criteria, *m* is the total number of alternatives.

Step 4: Determining the matrix of boundary approximate areas (*G*).

The cut-off approximate range (BAA) for each criterion is determined according to the following expression:

$$g_i = \left(\prod_{j=1}^{m} v_{ij} \right)^{1/m} \quad (7)$$

where are the v_{ij} elements of the weight matrix (*V*), *m* the total number of alternatives.

After calculating the value of g_i for each criterion, a matrix of boundary approximate areas (*G*) of the format *n*+1 is formed (*n* represents the total number of criteria according to which the offered alternatives are selected):

$$G = \begin{matrix} C_1 & C_2 & \ldots & C_n \end{matrix} \\ \begin{bmatrix} g_1 & g_2 & \cdots & g_n \end{bmatrix} \quad (8)$$

Step 5: Calculation of the elements of the alternative distance matrix from the boundary approximate domain (*Q*).

$$Q = \begin{bmatrix} q_{11} & q_{12} & \cdots & q_{1n} \\ q_{21} & q_{22} & \cdots & q_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ q_{m1} & q_{m2} & \ldots & q_{mn} \end{bmatrix} \quad (9)$$

The distance of the alternatives from the boundary approximate domain (q_{ij}) is determined as the difference between the elements of the weight matrix (*V*) and the values of the boundary approximate domains (*G*).

$$Q = V - G = \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1n} \\ v_{21} & v_{22} & \cdots & v_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ v_{m1} & v_{m2} & \ldots & v_{mn} \end{bmatrix} - \begin{bmatrix} q_1 & q_2 & \cdots & q_n \\ q_1 & q_2 & \cdots & q_n \\ \cdots & \cdots & \cdots & \cdots \\ q_1 & q_2 & \ldots & q_n \end{bmatrix} \quad (10)$$

$$Q\begin{bmatrix} v_{11}-g_1 & v_{12}-g_2 & \cdots & v_{1n}-g_n \\ v_{21}-g_1 & v_{22}-g_2 & \cdots & v_{2n}-g_n \\ \cdots & \cdots & \cdots & \cdots \\ v_{m1}-g_1 & v_{m2}-g_2 & \ldots & v_{mn}-g_n \end{bmatrix} - \begin{bmatrix} q_{11} & q_{12} & \cdots & q_{1n} \\ q_{21} & q_{22} & \cdots & q_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ q_{m1} & q_{m2} & \ldots & q_{mn} \end{bmatrix} \quad (11)$$

where g_i the boundary approximate area for criterion C_i, v_{ij} the elements of the weight matrix (V), n is the number of criteria, m is the number of alternatives.

Alternative A_i may belong to the boundary approximate region (G), the upper approximate region (G^+) or the lower approximate region (G^-), i.e. $A_i \in \{G \vee G^+ \vee G^-\}$. The upper approximate region (G^+) is the region in which the ideal alternative (A^+) is located and the lower approximate region is the region in which the anti-ideal alternative (A^-) is located (Figure 1).

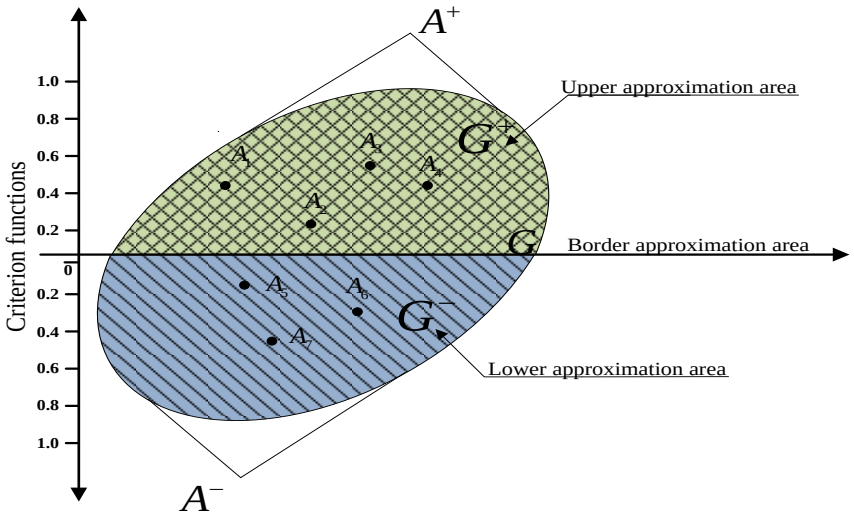

Figure 1. Representation of the upper (G^+), lower (G^-) and approximate areas
Source: Pamučar, 2015

The affiliation of alternative A_i approximate domain (G, G^+ or G^-) is determined on the basis of the following equation:

$$A_i \in \begin{cases} G^+ & if \quad q_{ij} > 0 \\ G & if \quad q_{ij} = 0 \\ G^- & if \quad q_{ij} < 0 \end{cases} \quad (12)$$

In order for alternative A_i to be chosen as the best from the set, it is necessary that it belongs to the upper approximate area (G^+) according to as many criteria as possible. If, for example, alternatives A_i as per 5 criteria (out of the 6 criteria) is from above the approximate area, and one criterion as belonging to the approximate area of (G^-), it indicates, in other words that after the 5 criteria alternative close to or equal

to an ideal alternative to, while by one criterion it is close to or equal to the anti-ideal alternative. If the value of $q_{ij} > 0$, i.e. $q_{ij} \in G^+$, then alternative A_i is close to or equal to the ideal alternative. However, if $q_{ij} < 0$, i.e. $q_{ij} \in G^-$, then alternative A_i is close to or equal to the anti-ideal alternative (Pamučar, 2015).

Step 6: Ranking the alternatives.

The calculation of the values of the criterion functions by alternatives (13) was obtained as the sum of the distances of the alternatives from the boundary approximate areas (q). By summing the elements of the matrix Q by rows, the final values of the criterion functions of the alternatives are obtained:

$$S_i = \sum_{j=1}^{n} q_{ij} \;\; j = 1, 2, \dots, n \;\;\; i = 1, 2, \dots, m \quad (13)$$

where n is the number of criteria, m is the number of alternatives.

3. The place and role and financial performance of the sector in Serbia

As part of the sectoral analysis of Serbia, we will present, in order to investigate the treatment problem in this paper, the place and role of individual sectors and their financial performance.

Table 1 shows the initial data for the purposes of sectoral analysis in Serbia for 2020.

Initial sector analysis in Serbia

Table 1

Sector	Number of enterprises	Number of employees	Business assets	Capital	Business revenues	Net result
Agriculture, forestry and fishing	3976	30541	888940	563131	369368	9712
Mining	377	25352	656975	362891	294832	1163
Manufacturing industry	17381	391855	3705443	1729272	3158961	130894
Construction	9323	81546	2190864	835491	1046519	58484
Electricity, gas, steam and air conditioning supply	865	38392	1859015	1136128	626316	26166
Water supply	871	36386	350258	192292	15639	1667
Wholesale and retail trade, repair of motor vehicles and motorcycles	32107	227618	2837599	1183026	4013414	134859
Traffic and storage	6883	101935	1235617	568686	621873	-11539

Sector	Number of enterprises	Number of employees	Business assets	Capital	Business revenues	Net result
Accommodation and catering services	4485	31986	24675	106585	79266	-9183
Information and communication	6387	62769	867325	368860	538191	44921
Financial and insurance activities	816	4596	381854	209989	19499	2307
Other activities	22640	184978	2179680	773099	917096	44069
Total - Serbian economy	106111	1217954	17178245	8029450	11700974	433520

Note: Absolute amounts of data are expressed in millions of dinars. The number of companies and the number of employees is expressed in whole numbers
Source: Agency for Business Registers of the Republic of Serbia

Table 2 shows the statistics of the initial data.

Statistics

Table 2

Statistics							
		Number of enterprises	Number of employees	Business assets	Capital	Business revenues	Net result
N	Valid	12	12	12	12	12	12
	Missing	0	0	0	0	0	0
Mean		8842.5833	101496.1667	1431520.4170	669120.8333	975081.1667	36126.6667
Median		5436.0000	50580.5000	1062278.5000	565908.5000	580032.0000	17939.0000
Std. Deviation		10093.01869	113761.12360	1126863.25300	486590.53360	1276084.49700	50492.86183
Minimum		377.00	4596.00	24675.00	106585.00	15639.00	-11539.00
Maximum		32107.00	391855.00	3705443.00	1729272.00	4013414.00	134859.00

Note: Author's calculation using the SPSS software program

It is noticeable that the sectors of transport and storage and accommodation and food services achieved a net result far below the average (i.e. negative). They are, due to their business nature and prohibited movements from the tannery, significantly affected by the pandemic corona virus a Covid-19.

Table 3 shows the correlation matrix of the initial data.

Correlation matrix

Table 3

Correlation							
		1	2	3	4	5	6
1 Number of enterprises	Pearson Correlation	1	.771 **	.748 **	.607 *	.854 **	.811 **
	Sig. (2-tailed)		.003	.005	.036	.000	.001
	N	12	12	12	12	12	12
2 Number of employees	Pearson Correlation	.771 **	1	.884 **	.830 **	.853 **	.849 **
	Sig. (2-tailed)	.003		.000	.001	.000	.000
	N	12	12	12	12	12	12
3 Business assets	Pearson Correlation	.748 **	.884 **	1	.963 **	.858 **	.887 **
	Sig. (2-tailed)	.005	.000		.000	.000	.000
	N	12	12	12	12	12	12
4 Capital	Pearson Correlation	.607 *	.830 **	.963 **	1	.814 **	.830 **
	Sig. (2-tailed)	.036	.001	.000		.001	.001
	N	12	12	12	12	12	12
5 Business revenues	Pearson Correlation	.854 **	.853 **	.858 **	.814 **	1	.946 **
	Sig. (2-tailed)	.000	.000	.000	.001		.000
	N	12	12	12	12	12	12
6 Net result	Pearson Correlation	.811 **	.849 **	.887 **	.830 **	.946 **	1
	Sig. (2-tailed)	.001	.000	.000	.001	.000	
	N	12	12	12	12	12	12
**. Correlation is significant at the 0.01 level (2-tailed).							
*. Correlation is significant at the 0.05 level (2-tailed).							

Note: Author's calculation using the SPSS software program

Correlation analysis shows that there is a strong correlation between the observed statistical variables (as criteria) at the level of statistical significance (Sig. <.05).

Table 4 shows the nonparametric test.

Nonparametric test

Table 4

NPar Tests	
Friedman Test	
Ranks	
	Mean Rank
1 Number of enterprises	1.17
2 Number of employees	3.17
3 Business assets	5.67
4 Capital	4.58
5 Business revenues	4.58
6 Net result	1.83
Test Statistics [a]	
N	12
Chi-Square	52,714 th most common
df	5
Asymp. Sig.	.000
a. Friedman Test	

Note: Author's calculation using the SPSS software program

Given that Asymp. Sig. .000 <.05 the null hypothesis is rejected. The conclusion is that there are significant differences between the observed statistical variables.

In order to see the importance of individual sectors, Table 5 shows their percentage share in the total observed statistical variables of the Serbian economy, with special reference to wholesale and retail trade, repair of motor vehicles and motorcycles.

The place and role of the sector in Serbia

Table 5

Sector	**Participation in the total number of companies in Serbia**	**Participation in the total number of employees in Serbia**	**Participation in total business assets in Serbia**	**Participation in the total capital in Serbia**	**Participation in total business revenues in Serbia**	**Participation in the total net result in Serbia**
Agriculture, forestry and fishing	3.75%	2.51%	5.17%	7.01%	3.16%	2.24%
Mining	0.36%	2.08%	3.82%	4.52%	2.52%	0.27%
Manufacturing industry	16.38%	32.17%	21.57%	21.54%	27.00%	30.19%
Construction	8.79%	6.70%	12.75%	10.41%	8.94%	13.49%
Electricity, gas, steam and air	0.82%	3.15%	10.82%	14.15%	5.35%	6.04%

Sector	Participation in the total number of companies in Serbia	Participation in the total number of employees in Serbia	Participation in total business assets in Serbia	Participation in the total capital in Serbia	Participation in total business revenues in Serbia	Participation in the total net result in Serbia
conditioning supply						
Water supply	0.82%	2.99%	2.04%	2.39%	0.13%	0.38%
Wholesale and retail trade, repair of motor vehicles and motorcycles	30.26%	18.69%	16.52%	14.73%	34.30%	31.11%
Traffic and storage	6.49%	8.37%	7.19%	7.08%	5.31%	-2.66%
Accommodation and catering services	4.23%	2.63%	0.14%	1.33%	0.68%	-2.12%
Information and communication	6.02%	5.15%	5.05%	4.59%	4.60%	10.36%
Financial and insurance activities	0.77%	0.38%	2.22%	2.62%	0.17%	0.53%
Other activities	21.34%	15.19%	12.69%	9.63%	7.84%	10.17%
Total - Serbian economy	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Note: Author's calculation

In the Serbian economy, wholesale and retail trade, repair of motor vehicles and motorcycles participates in the total number of enterprises with 30.26% and in the total number of employees with 18.69%. Wholesale and retail trade, repair of motor vehicles and motorcycles a part of the total amount of business assets with 16.52%, capital with 14.73%, operating income to 34.30% and the net result to 31.11%. Wholesale and retail trade, repair of motor vehicles and motorcycles therefore play a significant role in the development of the Serbian economy. Therefore, special attention is paid to it in the strategies and concept of sustainable development of the Serbian economy.

Table 6 shows the indicators of financial performance of the sector in Serbia.

Indicators of financial performance of the sector in Serbia

Table 6

Sector	Business revenues per employee (in thousands of dinars)	Net result per employee (in thousands of dinars)	Business assets per employee (in thousands of dinars)	Turnover ratio of business assets (Business revenues /	Return on business assets (net result / business assets)	Return on capital (net result / capital)	Return on sales (net result / business revenues)	Financial indebtedness (business assets / capital)
Agriculture, forestry and fishing	12094.17	317.9988	29106.45	0.415515	1.09%	1.72%	2.63%	1.578567
Mining	11629.54	45.87409	25914.13	0.448772	0.18%	0.32%	0.39%	1.810392
Manufacturing industry	8061.556	334.0368	9456.159	0.852519	3.53%	7.57%	4.14%	2.142776
Construction	12833.48	717.1903	26866.6	0.477674	2.67%	7.00%	5.59%	2.622247
Electricity, gas, steam and air conditioning supply	16313.71	681.5482	48421.94	0.336907	1.41%	2.30%	4.18%	1.636272
Water supply	429.8082	45.81432	9626.175	0.04465	0.48%	0.87%	10.66%	1.82149
Wholesale and retail trade, repair of motor vehicles and motorcycles	17632.23	592.4795	12466.5	1.41437	4.75%	11.40%	3.36%	2.398594
Traffic and storage	6100.682	-113.2	12121.62	0.503289	-0.93%	-2.03%	-1.86%	2.172758
Accommodation and catering services	2478.147	-287,094	771.4313	3.212401	-37.22%	-8.62%	-11.59%	0.231505
Information and communication	8574.153	715.6558	13817.73	0.620518	5.18%	12.18%	8.35%	2.351366
Financial and insurance activities	4242.602	501.9582	83083.99	0.051064	0.60%	1.10%	11.83%	1.818448
Other activities	4957.865	238.2391	11783.46	0.420748	2.02%	5.70%	4.81%	2.819406
Total - Serbian economy	9607.074	355.9412	14104.18	0.681151	2.52%	5.40%	3.70%	2.139405

Note: Author's calculation

The data in this table show that, for example, in wholesale and retail trade, repair of motor vehicles and motorcycles, business revenues per employee amounts to 17632.23 thousand dinars, net result per employee amounts to 592.4795 thousand dinars and business assets per employee amounts to 12466.5 thousand dinars. Labor productivity in wholesale and retail trade, repair of motor vehicles and motorcycles is therefore higher than for the whole of the Serbian economy. The efficiency of the use of business assets (measured by the turnover ratio of business assets) in wholesale and retail trade, repair of motor vehicles and motorcycles (1.41437) is also higher in relation to the total economy of Serbia (0.68115). Also, the profitability of wholesale and retail trade, repair of motor vehicles and motorcycles (measured by the return on business assets 4.75%, the return on capital 11.40%, the return on sales 3.36%) is almost higher than in the entire Serbian economy (2.51%, 5.40%, 3.70%,

respectively). The conclusion is that wholesale and retail trade, repair of motor vehicles and motorcycles is a significant generator of financial performance of the Serbian economy. For these reasons, special attention is paid to it in the strategies and concept of sustainable development of the Serbian economy.

4. Sectoral analysis of the efficiency of Serbia based on the MABAC method: results and discussion

During the sectoral analysis of the efficiency of Serbia based on the MABAC method, the following criteria were used: C1 - number of enterprises, C2 - number of employees, C3 - business assets, C4 - capital, C5 - business revenues and C6 - net result. Alternatives are sectors: A1 - agriculture, forestry and fishing, A2 - mining, A3 - manufacturing, A4 - construction, A5 - electricity, gas, steam and air conditioning supply, A6 - water supply, A7 - wholesale and retail trade, repair of motor vehicles and motorcycles, A8 - traffic and storage, A9 - accommodation and food services, A10 - information and communication, A11 - financial and insurance activities and A12 - other activities.

The calculation of the weight coefficients (weights) of the criteria was performed using the AHP (Analytical Hierarchical Process) method (Saaty, 2008). The obtained results (i.e. weighting coefficients of the criteria) are shown in Table 7 and in Figure 2.

Criteria weighting coefficients

Table 7

	Weights of Criteria
Number of enterprises	0.3002374462
Number of employees	0.1866602485
Business assets	0.0982781247
Capital	0.1350952934
Business revenues	0.1437737251
Net result	0.1359551620
SUM	1
Consistency Ratio (K = 100) **0.0417283**	COMPARE WITH 0.1; IT SHOULD BE LESS THAN 0.1.

Note: Author's AHP Software-Excel help calculation

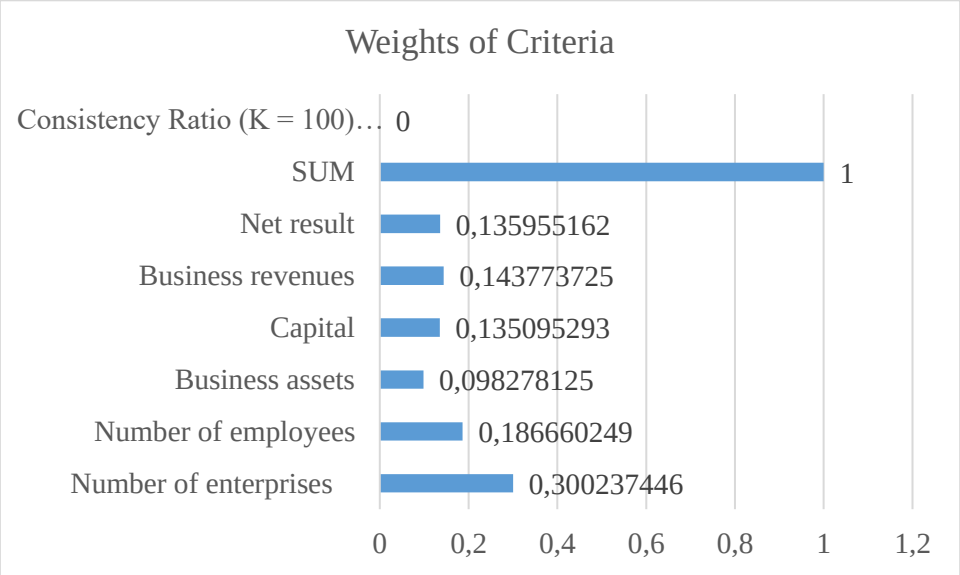

Figure 2. Criteria weight coefficients

In terms of importance, the criterion in the first place is the number of enterprises. Next: number of employees, business revenues, net result, capital, business assets. By forming the optimal number of enterprises and their size, it is possible to influence the achievement of targeted sectoral efficiency in Serbia. Also, efficient human resource management.

In the following tables (Tables 8, 9, 10, 11, 12 and 13) and in Figure 3 the results of the sector efficiency research in Serbia based on the MABAC method are presented.

Initial matrix

Table 8

Initial Matrix						
weights of criteria	0.300237	0.1866602	0.098278	0.135095	0.1437737	0.135955162
kind of criteria	1	-1	1	1	1	1
	C1	**C2**	**C3**	**C4**	**C5**	**C6**
A1	3976	30541	888940	563131	369368	9712
A2	377	25352	656975	362891	294832	1163
A3	17381	391855	3705443	1729272	3158961	130894
A4	9323	81546	2190864	835491	1046519	58484
A5	865	38392	1859015	1136128	626316	26166
A6	871	36386	350258	192292	15639	1667
A7	32107	227618	2837599	1183026	4013414	134859
A8	6883	101935	1235617	568686	621873	-11539

Initial Matrix						
weights of criteria	0.300237	0.1866602	0.098278	0.135095	0.1437737	0.135955162
kind of criteria	1	-1	1	1	1	1
	C1	C2	C3	C4	C5	C6
A9	4485	31986	24675	106585	79266	-9183
A10	6387	62769	867325	368860	538191	44921
A11	816	4596	381854	209989	19499	2307
A12	22640	184978	2179680	773099	917096	44069

MAX	32107	391855	3705443	1729272	4013414	134859
MIN	377	4596	24675	106585	15639	-11539

Normalized matrix

Table 9

Normalized Matrix						
weights of criteria	0.300237	0.1866602	0.098278	0.135095	0.1437737	0.135955162
kind of criteria	1	-1	1	1	1	1
	C1	C2	C3	C4	C5	C6
A1	0.1134	0.9330	0.2348	0.2814	0.0885	0.1452
A2	0.0000	0.9464	0.1718	0.1580	0.0698	0.0868
A3	0.5359	0.0000	1.0000	1.0000	0.7863	0.9729
A4	0.2819	0.8013	0.5885	0.4492	0.2579	0.4783
A5	0.0154	0.9127	0.4984	0.6345	0.1528	0.2576
A6	0.0156	0.9179	0.0885	0.0528	0.0000	0.0902
A7	1.0000	0.4241	0.7642	0.6634	1.0000	1.0000
A8	0.2050	0.7486	0.3290	0.2848	0.1516	0.0000
A9	0.1295	0.9293	0.0000	0.0000	0.0159	0.0000
A10	0.1894	0.8498	0.2289	0.1616	0.1307	0.3857
A11	0.0138	1.0000	0.0970	0.0637	0.0010	0.0946
A12	0.7016	0.5342	0.5855	0.4107	0.2255	0.3798

Normalized weight matrix

Table 10

Normalized Weighted Matrix (V)						
	C1	C2	C3	C4	C5	C6
A1	0.3343	0.3608	0.1214	0.1731	0.1565	0.1557
A2	0.3002	0.3633	0.1152	0.1564	0.1538	0.1478
A3	0.4611	0.1867	0.1966	0.2702	0.2568	0.2682
A4	0.3849	0.3362	0.1561	0.1958	0.1808	0.2010
A5	0.3049	0.3570	0.1473	0.2208	0.1657	0.1710
A6	0.3049	0.3580	0.1070	0.1422	0.1438	0.1482
A7	0.6005	0.2658	0.1734	0.2247	0.2875	0.2719
A8	0.3618	0.3264	0.1306	0.1736	0.1656	0.1360
A9	0.3391	0.3601	0.0983	0.1351	0.1461	0.1360
A10	0.3571	0.3453	0.1208	0.1569	0.1626	0.1884
A11	0.3044	0.3733	0.1078	0.1437	0.1439	0.1488
A12	0.5109	0.2864	0.1558	0.1906	0.1762	0.1876

Matrix of boundary approximate domains

Table 11

Border Approximation Area Matrix (G)	0.3709	0.3214	0.1330	0.1781	0.1739	0.1751

Matrix distance alternatives from boundary approximate domains

Table 12

Distance of Alternatives from BAA matrix (Q)						
	C1	C2	C3	C4	C5	C6
A1	-0.0366	0.0395	-0.0116	-0.0050	-0.0174	-0.0194
A2	-0.0706	0.0420	-0.0178	-0.0217	-0.0201	-0.0273
A3	0.0902	-0.1347	0.0636	0.0921	0.0829	0.0931
A4	0.0140	0.0149	0.0232	0.0177	0.0070	0.0259
A5	-0.0660	0.0357	0.0143	0.0427	-0.0081	-0.0041
A6	-0.0660	0.0366	-0.0260	-0.0359	-0.0301	-0.0269
A7	0.2296	-0.0555	0.0404	0.0466	0.1137	0.0968
A8	-0.0091	0.0050	-0.0023	-0.0045	-0.0083	-0.0391
A9	-0.0318	0.0388	-0.0347	-0.0430	-0.0278	-0.0391
A10	-0.0138	0.0239	-0.0122	-0.0212	-0.0113	0.0133
A11	-0.0665	0.0520	-0.0251	-0.0344	-0.0300	-0.0263
A12	0.1400	-0.0350	0.0229	0.0125	0.0023	0.0125

Ranking alternatives

Table 13

	Alternatives	Q	Q	Ranking
Agriculture, forestry and fishing	**A1**	-0.0505	-0.0505	**7**
Mining	**A2**	-0.1156	-0.1156	**9**
Manufacturing industry	**A3**	0.2873	0.2873	**2**
Construction	**A4**	0.1026	0.1026	**4**
Electricity, gas, steam and air conditioning supply	**A5**	0.0144	0.0144	**5**
Water supply	**A6**	-0.1482	-0.1482	**12**
Wholesale and retail trade, repair of motor vehicles and motorcycles	**A7**	0.4716	0.4716	**1**
Traffic and storage	**A8**	-0.0584	-0.0584	**8**
Accommodation and catering services	**A9**	-0.1377	-0.1377	**11**
Information and communication	**A10**	-0.0212	-0.0212	**6**
Financial and insurance activities	**A11**	-0.1303	-0.1303	**10**
Other activities	**A12**	0.1552	0.1552	**3**

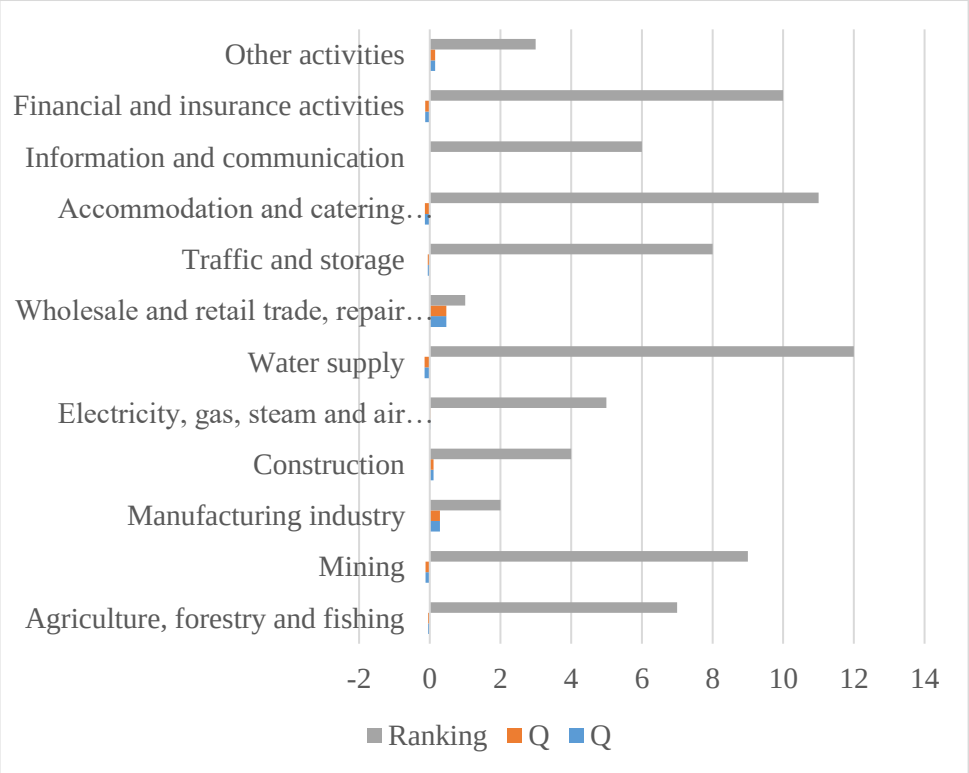

Figure 3. Ranking alternatives

Based on the obtained results of the sector efficiency research in Serbia on the basis of the MABAC method, it can be concluded that the wholesale and retail trade, repair of motor vehicles and motorcycles is in the first place in terms of the efficiency. Next: manufacturing, other activities, construction, electricity, gas, steam and air conditioning supply, information and communication, agriculture, forestry and fishing, transport and storage, mining, financial and insurance activities, accommodation and food services and water supply. The very nature of the sector significantly influences their positioning in terms of efficiency, especially in the conditions of the Covid-19 virus coronary epidemic. Thus, for example, the impact of the Covid-19 coronary virus pandemic on the efficiency of wholesale and retail trade, repair of motor vehicles and motorcycles is negligible. It has been greatly mitigated with increased electronic sales. In contrast, transport and storage, banks and food and accommodation services have significantly felt the negative effect of the Covid-19 coronary virus pandemic on efficiency. In order to improve sectoral efficiency in Serbia in the future, it is necessary to optimize the number and size of enterprises, and more efficiently manage human resources, assets, capital, sales and profits.

5. Conclusion

It is noticeable that the sectors of transport and storage and accommodation and food services achieved a net result far below the average (i.e. negative). Given the nature of their business and the forbidden movement of the population, they are significantly affected by the Covid-19 corona virus pandemic.

There is a strong correlation at the level of statistical significance between the observed statistical variables as criteria (number of enterprises, number of employees, operating assets, capital, operating income and net result).

According to the importance of the criteria, the number of enterprises is in the first place. Next: number of employees, business revenues, net result, capital, business assets. By forming the optimal number of enterprises, as well as their size, it is possible to influence the achievement of targeted sectoral efficiency in Serbia. Also, efficient human resource management.

The research of sectoral efficiency in Serbia on the basis of the MABAC method also shows that in the first place in terms of efficiency, wholesale and retail trade, repair of motor vehicles and motorcycles. Next: manufacturing, other activities, construction, electricity, gas, steam and air conditioning supply, information and communication, agriculture, forestry and fishing, transport and storage, mining, financial and insurance activities, accommodation and food services and water supply. The very nature of them significantly influences their positioning in terms of efficiency, especially in the conditions of the Covid-19 virus coronary virus. The impact of the Covid-19 coronary virus pandemic on the efficiency of wholesale and retail trade, repair of motor vehicles and motorcycles, for example, is negligible. It has been greatly mitigated with increased electronic sales. In contrast, transport and storage, banks and food and accommodation services have

significantly felt the negative effect of the Covid-19 coronary virus pandemic on efficiency.

In order to improve sectoral efficiency in Serbia in the future, it is necessary to optimize the number and size of enterprises, as well as more efficiently manage human resources, assets, capital, sales and profits.

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