PRODUCTIVITY ANALYSIS OF RETAIL TRADE IN THE EUROPEAN UNION AND SERBIA USING THE AHP-TOPSIS METHOD

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Abstract

Measuring retail trade has received considerable attention in both theory and practice. Taking up this important issue, this paper analyses retail trade productivity by means of the AHP-TOPSIS method. The empirical research has shown varying retail trade productivity across different countries in Europe. For example, in 2016, retail trade productivity measured as sales per employee in Luxemburg, Belgium and the Netherlands exceeded the EU average. It can be seen from the decision matrix rankings obtained using the TOPSIS method that in 2016 in terms of retail productivity, the European Union seen as a single market ranked first, followed by individual countries: Malta ranked second, Luxembourg ranked third, while Germany was fourth. As for some countries in transition in South-Eastern Europe, Slovenia came 11th, Croatia came 23rd and Serbia came 18th. The application of new business models in retail trade varies across countries and, as a result, so does their retail productivity.

Key words: efficiency, factors, trade, Serbia, AHP-TOPSIS method.

1. INTRODUCTION

Given the increasing interest in the subject and its relevance, this paper analyses the productivity of retail trade in the European Union using the AHP - TOPSIS method. The aim of the research is to describe the current situation, and propose measures for future improvement of the retail trade productivity in the EU, as well as in Serbia, as a candidate country for membership.

Recently, in addition to the DEA method, the AHP (Chang, 1996) and the TOPSIS method are increasingly used in scholarly literature (Hwang, 1981; Hwang, 1995; Andersen, 1993; Yousefi, 2010; Li, 2014, 2017; Tsolas, 2015; Bhargava, 1998;

Karan, 2008; Keener, 2013; Kingyens, 2012; Konuk, 2018; Lau, 2013; Manini, 2018; Martini 2017; Pang, 2013; Paradi, 2014; Rogova, 2018; Simbolon, 2017; Trejo, 2017; Zaernyuk, 2016; Üçüncü, 2018; Urbonaviči ūtė, 2019; Lukic, 2011a,b; 2018, 2019; Лукић, 2018) to assess the productivity and efficiency of retail trade. Compared to the traditional measurement methods, the AHP-TOPSIS methods provide a better insight into the retail trade productivity. It was therefore used in this paper to assess the retail productivity of individual EU Member States, with an aim to propose adequate measures for improving it in the future. In doing so, the paper makes an important contribution to research in this area.

The very nature of the issue addressed in this paper defines its main objective: to understand the current situation regarding retail productivity in the European Union, which is necessary for improvement by taking adequate measures in the future.

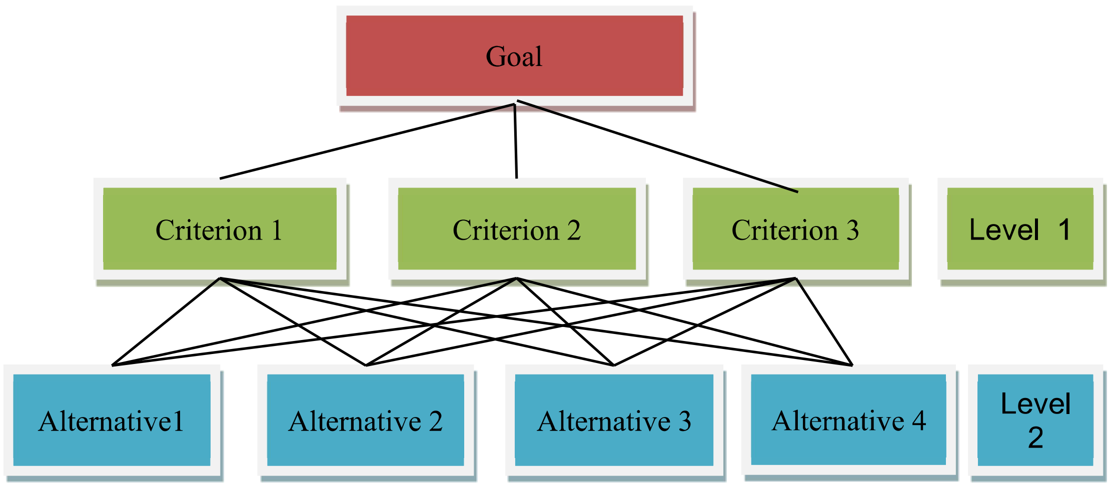
The insights into the current situation was provided by means of the AHP - TOPSIS methods. Ratio analysis and statistical analysis were also used.

For the purpose of examining the issues addressed in this paper, up-to-date empirical data were taken from Eurostat. They are aligned with relevant international standards and as such internationally comparable. This also applies to the research results obtained in this paper.

2. THE AHP METHOD

The Analytical Hierarchy Process (AHP) is a multi-criteria decision making method proposed by Thomas Saaty in the 1970s (Saaty, 1970; Saaty 1980; Saaty, 2001; Saaty, 2008). It is used to solve complex structural hierarchical problems in decision making and determine the weighted coefficients for each criterion (Harker, 1987; Hanie, 2016; Stojanović, 2016). Figure 1 shows an example of hierarchy in AHP.

Figure 1. Example of hierarchy structure of AHP



The method of Analytical Hierarchical Process is based on the following axioms (Saaty, 1986; Harker, 1987; Alphonce, 1997):

The reciprocal axiom: If element A is n times more important than element B, then element B is 1/n times more important than the element A.

The homogeneity axiom: A comparison is meaningful only if the elements are comparable.

Axiom of dependence: A comparison can be made between elements in one level of the hierarchy to the elements of a higher level, i.e. comparisons among lower-level elements depend on higher-level elements.

The axiom of expectations: Any change in the structure of the hierarchy requires a recalculation of priorities in the new hierarchy.

Comparisons between two elements of the hierarchy (model) is performed using Saaty's value scale (Table 1).

Table 1. Saaty's scale of pairwise comparison

Relative importance/Intensity of importance on an absolute scale	Definition	Explanation
1	Equal importance	The two elements are of equal importance in relation to the objective
3	Moderate importance of one over another	Experience or judgment slightly favours one element over another
5	Essential or strong importance	Experience or judgment strongly favours one element over another
7	Very strong importance	The dominance of one element has been demonstrated in practice
9	Extreme importance	Dominance of the highest degree
2, 4, 6, 8	Ratios arising from the scale	A compromise or further division is needed

Source: Saaty, 2008

The Analytical Hierarchical Process (AHP) involves the following steps (Saaty, 2001; Saaty, 2008; Hanie, 2016; Stojanović, 2016):

Step 1: Forming a pairwise comparisons matrix

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

Step 2: Normalization of the pairwise comparisons matrix

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

Step 3: Determining the relative importance, i.e. the weight vectors

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

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

$$CI = \frac{\lambda_{max} - n}{n} \qquad (4)$$

If CI < 0.1, the estimated values of the coefficients a_{ij} are consistent, and the deviation of λ_{max} from n is negligible. In other words, this means 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 a random index. Random consistency indices are given in Table 2.

Table 2. Random consistency indices

Number of criteria (n)	1	2	3	4	5	6	7	8	9	10
RI	0	0	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49

Source: Hanine, M. et al. 2016

3. THE TOPSIS METHOD

The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) has been used very successfully in evaluating companies' financial performance (Üçüncü et al., 2018). It is a multi-criteria decision-making technique originally developed and applied by Hwang and Yoon (1981) (Hwang, 1981; Hwang, 1995). According to this method, the alternatives are determined by their distances from the ideal solution. The aim is to choose an optimal alternative that is closest to the ideal solution, that is, furthest from the negative ideal solution (Young, 1994). A positive ideal solution maximizes utility, i.e. minimizes costs (associated with a given problem). In contrast, a negative ideal solution maximizes costs, i.e. minimizes utility (Yousefi 2010; Wang 2007).

The TOPSIS method involves six steps (Üçüncü et al., 2018).

Step 1: Construct an initial matrix

In the initial matrix A_{ij}, *"m"* denotes the number of alternatives and *"n"* the number of criteria:

$$A_{ij} = \begin{vmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{vmatrix}$$

Step 2: Calculate the weighted normalised decision matrix

The normalized decision matrix (R_{ij}; i=1,…,m; j=1,…,n) is determined by equation (14) with the elements of the matrix A_{ij}:

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^{m} a_{ij}^2}} \quad (5)$$

$$t = 1,2,3,\dots,m \qquad j = 1,2,3,\dots,n$$

$$R_{ij} = \begin{vmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{vmatrix}$$

In the equation (6) the weighed measure "*j*" is represented by W_{ij}. The weighted normalized decision matrix (V_{ij}; *i=1,…,m; j=1,…,n*) is determined by using equation (6) with the elements of the normalized matrix:

$$V_{ij} = W_{ij} * r_{ij} \quad (6)$$

$$i = 1,2,3,\dots,m \qquad j = 1,2,3,\dots,n$$

Step 3: Determine the positive and the negative ideal solutions

The values of the positive ideal solution (A^+) and the negative ideal solution (A^-) are determined from the values of the weighted normalized matrix (V_{ij}). A^+ indicates a higher performance score, while A^- indicates a lower performance score.

The values of the positive ideal solution (A^+) and the negative ideal solution (A^-) are determined as follows (equation (7) and (8), respectively):

$$A^+ = \{v_i^+, \dots, v_n^+\} = \left\{\left(\max_i v_{ij}, j \in j\right)\left(\min_i v_{ij}, j \in j'\right)\right\} \; i = 1,2,\dots,m \quad (7)$$

$$A^- = \{v_i^-, \dots, v_n^-\} = \left\{\left(\min_i v_{ij}, j \in j\right)\left(\max_i v_{ij}, j \in j'\right)\right\} \; i = 1,2,\dots,m \quad (8)$$

where *j* is related to the benefit criterion, and *j'* is related to the cost criterion.

Step 4: Determine separation measures (i.e. the distance of alternatives from the ideal solution and the negative ideal solution)

The distance from the positive ideal solution (S_i^+) and the negative ideal solution (S_i^-) for each alternative according to the given criterion is determined using equations (9) and (10).

$$S_i^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^+)^2} \quad (9)$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2} \quad (10)$$

$$i = 1,2,3,\dots,m \qquad j = 1,2,3,\dots,n$$

Step 5: Determine the relative closeness coefficient to the ideal solution

Separation measures of the positive ideal solution (S_i^+) and the negative ideal solution (S_i^-) were used to determine the relative closeness to the ideal solution (C_i^+) for each decision point. C_i^+ represents the relative closeness to the ideal solution and its value can range between $0 \leq C_i + \leq 1$. "C_i^+" = 1 indicates the relative closeness to the positive ideal solution. "C_i^+" = 0 indicates relative closeness to the negative ideal solution.

The relative closeness to the ideal solution (C_i^+; i=1,…,m; $j=1,\dots,n$) was determined using the following equation (11):

$$C_i^+ = \frac{S_i^-}{S_i^- + S_i^+} \qquad (11)$$

$$i = 1,2,3,\dots,m$$

Step 6: Rank the alternatives according to their scores

The score represents a company's performance. Higher scores are indicative of stronger performance. The results can be used to determine a company's ranking within an industry (Üçüncü et al., 2018).

4. MEASURING THE IMPORTANCE OF SELECTED CRITERIA FOR THE PRODUCTIVITY OF EUROPEAN UNION RETAIL TRADE USING THE AHP METHOD

The following criteria are selected for evaluating the productivity of EU retail trade: investment per person employed (C1), personnel costs (C2), wages and salaries (C3), share of personnel costs in total purchases of goods and services (C4), share of personnel costs in production (C5), turnover per person employed (C6), gross value added per employee (C7), apparent labour productivity (C8), wage adjusted labour productivity (C9), and average personnel costs (C10). Their weights were determined using the AHA method. Table 3 shows the initial matrix and priorities (criteria weights).

Table 3. Resulting priorities based on the AHP method
Resulting Priorities
Priorities
These are the resulting weights for the criteria based on the pairwise comparisons:

Cat		Priority	Rank	(+)	(-)
1	Investment per person employed	21.0%	3	11.6%	11.6%
2	Personnel costs	21.8%	2	10.7%	10.7%
3	Wages and Salaries	22.5%	1	10.3%	10.3%
4	Share of personnel costs in total purchases o	8.4%	5	3.7%	3.7%

5	Share of personnel costs in production	8.9%	4	4.8%	4.8%
6	Turnover per person employed	6.0%	6	3.2%	3.2%
7	Gross value added per employee	4.4%	7	2.1%	2.1%
8	Apparent labour productivity	2.3%	9	1.1%	1.1%
9	Wage adjusted labour productivity	2.8%	8	1.4%	1.4%
10	Average personnel costs	1.9%	10	0.8%	0.8%

Decision Matrix

The resulting weights are based on the principal eigenvector of the decision matrix:

	1	2	3	4	5	6	7	8	9	10
1	1	1.00	1.00	4.00	6.00	5.00	4.00	5.00	4.00	6.00
2	1.00	1	1.00	5.00	5.00	5.00	6.00	5.00	4.00	6.00
3	1.00	1.00	1	5.00	5.00	6.00	4.00	6.00	5.00	9.00
4	0.25	0.20	0.20	1	1.00	2.00	4.00	5.00	4.00	5.00
5	0.17	0.20	0.20	1.00	1	3.00	4.00	5.00	5.00	4.00
6	0.20	0.20	0.17	0.50	0.33	1	2.00	4.00	5.00	5.00
7	0.25	0.17	0.25	0.25	0.25	0.50	1	4.00	2.00	4.00
8	0.20	0.20	0.17	0.20	0.20	0.25	0.25	1	1.00	1.00
9	0.25	0.25	0.20	0.25	0.20	0.20	0.50	1.00	1	2.00
10	0.17	0.17	0.11	0.20	0.25	0.20	0.25	1.00	0.50	1

Number of comparisons = 45 **Consistency Ratio CR** = 8.4% Principal eigenvalue = 11.125
Eigenvector solution: 7 iterations, delta = 5.3E-8
Note: Authors' calculation using the AHP online calculator

5. MEASURING THE PRODUCTIVITY OF EUROPEAN UNION RETAIL TRADE USING THE TOPSIS METHOD

Table 4 shows the initial data for measuring the productivity of European Union retail trade using the TOPSIS method. (The initial data were further processed using the ARAS Software.xlsx)

Table 4. Initial data for measuring the productivity of retail trade (Wholesale and retail trade; repair of motor vehicles and motorcycles) of the European Union, 2016

	Investment per person employed - thousands euro C1	Personnel costs - million euro C2	Wages and Salaries - million euro C3	Share of personnel costs in total purchases of goods and services – percentage C4	Share of personnel costs in production – percentage C5	Turnover per person employed - thousand euro C6	Gross value added per employee - thousand euro C7	Apparent labour productivity (Gross value added per person employed) - thousand euro C8	Wage adjusted labour productivity (Apparent labour productivity by average personnel costs) – percentage C9	Average personnel costs (personnel costs per employee) - thousand euro C10
European Union - 28 countries A1	4.5	808013.1	646537.1	9.4	30.1	298	48	41	142	28.7
Belgium A2	12.4	24441.8	18541.8	5.7	22.7	733.8	86.9	69.2	139.5	49.6
Bulgaria A3	2.0	2462.7	2130.5	4.9	23.0	107.5	13.3	10.4	167.3	6.2
Czechia A4	3.8	7983.1	5940.4	6.3	23.4	197.0	29.7	21.2	134.6	15.8
Denmark A5	5.2	18107.0	16588.3	12.1	36.5	384.5	62.3	59.9	144.4	41.5
Germany* A6	4.0	181280.5	151057.4	10.8	35.9	311.2	52.9	48.3	153.5	31.5
Estonia A7	3.7	1341.1	1004.6	6.5	29.4	241.4	25.7	24.1	157.8	15.3
Ireland A8	9.2	12759.2	11396.9	7.9	29.8	515.2	66.7	62.4	163.1	38.3
Greece A9	2.1	8172.8	6568.4	8.7	31.9	144.1	22.1	14.7	84.4	17.4
Spain A10	3.2	65626.7	51614.1	10.3	34.5	233.2	42.2	33.5	125.8	26.6
France A11	5.9	134447.9	97219.8	11.1	32.7	408.3	57.4	51.3	118.8	43.2
Croatia A12	2.1	2551.1	2194.1	9.1	28.8	137.3	21.2	19.5	159.7	12.2
Italy A13	4.0	69499.0	51095.6	8.0	24.4	291.0	65.0	39.5	116.6	33.9
Cyprus A14	2.3	1129.1	998.5	11.7	40.1	175.4	28.1	26.8	146.1	18.3
Latvia A15	2.3	1409.7	1146.2	5.9	26.0	163.6	16.9	15.9	169.5	9.4
Lithuania A16	2.6	2224.8	1703.2	7.5	29.3	128.9	17.6	15.7	160.4	9.8
Luxembourg A17	10.2	2345.3	2054.9	3.2	15.4	1551.3	105.7	102.2	214.7	47.6
Hungary A18	2.7	5246.8	4175.3	6.6	25.6	154.7	18.9	16.5	158.0	10.5
Malta A19	2.8	445.4	417.0	6.2	20.6	238.3	38.3	30.3	184.4	16.4

	Investment per person employed - thousands euro C1	Personnel costs - million euro C2	Wages and Salaries - million euro C3	Share of personnel costs in total purchases of goods and services – percentage C4	Share of personnel costs in production – percentage C5	Turnover per person employed - thousand euro C6	Gross value added per employee - thousand euro C7	Apparent labour productivity (Gross value added per person employed) - thousand euro C8	Wage adjusted labour productivity (Apparent labour productivity by average personnel costs) – percentage C9	Average personnel costs (personnel costs per employee) - thousand euro C10
Netherlands A20	4.1	42300.2	34182.1	7.9	26.9	414.4	59.9	53.0	165.0	32.1
Austria A21	4.8	23157.2	17726.1	11.5	33.5	365.5	61.1	54.2	136.7	39.7
Poland A22	2.2	18261.5	15244.0	5.9	21.1	154.7	22.6	17.0	160.6	10.6
Portugal A23	3.7	10454.2	8143.0	9.0	32.3	171.0	26.6	21.9	129.3	16.9
Romania A24	3.7	6155.6	5021.7	6.2	19.9	122.9	16.6	15.6	217.2	7.2
Slovenia A25	4.9	2264.3	1975.5	8.3	29.2	272.2	38.8	34.0	150.4	22.6
Slovakia A26	4.6	3322.1	2505.7	6.8	22.4	159.5	23.8	17.9	139.7	12.8
Finland A27	5.0	10570.6	8426.6	10.3	34.0	399.2	57.6	52.8	132.3	39.9
Sweden A28	4.9	29759.6	20819.0	12.4	38.0	415.5	72.2	61.6	119.5	51.6
United Kingdom A29	6.3	120293.9	106646.4	9.9	26.7	315.5	50.2	48.5	183.0	26.5
Serbia A30	2.0	1481.7	1285.1	0	23.6	117.1	12.9	11.4	166.7	6.9

*(until 1990 former territory of the FRG)
Source: Eurostat

Table 5 shows the initial matrix of the TOPSIS method.

Table 5. Initial Matrix

weights of criteria	0.21	0.218	0.225	0.084	0.089	0.06	0.044	0.023	0.028	0.019
kind of criteria	1	-1	1	1	1	1	1	1	1	-1
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
A1	4.5	808013.1	646537	9.4	30.1	298	48	41	142	28.7
A2	12.4	24441.8	18541.8	5.7	22.7	733.8	86.9	69.2	139.5	49.6
A3	2	2462.7	2130.5	4.9	23	107.5	13.3	10.4	167.3	6.2
A4	3.8	7983.1	5940.4	6.3	23.4	197	29.7	21.2	134.6	15.8
A5	5.2	18107	16588.3	12.1	36.5	384.5	62.3	59.9	144.4	41.5
A6	4	181280.5	151057	10.8	35.9	311.2	52.9	48.3	153.5	31.5
A7	3.7	1341.1	1004.6	6.5	29.4	241.4	25.7	24.1	157.8	15.3

A8	9.2	12759.2	11396.9	7.9	29.8	515.2	66.7	62.4	163.1	38.3
A9	2.1	8172.8	6568.4	8.7	31.9	144.1	22.1	14.7	84.4	17.4
A10	3.2	65626.7	51614.1	10.3	34.5	233.2	42.2	33.5	125.8	26.6
A11	5.9	134447.9	97219.8	11.1	32.7	408.3	57.4	51.3	118.8	43.2
A12	2.1	2551.1	2194.1	9.1	28.8	137.3	21.2	19.5	159.7	12.2
A13	4	69499	51095.6	8	24.4	291	65	39.5	116.6	33.9
A14	2.3	1129.1	998.5	11.7	40.1	175.4	28.1	26.8	146.1	18.3
A15	2.3	1409.7	1146.2	5.9	26	163.6	16.9	15.9	169.5	9.4
A16	2.6	2224.8	1703.2	7.5	29.3	128.9	17.6	15.7	160.4	9.8
A17	10.2	2345.3	2054.9	3.2	15.4	1551.3	105.7	102.2	214.7	47.6
A18	2.7	5246.8	4175.3	6.6	25.6	154.7	18.9	16.5	158	10.5
A19	2.8	445.4	417	6.2	20.6	238.3	38.3	30.3	184.4	16.4
A20	4.1	42300.2	34182.1	7.9	26.9	414.4	59.9	53	165	32.1
A21	4.8	23157.2	17726.1	11.5	33.5	365.5	61.1	54.2	136.7	39.7
A22	2.2	18261.5	15244	5.9	21.1	154.7	22.6	17	160.6	10.6
A23	3.7	10454.2	8143	9	32.3	171	26.6	21.9	129.3	16.9
A24	3.7	6155.6	5021.7	6.2	19.9	122.9	16.6	15.6	217.2	7.2
A25	4.9	2264.3	1975.5	8.3	29.2	272.2	38.8	34	150.4	22.6
A26	4.6	3322.1	2505.7	6.8	22.4	159.5	23.8	17.9	139.7	12.8
A27	5	10570.6	8426.6	10.3	34	399.2	57.6	52.8	132.3	39.9
A28	4.9	29759.6	20819	12.4	38	415.5	72.2	61.6	119.5	51.6
A29	6.3	120293.9	106646	9.9	26.7	315.5	50.2	48.5	183	26.5
A30	2	1481.7	1285.1	0	23.6	117.1	12.9	11.4	166.7	6.9

MAX	12.4	808013.1	646537.1	12.4	40.1	1551.3	105.7	102.2	217.2	51.6
MIN	2	1129.1	998.5	4.9	22.7	107.5	13.3	10.4	84.4	6.2
0-Optimal Value	12.4	1129.1	646537.1	12.4	40.1	1551.3	105.7	102.2	217.2	51.6

Table 6 shows the normalized matrix of the TOPSIS method.

Table 6. Normalized Matrix

weights of criteria	0.21	0.218	0.225	0.084	0.089	0.06	0.044	0.023	0.028
kind of criteria	1	-1	1	1	1	1	1	1	-1
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
0-Optimal Value	0.0864	0.0910	0.3331	0.0491	0.0452	0.1427	0.0773	0.0857	0.0456
A1	0.0313	0.0001	0.3331	0.0372	0.0339	0.0274	0.0351	0.0344	0.0298
A2	0.0864	0.0042	0.0096	0.0226	0.0256	0.0675	0.0636	0.0580	0.0293
A3	0.0139	0.0417	0.0011	0.0194	0.0259	0.0099	0.0097	0.0087	0.0352
A4	0.0265	0.0129	0.0031	0.0250	0.0264	0.0181	0.0217	0.0178	0.0283
A5	0.0362	0.0057	0.0085	0.0479	0.0411	0.0354	0.0456	0.0502	0.0303
A6	0.0279	0.0006	0.0778	0.0428	0.0404	0.0286	0.0387	0.0405	0.0323
A7	0.0258	0.0766	0.0005	0.0257	0.0331	0.0222	0.0188	0.0202	0.0332
A8	0.0641	0.0081	0.0059	0.0313	0.0336	0.0474	0.0488	0.0523	0.0343
A9	0.0146	0.0126	0.0034	0.0345	0.0359	0.0133	0.0162	0.0123	0.0177
A10	0.0223	0.0016	0.0266	0.0408	0.0389	0.0214	0.0309	0.0281	0.0264

weights of criteria	0.21	0.218	0.225	0.084	0.089	0.06	0.044	0.023	0.028
kind of criteria	1	-1	1	1	1	1	1	1	-1
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
A11	0.0411	0.0008	0.0501	0.0440	0.0368	0.0376	0.0420	0.0430	0.0250
A12	0.0146	0.0403	0.0011	0.0360	0.0324	0.0126	0.0155	0.0164	0.0336
A13	0.0279	0.0015	0.0263	0.0317	0.0275	0.0268	0.0476	0.0331	0.0245
A14	0.0160	0.0910	0.0005	0.0463	0.0452	0.0161	0.0206	0.0225	0.0307
A15	0.0160	0.0729	0.0006	0.0234	0.0293	0.0150	0.0124	0.0133	0.0356
A16	0.0181	0.0462	0.0009	0.0297	0.0330	0.0119	0.0129	0.0132	0.0337
A17	0.0710	0.0438	0.0011	0.0127	0.0173	0.1427	0.0773	0.0857	0.0451
A18	0.0188	0.0196	0.0022	0.0261	0.0288	0.0142	0.0138	0.0138	0.0332
A19	0.0195	0.2306	0.0002	0.0246	0.0232	0.0219	0.0280	0.0254	0.0388
A20	0.0286	0.0024	0.0176	0.0313	0.0303	0.0381	0.0438	0.0444	0.0347
A21	0.0334	0.0044	0.0091	0.0455	0.0377	0.0336	0.0447	0.0455	0.0287
A22	0.0153	0.0056	0.0079	0.0234	0.0238	0.0142	0.0165	0.0143	0.0338
A23	0.0258	0.0098	0.0042	0.0356	0.0364	0.0157	0.0195	0.0184	0.0272
A24	0.0258	0.0167	0.0026	0.0246	0.0224	0.0113	0.0121	0.0131	0.0456
A25	0.0341	0.0454	0.0010	0.0329	0.0329	0.0250	0.0284	0.0285	0.0316
A26	0.0320	0.0309	0.0013	0.0269	0.0252	0.0147	0.0174	0.0150	0.0294
A27	0.0348	0.0097	0.0043	0.0408	0.0383	0.0367	0.0421	0.0443	0.0278
A28	0.0341	0.0035	0.0107	0.0491	0.0428	0.0382	0.0528	0.0517	0.0251
A29	0.0439	0.0009	0.0549	0.0392	0.0301	0.0290	0.0367	0.0407	0.0385
A30	0.0139	0.0693	0.0007	0.0000	0.0266	0.0108	0.0094	0.0096	0.0350

Table 7 shows the normalized weighted matrix.

Table 7. Normalized Weighted Matrix

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
0-Optimal Value	0.0181	0.0198	0.0750	0.0041	0.0040	0.0086	0.0034	0.0020	0.0013	0.0012
A1	0.0066	0.0000	0.0750	0.0031	0.0030	0.0016	0.0015	0.0008	0.0008	0.0007
A2	0.0181	0.0009	0.0021	0.0019	0.0023	0.0040	0.0028	0.0013	0.0008	0.0012
A3	0.0029	0.0091	0.0002	0.0016	0.0023	0.0006	0.0004	0.0002	0.0010	0.0001
A4	0.0056	0.0028	0.0007	0.0021	0.0023	0.0011	0.0010	0.0004	0.0008	0.0004
A5	0.0076	0.0012	0.0019	0.0040	0.0037	0.0021	0.0020	0.0012	0.0008	0.0010
A6	0.0058	0.0001	0.0175	0.0036	0.0036	0.0017	0.0017	0.0009	0.0009	0.0008
A7	0.0054	0.0167	0.0001	0.0022	0.0029	0.0013	0.0008	0.0005	0.0009	0.0004
A8	0.0135	0.0018	0.0013	0.0026	0.0030	0.0028	0.0021	0.0012	0.0010	0.0009
A9	0.0031	0.0027	0.0008	0.0029	0.0032	0.0008	0.0007	0.0003	0.0005	0.0004
A10	0.0047	0.0003	0.0060	0.0034	0.0035	0.0013	0.0014	0.0006	0.0007	0.0006
A11	0.0086	0.0002	0.0113	0.0037	0.0033	0.0023	0.0018	0.0010	0.0007	0.0010
A12	0.0031	0.0088	0.0003	0.0030	0.0029	0.0008	0.0007	0.0004	0.0009	0.0003
A13	0.0058	0.0003	0.0059	0.0027	0.0024	0.0016	0.0021	0.0008	0.0007	0.0008
A14	0.0034	0.0198	0.0001	0.0039	0.0040	0.0010	0.0009	0.0005	0.0009	0.0004

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
A15	0.0034	0.0159	0.0001	0.0020	0.0026	0.0009	0.0005	0.0003	0.0010	0.0002
A16	0.0038	0.0101	0.0002	0.0025	0.0029	0.0007	0.0006	0.0003	0.0009	0.0002
A17	0.0149	0.0095	0.0002	0.0011	0.0015	0.0086	0.0034	0.0020	0.0013	0.0011
A18	0.0039	0.0043	0.0005	0.0022	0.0026	0.0009	0.0006	0.0003	0.0009	0.0003
A19	0.0041	0.0503	0.0000	0.0021	0.0021	0.0013	0.0012	0.0006	0.0011	0.0004
A20	0.0060	0.0005	0.0040	0.0026	0.0027	0.0023	0.0019	0.0010	0.0010	0.0008
A21	0.0070	0.0010	0.0021	0.0038	0.0034	0.0020	0.0020	0.0010	0.0008	0.0010
A22	0.0032	0.0012	0.0018	0.0020	0.0021	0.0009	0.0007	0.0003	0.0009	0.0003
A23	0.0054	0.0021	0.0009	0.0030	0.0032	0.0009	0.0009	0.0004	0.0008	0.0004
A24	0.0054	0.0036	0.0006	0.0021	0.0020	0.0007	0.0005	0.0003	0.0013	0.0002
A25	0.0072	0.0099	0.0002	0.0028	0.0029	0.0015	0.0012	0.0007	0.0009	0.0005
A26	0.0067	0.0067	0.0003	0.0023	0.0022	0.0009	0.0008	0.0003	0.0008	0.0003
A27	0.0073	0.0021	0.0010	0.0034	0.0034	0.0022	0.0019	0.0010	0.0008	0.0010
A28	0.0072	0.0008	0.0024	0.0041	0.0038	0.0023	0.0023	0.0012	0.0007	0.0012
A29	0.0092	0.0002	0.0124	0.0033	0.0027	0.0017	0.0016	0.0009	0.0011	0.0006
A30	0.0029	0.0151	0.0001	0.0000	0.0024	0.0006	0.0004	0.0002	0.0010	0.0002

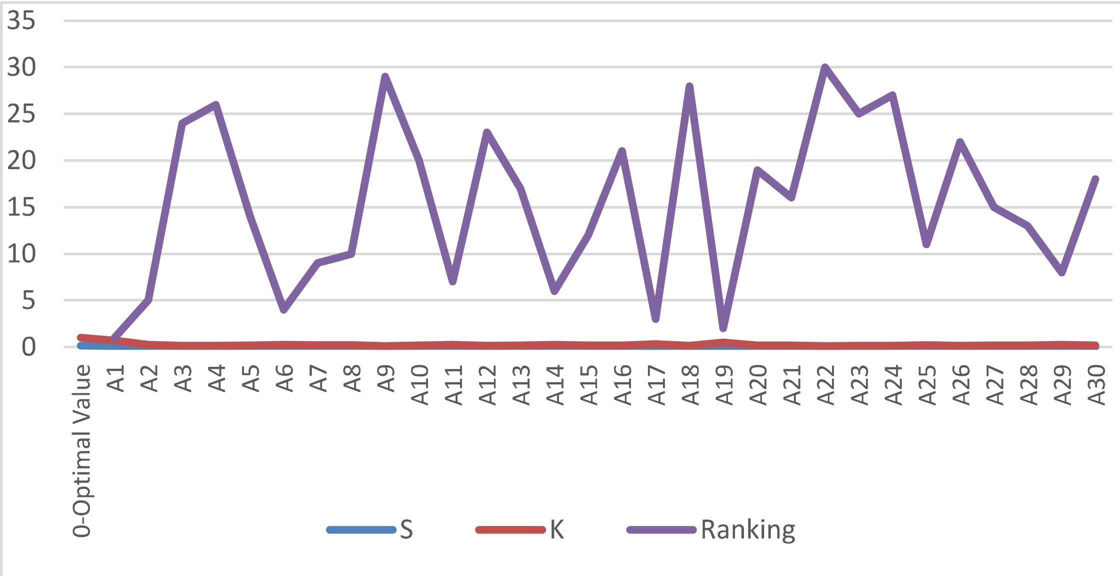
Table 8 and Figure 2 show the decision matrix rankings of the TOPSIS method.

Table 8. Decision matrix rankings

	S	K	Ranking
0-Optimal Value	0.1375	1.0000	
European Union - 28 countries A1	0.0932	0.6778	1
Belgium A2	0.0356	0.2586	5
Bulgaria A3	0.0186	0.1349	24
Czechia A4	0.0171	0.1245	26
Denmark A5	0.0256	0.1860	14
Germany (until 1990 former territory of the FRG) A6	0.0367	0.2668	4
Estonia A7	0.0313	0.2273	9
Ireland A8	0.0302	0.2198	10
Greece A9	0.0154	0.1118	29
Spain A10	0.0226	0.1641	20
France A11	0.0339	0.2463	7
Croatia A12	0.0211	0.1532	23
Italy A13	0.0232	0.1684	17
Cyprus A14	0.0349	0.2539	6
Latvia A15	0.0269	0.1958	12
Lithuania A16	0.0223	0.1619	21
Luxembourg A17	0.0437	0.3174	3
Hungary A18	0.0164	0.1194	28
Malta A19	0.0632	0.4593	2
Netherlands A20	0.0228	0.1657	19
Austria A21	0.0240	0.1746	16
Poland A22	0.0134	0.0974	30
Portugal A23	0.0181	0.1318	25
Romania A24	0.0167	0.1211	27

	S	K	Ranking
Slovenia A25	0.0278	0.2022	11
Slovakia A26	0.0214	0.1555	22
Finland A27	0.0241	0.1749	15
Sweden A28	0.0260	0.1892	13
United Kingdom A29	0.0337	0.2453	8
Serbia A30	0.0230	0.1671	18

Figure 2. Decision matrix rankings



In 2016, in the selected EU Member States, the productivity of retail trade measured by turnover per person employed (expressed in thousands of euros) amounted to: Germany - 311.2, France - 408.3, Italy - 291.0, Spain - 233.2, the United Kingdom - 315.5, Croatia - 137.3, Slovenia - 272.2, and Serbia - 117.1. The productivity of the retail trade of the 'old' Member States was higher than the European Union average (298). As for the productivity of Serbia's retail trade, it was lower than in Croatia and, in particular, Slovenia, but higher in comparison to Bulgaria. It should be noted that the productivity of retail trade in Serbia has recently increased.

Based on the decision matrix rankings obtained using the TOPSIS method, we can conclude that in terms of retail productivity achieved in 2016, Malta ranked first, Cyprus ranked second, Latvia ranked third, and Estonia was fourth, which indicates that retail trade productivity is not related to the size of the market. As for retail productivity in some countries in South-Eastern Europe, Slovenia ranked 11th, Croatia ranked 23rd and Serbia ranked 18th.

Retail productivity is affected by a number of factors. However, the following factors are the ones that depend on companies themselves and their strategic orientation: increasing application of modern cost management concepts (for example, activity-based costing), product category management, Japanese business philosophy, private brand development, increasing organic product sales, accelerated digitalisation of the entire business. The application of new business models in retail trade varies across countries and, as a result, so does their productivity.

Based on the empirical research conducted for the purpose of this paper, we can conclude that retail productivity measured by turnover per person employed (expressed in thousands of euros) in 2016 amounted from 1,551.3 in Luxemburg to 107.5 in Bulgaria (EU average 298). As for Serbia's results, it makes sense to compare them with neighbouring countries or those with similar development trajectory: retail productivity in Croatia was 137.3, in Slovenia it was 272.2 in Slovenia, whereas it amounted to 117.1 in Serbia. The productivity of retail trade of Germany, France, and the United Kingdom was above the European Union average (298). As for the productivity of Serbia's retail trade, it is lower than in Croatia and, in particular, Slovenia. However, it is of note that the productivity in Serbia has been increasing lately.

The decision matrix results obtained using the TOPSIS method show that in 2016 the retail trade of Malta was best ranked. Looking specifically at some countries of South-Eastern Europe (Croatia, Slovenia, Hungary, Romania, Bulgaria, Serbia), Croatia is in the 23th, Slovenia in the 11th, and Serbia in the 18th place. Recently, Serbia experienced an increase in the retail trade productivity as a result of several factors, such as improved general business conditions, reduced public debt, low bank interest rates, stable exchange rate, low inflation, reduced unemployment, increased purchasing power of the population, increasing number of foreign retail chains with new business models (multi-channel retailing, private label, organic products).

As retailers are constantly seeking for ways to increase their productivity and thus profits, further research using the TOPSIS method might provide certain alternative solutions and enable managers to take into account different options. By alternating the factors, i.e. criteria for evaluation, we could detect their impact on the decision matrix rankings and thus determine how they influence the retail trade productivity. Given that business in 2020 has been marked by Covid-19 pandemic and its aftermath, the TOPSIS method will enable us to determine the most significant factors in retail trade productivity during national and local lock-downs once the pandemic is over.

6. CONCLUSION

Retail trade productivity is an important research topic for practical day-to-day business decisions as well as for theoretical considerations on which strategic decisions can be based. In this context, our research using the APH-TOPSIS method shows the recent situation in the EU as a whole, in individual Member States and the Republic of Serbia as a candidate country.

Based on the empirical research conducted for the purpose of this paper, we can conclude that retail trade productivity measured by turnover per person employed (expressed in thousands of euros) in 'new' Member States (i.e. those countries that joined the EU in 2004 or later) was below the European Union average (298). For example, in 2016 it amounted to 241.4 in Estonia, 122.9 in Romania, whereas the lowest value of 107.5 was recorded in Bulgaria.

Based on the decision matrix rankings obtained using the TOPSIS method, we can conclude that in terms of retail productivity achieved in 2016, the European Union viewed as a whole ranked first, Malta ranked second, Luxembourg ranked third, and Germany was fourth. Among the countries of South-Eastern Europe, Slovenia achieved a very good ranking, which is not unexpected given its overall level of development.

Retail productivity is affected by both external and internal factors. Although retail trade is one of the oldest economic sectors, retailers need to apply not only new technologies, but also new business models, such as modern cost management concepts (for example, activity-based costing), product category management, Japanese business philosophy, private brand development, increasing organic product sales, and digitalisation of the entire business and others. Retailers in countries lagging behind in retail productivity need to accelerate the changes in their business practices and adopt modern business models that suit their circumstances and general business environment.

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