Analysis of development and effects of electronic trade in Serbia based on SF-TOPSIS and TOPSIS methods

Анализа развоја и ефекти електронске трговине у Србији на бази SF-ТОПСИС и ТОПСИС метода

Abstract: The issues of measuring and analysing the development dynamics and effects of electronic trade are currently topical, significant and complex in any country, including Serbia. In the observed period from 2017 to 2021, according to the obtained empirical results based on the SF TOPSIS method, the largest number of trading companies introducing e-business (IT technology) and e-trading appeared in Serbia in 2017. According to the obtained empirical results based on the classical TOPSIS method, the largest number of trading companies introducing e-business (IT technology) and e-trading was recorded in Serbia in 2019. The following is the ranking according to the SF-TOPSIS method: 2021, 2018, 2019 and 2020. The ranking according to the TOPSIS method is as follows: 2020, 2021, 2018 and 2017. The digitalisation factors of overall business operation of trade industry in Serbia are the global trend and requirements, degree of development of contemporary IT technology and the possibility of application in all the segments of trading operations, the economic climate, financial opportunities, entry of international retail chains, development of multichannel sale – classic and e-retail facilities, around-the-clock business operations without time and geographical barriers etc. Considering the positive effects, significantly more should be invested in new information and communication technology in the future.

Keywords: development, effects, electronic trade, Serbia, SF-TOPSIS- TOPSIS method

JEL classification: D22, P25


ЈЕЛ класификација: D22, P25
Introduction

The application of modern information and communication technology in trade has a positive effect on sales revenues and costs, i.e. affects the achievement of the target profit (Berman et al., 2018; Levy et al., 2019; Lacey, 2021; Zu et al., 2022; Končar, 2003; Lukic & Vojteski Kljenak, 2017; Kazakov et al., 2021; Lovreta & Petković, 2021; Jorgensen et al., 2022; Miller & Miller, 2021; Miletić et al., 2021, Gluhović, 2020; Lukic, 2022, 2023; Antić et al., 2021). The effects of the improvement of electronic trade are the improvement of the overall performance (higher revenues from sales, lower costs and, finally, higher profits) of trade in Serbia (López González & Jouanjean, 2017; Argilés-Bosch et al., 2022; Gu et al., 2021; Liu et al., 2022; Lukić et al., 2016; Rehman et al., 2022; Tolstoy et al., 2022; Belouaar et al., 2022). This is completely understandable when you take into account the fact that empirical analysis has established that information and communication technology significantly contributes to the improvement of financial performance and efficiency of all sectors, which means trade as well (Lukić, 2011; Berman et al., 2018; Levy et al., 2019; Lovreta & Petković, 2021; Gherghina et al., 2021; Alam et al., 2022).

1. Methodology

The procedure of the SF-TOPSIS method takes place through several stages shown below (Gündoğdu & Kahraman, 2019a,c; Gündoğdu & Kahraman, 2019a,b,c, 2020a,b; Sharaf, 2022).

Let us mark the alternative with \( X = \{ x_1, x_2, ..., x_m \} (x \geq 2) \), the criteria with \( C = \{ C_1, C_2, ..., C_n \} \), and the weight vector of criteria with \( w = \{ w_1, w_2, ..., w_n \} \); \( 0 \leq w_j \leq 1 \) and \( \sum_{j=1}^{n} w_j = 1 \).

Step 1: Using linguistic terms, spherical fuzzy numbers (Gündoğdu & Kahraman, 2019a)

Step 2: Evaluation of decision makers (DM),

that is

\[
   w = (w_1, w_2, ..., w_n); \quad w_j \in [0,1]; \quad \sum_{i=1}^{n} w_i = 1
\]

Spherical Weighted Arithmetic Mean (SWAM) is defined as
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\[ SWAM_w(\tilde{A}_{S1}, \ldots, \tilde{A}_{Sn}) = w_1\tilde{A}_{S1} + w_2\tilde{A}_{S2} + \ldots + w_n\tilde{A}_{Sn} \]

\[ = \left\{ \left[ 1 - \prod_{i=1}^{n} (\mu_{\tilde{A}_{Si}}^2)^{w_i} \right]^{1/2}, \prod_{i=1}^{n} v_{\tilde{A}_{Si}}^{w_i}, \prod_{i=1}^{n} (1 - \mu_{\tilde{A}_{Si}}^2)^{w_i} \right\} \]

\[ = \left\{ \left[ 1 - \prod_{i=1}^{n} (1 - v_{\tilde{A}_{Si}}^2)^{w_i} \right]^{1/2} \right\} \quad (1) \]

that is

\[ w = (w_1, w_2, \ldots, w_n); \quad w_j \in [0,1]; \quad \sum_{i=1}^{n} w_i = 1 \]

Spherical Weighted Geometric Mean (SWGM) is defined as

\[ SWGM_w\left((\tilde{A}_1, \ldots, \tilde{A}_n)\right) = \tilde{A}_{S1}^{w_1} + \tilde{A}_{S2}^{w_2} + \ldots + \tilde{A}_{Sn}^{w_n} \]

\[ = \left\{ \prod_{i=1}^{n} \mu_{\tilde{A}_{Si}}^{w_i}, \left[ 1 - \prod_{i=1}^{n} (1 - v_{\tilde{A}_{Si}}^2)^{w_i} \right]^{1/2}, \prod_{i=1}^{n} (1 - \mu_{\tilde{A}_{Si}}^2)^{w_i} \right\} \]

\[ = \left\{ \prod_{i=1}^{n} (1 - v_{\tilde{A}_{Si}}^2)^{w_i} \right\} \quad (2) \]

2.1: Aggregation of criteria weights

2.2: Aggregated spherical fuzzy decision matrix

Denote the values of the evaluation of alternatives by \( X_i (i = 1, 2, \ldots, m) \), respecting the criteria \( C_j (j = 1, 2, \ldots, n) \), with \( C_j(X_i) = (\mu_{ij}, v_{ij}, \pi_{ij}) \) and \( D = (C_j(X_i))_{m \times n} \) for the purposes of determining the spherical fuzzy decision matrix. For the MCDM problem with SFS (Spherical Fuzzy Set), the decision matrix \( D = (C_j(X_i))_{m \times n} \) is constructed as
Step 3: The aggregated weighted spherical fuzzy decision matrix

The aggregated weighted spherical decision matrix is constructed by applying the following equation:

\[
D = \left( C_j(X_{ij}) \right)_{m \times n}
\]

\[
= \begin{pmatrix}
(\mu_{11}, v_{11}, \pi_{11}) & (\mu_{12}, v_{12}, \pi_{12}) & \ldots & (\mu_{1n}, v_{1n}, \pi_{1n}) \\
(\mu_{21}, v_{21}, \pi_{21}) & (\mu_{22}, v_{22}, \pi_{22}) & \ldots & (\mu_{2n}, v_{2n}, \pi_{2n}) \\
\vdots & \vdots & \ddots & \vdots \\
(\mu_{m1}, v_{m1}, \pi_{m1}) & (\mu_{m2}, v_{m2}, \pi_{m2}) & \ldots & (\mu_{mn}, v_{mn}, \pi_{mn})
\end{pmatrix}
\]  

(3)

Step 4: Diffusing the aggregated decision weight matrix using the following equation

\[
Score \left( C_j(X_{iw}) \right) = \left( 2\mu_{ijw} - \pi_{ijw} / 2 \right)^2 - \left( v_{ijw} - \pi_{ijw} / 2 \right)^2
\]  

(6)

Step 5. Spherical fuzzy positive ideal solution (SF-PIS) and spherical fuzzy negative ideal solution (SF-NIS)

For SF-PIS

\[
X^* = \left\{ \{ C_j, \max_i < Score \left( C_j(X_{iw}) \right) > j = 1,2 \ldots n \} \right\}
\]  

(7)

For SF-NIS

\[
X^* = \left\{ \{ C_j, (\mu'_j, v'_j, \pi'_j), (C_{2j}, (\mu'_2, v'_2, \pi'_2)) \ldots \ldots (C_{nj}, (\mu'_n, v'_n, \pi'_n)) \} \right\}
\]
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\[ X^+ = \left\{ \left( C_j, \min <\text{Score} \left( C_j(X_{i0}) \right) > \right| j = 1, 2 \ldots n \right\} \] (8)

\[ X^- = \left\{ (C_j, (\mu_{C_j}, \nu_{C_j}, \pi_{C_j})) \left| (C_2, (\mu_{C_2}, \nu_{C_2}, \pi_{C_2})) \ldots \ldots (C_n, (\mu_{C_n}, \nu_{C_n}, \pi_{C_n})) \right. \right\} \]

Step 6: The distance between alternatives \( X_t \), SF-PIS and SF-NIS

For SF-NIS

\[
D(X_t, X^-) = \sqrt{\frac{1}{2n} \sum_{i=1}^{n} \left( (\mu_{X_t} - \mu_{X^-})^2 + (\nu_{X_t} - \nu_{X^-})^2 + (\pi_{X_t} - \pi_{X^-})^2 \right)}
\] (9)

For SF-PIS

\[
D(X_t, X^+) = \sqrt{\frac{1}{2n} \sum_{i=1}^{n} \left( (\mu_{X_t} - \mu_{X^+})^2 + (\nu_{X_t} - \nu_{X^+})^2 + (\pi_{X_t} - \pi_{X^+})^2 \right)}
\] (10)

Step 7: The classical proximity ratio

\[
\xi(X_t) = \frac{D(X_t, X^-)}{D(X_t, X^+) + D(X_t, X^-)}
\] (11)

Step 8: Optimal alternatives

Alternatives are ranked in order of decreasing proximity value.

The stages of the TOPSIS method are as follows (Hwang & Yoon, 1981, 1995; Young et al., 1994; Üçüncü et al., 2018):

Step 1: Creating the initial matrix

\[
A_{ij} = \begin{bmatrix}
    a_{11} & a_{12} & \ldots & a_{1n} \\
    a_{21} & a_{22} & \ldots & a_{2n} \\
    \vdots & \vdots & \ddots & \vdots \\
    a_{m1} & a_{m2} & \ldots & a_{mn}
\end{bmatrix}
\]

Step 2: The weighted normalized decision matrix

\[
r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{t=1}^{m} a_{ij}^2}}
\] (12)

\[ t = 1, 2, 3, \ldots, m \quad j = 1, 2, 3, \ldots, n \]
\[ V_{ij} = W_{ij} \times r_{ij}, i = 1,2,3,\ldots, m, j = 1,2,3,\ldots, n \] (13)

**Step 3:**
- \((A^+)\) Positive ideal solution; \((A^-)\) Negative ideal solution
  
  \[ A^+ = \{ v_{ij}^+, \ldots, v_{m}^+ \} = \left\{ \left( \max_{i} v_{ij}, j \in j \right) \left( \min_{i} v_{ij}, j \in j' \right) \right\} i = 1,2,\ldots, m \] (14)
  
  \[ A^- = \{ v_{ij}^-, \ldots, v_{m}^- \} = \left\{ \left( \min_{i} v_{ij}, j \in j \right) \left( \max_{i} v_{ij}, j \in j' \right) \right\} i = 1,2,\ldots, m \] (15)

(j benefit criterion, j' cost criterion.)

**Step 4:**
- \((S_{ij}^+)\) Positive ideal solution; \((S_{ij}^-)\) Negative ideal solution:
  
  \[ S_{ij}^+ = \sum_{j=1}^{n} (v_{ij} - v_{i}^+)^2 \] (16)
  
  \[ S_{ij}^- = \sum_{j=1}^{n} (v_{ij} - v_{i}^-)^2 \] (17)

\[ i = 1,2,3,\ldots, m, j = 1,2,3,\ldots, n \]

**Step 5:**
The relative closeness to the ideal solution \((C_{ij}^+)\)

It is determined as follows:

\[ (C_{ij}^+; i=1,\ldots, m; j=1,\ldots, n): \]

\[ C_{ij}^+ = \frac{S_{ij}^-}{S_{ij}^- + S_{ij}^+}, i = 1,2,3,\ldots, m \] (18)

**Step 6:**
Optimal alternatives

High scores correspond to better performance (Üçüncü et al., 2018).

### 2. Results

The initial statistical data of EUROSTAT indicators for the period 2017 - 2021 are presented in Table 1 and Figure 1. (All calculations and results are the author's.)
Table 1: Indicators

<table>
<thead>
<tr>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
<th>C9</th>
<th>C10</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 2017</td>
<td>23</td>
<td>1</td>
<td>23</td>
<td>14</td>
<td>17</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>A2 2018</td>
<td>21</td>
<td>0</td>
<td>21</td>
<td>9</td>
<td>20</td>
<td>0</td>
<td>4</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>A3 2019</td>
<td>40</td>
<td>6</td>
<td>0</td>
<td>26</td>
<td>25</td>
<td>7</td>
<td>7</td>
<td>23</td>
<td>18</td>
</tr>
<tr>
<td>A4 2020</td>
<td>33</td>
<td>3</td>
<td>32</td>
<td>21</td>
<td>26</td>
<td>0</td>
<td>13</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>A5 2021</td>
<td>35</td>
<td>1</td>
<td>35</td>
<td>22</td>
<td>26</td>
<td>2</td>
<td>10</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: Eurostat
Table 2 shows descriptive statistics of indicators of electronic commerce in Serbia.

### Table 2: Descriptive statistics

<table>
<thead>
<tr>
<th>Statistics</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
<th>C9</th>
<th>C10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>33.0000</td>
<td>1.0000</td>
<td>23.0000</td>
<td>21.0000</td>
<td>25.0000</td>
<td>2.0000</td>
<td>7.0000</td>
<td>7.0000</td>
<td>6.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>Minimum</td>
<td>21.00</td>
<td>0.00</td>
<td>0.00</td>
<td>9.00</td>
<td>17.00</td>
<td>.00</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Maximum</td>
<td>40.00</td>
<td>9.00</td>
<td>95.00</td>
<td>26.00</td>
<td>26.00</td>
<td>7.00</td>
<td>13.00</td>
<td>23.00</td>
<td>18.00</td>
<td>5.00</td>
</tr>
</tbody>
</table>
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Descriptive statistics show that the criteria range from C1 21.00 (2018) to 40.00 (2019), from C2 .00 (2018) to 6.00 (2019), from C3 .00 (2019) to 35.00 (2021), from C4 9.00 (2018) to 26.00 (2019), from C5 17.00 (2017) to 26.00 (2020, 2021), from C6 .00 (2018,2020) to 7.00 (2019), from C7 4.00 (2017,2018) to 13.00 (2020), from C8 5.00 (2017) to 23.00 (2019), from C9 4.00 (2017) to 18.00 (2019) and from C10 1.00 (2017,2018,2021) to 5.00 (2019). The averages are C1 30.4000, C2 2.2000, C3 22.200, C4 18.4000, C5 22.8000, C6 1.6000, C7 7.600, C8 10.800, C9 8.600 and C10 2.200. Therefore, the importance of e-commerce in Serbia has increased recently.

The correlation between criteria C1 and C4 is strong, and at the level of statistical significance (Table3).

Table 3: Correlations

<table>
<thead>
<tr>
<th>Correlations</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 C1 Pearson Correlation</td>
<td>1</td>
<td>0.808</td>
<td>-0.277</td>
<td>0.984**</td>
<td>0.855</td>
<td>0.486</td>
<td>0.629</td>
<td>0.738</td>
<td>0.731</td>
<td>0.751</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.098</td>
<td>0.652</td>
<td>0.065</td>
<td>0.406</td>
<td>0.256</td>
<td>0.155</td>
<td>0.161</td>
<td>0.143</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 C2 Pearson Correlation</td>
<td>0.808</td>
<td>1</td>
<td>-0.688</td>
<td>0.809</td>
<td>0.518</td>
<td>0.685</td>
<td>0.305</td>
<td>0.967**</td>
<td>0.958**</td>
<td>0.983**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.098</td>
<td>0.200</td>
<td>0.097</td>
<td>0.372</td>
<td>0.202</td>
<td>0.618</td>
<td>0.007</td>
<td>0.010</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>3 C3 Pearson Correlation</td>
<td>-0.277</td>
<td>-0.688</td>
<td>1</td>
<td>-0.239</td>
<td>0.099</td>
<td>0.777</td>
<td>0.458</td>
<td>-0.755</td>
<td>-0.768</td>
<td>-0.704</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.652</td>
<td>0.200</td>
<td>0.698</td>
<td>0.874</td>
<td>0.122</td>
<td>0.438</td>
<td>0.141</td>
<td>0.130</td>
<td>0.184</td>
<td></td>
</tr>
<tr>
<td>4 C4 Pearson Correlation</td>
<td>0.984**</td>
<td>0.809</td>
<td>-0.239</td>
<td>1</td>
<td>0.795</td>
<td>0.530</td>
<td>0.837</td>
<td>0.698</td>
<td>0.685</td>
<td>0.731</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.002</td>
<td>0.097</td>
<td>0.698</td>
<td>0.108</td>
<td>0.358</td>
<td>0.248</td>
<td>0.900</td>
<td>0.292</td>
<td>0.160</td>
<td></td>
</tr>
<tr>
<td>5 C5 Pearson Correlation</td>
<td>0.855</td>
<td>0.518</td>
<td>0.099</td>
<td>0.795</td>
<td>1</td>
<td>0.029</td>
<td>0.864</td>
<td>0.512</td>
<td>0.508</td>
<td>0.520</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.065</td>
<td>0.372</td>
<td>0.784</td>
<td>0.108</td>
<td>0.963</td>
<td>0.066</td>
<td>0.377</td>
<td>0.382</td>
<td>0.369</td>
<td></td>
</tr>
<tr>
<td>6 C6 Pearson Correlation</td>
<td>0.486</td>
<td>0.685</td>
<td>-0.777</td>
<td>0.530</td>
<td>-0.029</td>
<td>1</td>
<td>0.297</td>
<td>0.591</td>
<td>0.592</td>
<td>0.584</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.406</td>
<td>0.202</td>
<td>0.122</td>
<td>0.358</td>
<td>0.963</td>
<td>0.297</td>
<td>0.729</td>
<td>0.293</td>
<td>0.301</td>
<td></td>
</tr>
<tr>
<td>7 C7 Pearson Correlation</td>
<td>0.629</td>
<td>0.305</td>
<td>0.458</td>
<td>0.637</td>
<td>0.854</td>
<td>-0.297</td>
<td>1</td>
<td>0.235</td>
<td>0.214</td>
<td>0.300</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.256</td>
<td>0.618</td>
<td>0.438</td>
<td>0.248</td>
<td>0.066</td>
<td>0.627</td>
<td>0.703</td>
<td>0.729</td>
<td>0.624</td>
<td></td>
</tr>
</tbody>
</table>

The correlation between criteria C1 and C4 is strong, and at the level of statistical significance (Table 3).
Non-parametric tests are presented in Table 4.

### Table 4: Npar Tests – Friedman Test

<table>
<thead>
<tr>
<th>Ranks</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>9.70</td>
</tr>
<tr>
<td>C2</td>
<td>2.00</td>
</tr>
<tr>
<td>C3</td>
<td>7.70</td>
</tr>
<tr>
<td>C4</td>
<td>7.40</td>
</tr>
<tr>
<td>C5</td>
<td>8.00</td>
</tr>
<tr>
<td>C6</td>
<td>2.80</td>
</tr>
<tr>
<td>C7</td>
<td>4.80</td>
</tr>
<tr>
<td>C8</td>
<td>5.90</td>
</tr>
<tr>
<td>C9</td>
<td>4.60</td>
</tr>
<tr>
<td>C10</td>
<td>2.10</td>
</tr>
</tbody>
</table>

### Test Statistics*

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>5</td>
</tr>
<tr>
<td>Chi-Square</td>
<td>35.967</td>
</tr>
<tr>
<td>df</td>
<td>9</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>

*Non-parametric tests are presented in Table 4.
A n a l y s i s  o f  d e v e l o p m e n t  a n d  e f f e c t s  o f  e l e c t r o n i c  t r a d e  i n  
S e r b i a  b a s e d  o n  S F - T O P S I S  a n d  T O P S I S  m e t h o d s

Source: the author's statistics

There is a significant statistical difference between the given variables (Asymp. Sig. .000 < .05).

The Relative Closeness Ratio is shown in Table 5 and Figure 2.

Table 5: Relative Closeness Ratio

<table>
<thead>
<tr>
<th>Year</th>
<th>D(A, A+)</th>
<th>D(A, A-)</th>
<th>Closeness Ratio</th>
<th>Closeness Ratio</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017 - A1</td>
<td>0.088</td>
<td>0.179</td>
<td>0.000</td>
<td>1.000</td>
<td>1</td>
</tr>
<tr>
<td>2018 - A2</td>
<td>0.145</td>
<td>0.133</td>
<td>0.907</td>
<td>0.907</td>
<td>3</td>
</tr>
<tr>
<td>2019 - A3</td>
<td>0.153</td>
<td>0.129</td>
<td>1.024</td>
<td>1.024</td>
<td>4</td>
</tr>
<tr>
<td>2020 - A4</td>
<td>0.165</td>
<td>0.105</td>
<td>1.294</td>
<td>1.294</td>
<td>5</td>
</tr>
<tr>
<td>2021 - A5</td>
<td>0.113</td>
<td>0.152</td>
<td>0.444</td>
<td>0.444</td>
<td>2</td>
</tr>
</tbody>
</table>

MIN       0.088     0.179
MAX

a. Friedman Test
The dynamic selection and ranking of electronic trade in Serbia according to the SF-TOPSIS method is as follows: 2017, 2021, 2018, 2019 and 2020. Recently, therefore, the results have been positive. In the future, considering the positive effects, significantly more should be invested in new information and communication technology.

Table 6 and Figure 3 show the results.

<table>
<thead>
<tr>
<th>Year</th>
<th>Ranking</th>
<th>Si+</th>
<th>Si-</th>
<th>Ci</th>
<th>Ci</th>
<th>Closeness Ratio</th>
<th>Closeness Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017 A1</td>
<td>4</td>
<td>1.0023</td>
<td>0.1381</td>
<td>0.121</td>
<td>0.121</td>
<td>4</td>
<td>0.121</td>
</tr>
<tr>
<td>2018 A2</td>
<td>5</td>
<td>0.7780</td>
<td>0.0851</td>
<td>0.0986</td>
<td>0.099</td>
<td>5</td>
<td>0.099</td>
</tr>
<tr>
<td>2019 A3</td>
<td>1</td>
<td>0.2249</td>
<td>0.9822</td>
<td>0.8137</td>
<td>0.814</td>
<td>1</td>
<td>0.814</td>
</tr>
<tr>
<td>2020 A4</td>
<td>2</td>
<td>0.5146</td>
<td>0.5914</td>
<td>0.5347</td>
<td>0.535</td>
<td>2</td>
<td>0.535</td>
</tr>
<tr>
<td>2021 A5</td>
<td>3</td>
<td>0.8914</td>
<td>0.4216</td>
<td>0.3211</td>
<td>0.321</td>
<td>3</td>
<td>0.321</td>
</tr>
</tbody>
</table>
The ranking results are as follows: (1) SF-TOPSIS method: 2017, 2021, 2018, 2019 and 2020; (2) TOPSIS: 2019, 2020, 2021, 2017 and 2018. The conclusion is that e-commerce in Serbia has improved recently. This had a positive impact on the overall performance of trade in Serbia.

**Discussion**

In order to obtain as complete a picture as possible of the dynamics of the development and effects of electronic trade in Serbia, it is recommended that the analysis be carried out continuously using not only the analysed (SF-TOPSIS, TOPSIS) but also other multi-criteria decision-making methods (MABAC, MARCOS, LMAW-DNMA, etc.).

The SF-TOPSIS method is based on linguistic terms and their assignment to certain criteria by decision makers. To a large extent, it depends on the expertise of the decision-makers, which linguistic term will be assigned to certain criteria, and thus the accuracy of the results obtained. It has elements of “subjectivity”. However, regardless of certain elements of “subjectivity” in both methods, those in relation compared to classical methods, for example, ratio analysis, they give more precise results because they simultaneously take into account several criteria – integrated which is not the case with ratio analysis, where each indicator – criterion is considered in isolation.

In any case, it can be freely said that compared to traditional methods, multi-criteria decision-making methods give more precise results in terms of understanding the dynamics of development and effects of electronic trade in Serbia.
of the development of electronic commerce, because they simultaneously include several criteria viewed as factors. For these reasons, their application in the analysis of electronic commerce is recommended.

**Conclusion**

The ranking results are as follows: (1) SF-TOPSIS method: 2017, 2021, 2018, 2019 and 2020; (2) TOPSIS: 2019, 2020, 2021, 2017 and 2018. By themselves, they point to the general conclusion that electronic trade in Serbia has improved recently. Considering the positive effects in the future, as much as possible should be invested in improving the information and communication technology of trade in Serbia.

**References**


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