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SELECTION WITH TOPSIS METHOD AMONG OF EU CANDIDATE AND PRE-ACCESSION COUNTRIES

Abstract: *The paper deals with issues of admission of countries in the European Union, which is discussed in terms of economic criteria and political criteria. The authors analyse this problem on the basis of economic criteria assessed by the EU. There are various methods to evaluate the variants, while the authors have chosen the TOPSIS method. The result of this method of multi-criterial evaluation of variants is the arrangement of alternatives, in our case – candidates and potential candidates for admission to the EU on the basis of GDP criteria (in real terms, annual % change), unemployment (LFS, in % of workface), current account balance (% of GDP), and inflation (consumer price index, annual % change), while it was EU reports that have been used as input data.*

Keywords: *EU, multi-criterial decision making, TOPSIS*

JEL: C 6, C 61, C 63

Introduction

After signing The Treaty on European Union (EU) in Maastricht, the EU has been enlarged three times. The first enlargement occurred on 1 January 1995 when Austria, Finland and Sweden joined the EU. Then, on 1 May 2004, the Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Slovenia, Slovakia, Cyprus, and Malta also became members. Finally, two more countries from Eastern Europe joined the EU, Bulgaria and Romania, bringing the number of member states to 27 countries on 1 May 2007. Croatia, the former Yugoslav Republic of Macedonia, Iceland, and Turkey are also candidates for future EU membership. EU Candidate and Pre-Accession Countries, Economic Quarterly Report was published by the European Commission on 8 July 2010. In this report, 4 candidate countries and 5 potential candidate countries have been compared by some economic data (European Commission, EU Candidate and Pre-Accession Countries Quarterly Report, July 2010)

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In this case, by using TOPSIS Method, we have determined which country is going to join the EU. We have considered four criteria in this study, namely: GDP (in real terms, annual % change), Unemployment (LFS, in % of workface), Current account balance (% of GDP) and Inflation (Consumer price index, annual % change). TOPSIS is a method to solve multiple criteria decision-making problems. The problem is to arrange countries between candidate and potential candidate countries by using some economic data. Next section briefly discusses the methodology of TOPSIS. Then, we apply the TOPSIS method to the selection of EU Candidate and Potential Candidate countries. Finally, concluding remarks are drawn in the last section.

1 TOPSIS Methodology

When a decision maker has to choose one from among a number of possible actions, the ultimate consequences of some, if not all of these actions, will generally depend on uncertain events and future actions extending indefinitely far into the future.

Upon systematically describing the problem and recording all necessary data, judgments, and preferences, the decision maker has to synthesize the information set before him/her using the most appropriate decision rules. A tool commonly used to display information needed for the decision process is a payoff matrix or decision table.

These actions represent controllable variables in the system. The uncertain events or states of nature are represented [6], [7].

The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), firstly introduced by Hwang and Yoon, is a multi-criteria decision-making (MCDM) methodology based on the assumption that the best alternative should be as close as possible to the ideal solution and the farthest from the negative-ideal solution [3], [1] .

The principle of compromise (of TOPSIS) for MCDM is that the chosen solution should have the shortest distance from the positive ideal solution as well as the longest distance from the negative ideal solution [8], [5].

TOPSIS defines an index called similarity to the positive-ideal solution by combining the proximity to the positive-ideal solution and remoteness from the negative-ideal solution. Then the method chooses an alternative with the maximum similarity to the positive-ideal solution. The method is presented as a series of successive steps:

Step 1: Calculate Normalized Ratings: The vector normalization is used for computing$_{ij}$, which is given as

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad i = 1,\ldots,m \text{ and } j = 1,\ldots,n \qquad [1]$$

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Step 2: Calculate Weighted Normalized Ratings: The weighted normalized value is calculated as

$$\boldsymbol{v}_{ij} = \boldsymbol{w}_j * \boldsymbol{r}_{ij} \quad i = 1,2,...,m;\ j = 1,2,...,n \qquad [2]$$

where $_{w_j}$ is the weight of the $_{j}$ attribute.

Step 3: Identify Positive-Ideal and Negative-Ideal Solutions: The $_{A^*}$ and $_{A^-}$ are defined in terms of the weighted normalized values:

$$A^* = \left\{v_1^*, v_2^*, ..., v_j^*, ..., v_n^*\right\} = \left\{(\max v_{ij} \,|\, j \in J_1\ ),\ (\min v_{ij} \,|\, j \in J_2) \,|\, i = 1, 2, ..., m\right\} \qquad [3]$$

$$A^- = \left\{v_1^-, v_2^-, ..., v_j^-, ..., v_n^-\right\} = \left\{(\min v_{ij} \,|\, j \in J_1),\ (\max v_{ij} \,|\, j \in J_2) \,|\, i = 1, 2, ..., m\right\} \qquad [4]$$

where J_1 is a set of benefit attributes and J_2 is a set of cost attributes.

Step 4: Calculate Separation Measures: The separation between alternatives can be measured by the n-dimensional Euclidean distance. The separation of each alternative from the positive-ideal solution, $_{A^-}$, is then given by

$$S_i^* = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_j^*\right)^2}, i = 1, 2, \ldots, m \qquad [5]$$

Similarly, the separation from the negative-ideal solution, $_{A^-}$, is given by

$$S_i^- = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_j^-\right)^2}, \quad i = 1, 2, \ldots, m \qquad [6]$$

Step 5: Calculate Similarities to Positive-Ideal Solution:

$$C_i^* = \frac{S_i^-}{\left(S_i^* + S_i^-\right)} \quad i = 1, 2, \ldots, m \quad 0 \le C_i^* \le 1 \qquad [7]$$

Step 6: Rank Preference Order:
Choose an alternative with the maximum C_i^* or rank alternatives in descending order.

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2 Numerical Example

While building up the main body of decision matrix the arithmetic means of the considered data were calculated from 2005 to 2009. The evaluation process is valid for all the countries which are dealt with in the report. Finally, weights of the attributes are determined by the Laplace Criterion.

The Laplace insufficient reason criterion postulates that if no information is available about the probabilities of the various outcomes, it is reasonable to assume that they are equally likely. Therefore, if there are *n* outcomes, the probability of each is 1/*n*. The use of expected values distinguishes this approach from the criteria that use only extreme payoffs. This characteristic makes the approach similar to decision making under risk [4].

Finally, according to the report data, the best solution had been chosen using TOPSIS.

The data of nine countries related to each attribute are given in Table 1. Also, weights of each attribute are given in Table 1.

Table 1

The Data of Nine Countries

	GDP (in real terms, annual % change)	Unemployment (LFS, in % of workforce)	Current account balance (% of GDP)	Inflation (Consumer price index, annual % change).
Croatia	2.2	15.48	-6.98	3.58
The FYR of Macedonia	3.7	34.84	-5.76	2.7
Iceland	2.52	3.6	-15.78	8.1
Turkey	3.2	11.02	-4.9	8.66
Albania	5.64	13.48	-11.32	2.66
Bosnia Herzegovina	3.74	43.02	-11.58	3.78
Montenegro	5.02	13.44	-30.52	4.1
Serbia	4.04	18.86	-12.52	11.4
Kosovo	4.2	44.35	-11.5	2.12
Weights	0.25	0.25	0.25	0.25

Source: [2].

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Step 1. *Normalization:*
Since each attribute is measured on a different scale, normalization is required. By using equation [1] the normalized ratings are calculated and given in Table 2.

Table 2

The Normalized Ratings

	GDP (in real terms, annual % change)	Unemployment (LFS, in % of workforce)	Current account balance (% of GDP)	Inflation (Consumer price index, annual % change).
Croatia	0.1859	0.1978	-0.1628	0.1961
The FYR of Macedonia	0.3126	0.4452	-0.1344	0.1479
Iceland	0.2129	0.0460	-0.3681	0.4437
Turkey	0.2704	0.1408	-0.1143	0.4743
Albania	0.4765	0.1723	-0.2641	0.1457
Bosnia Herzegovina	0.3160	0.5498	-0.2701	0.2070
Montenegro	0.4241	0.1718	-0.7120	0.2246
Serbia	0.3413	0.2410	-0.2921	0.6244
Kosovo	0.3549	0.5668	-0.2683	0.1161

Source: Authors.

Step 2. *Weighted Normalization:*
The chosen weights are equal and each column of the normalized rating matrix according to equation [2]. The results are given in Table 3.

Table 3

The Normalized Rating Matrix

	GDP (in real terms, annual % change)	Unemployment (LFS, in % of workface)	Current account balance (% of GDP)	Inflation (Consumer price index, annual % change).
Croatia	0.0465	0.0495	-0.0407	0.0490
The FYR of Macedonia	0.0782	0.1113	-0.0336	0.0370
Iceland	0.0532	0.0115	-0.0920	0.1109
Turkey	0.0676	0.0352	-0.0286	0.1186
Albania	0.1191	0.0431	-0.0660	0.0364
Bosnia Herzegovina	0.0790	0.1374	-0.0675	0.0518
Montenegro	0.1060	0.0429	-0.1780	0.0561
Serbia	0.0853	0.0603	-0.0730	0.1561
Kosovo	0.0887	0.1417	-0.0671	0.0290

Source: Authors.

Step 3. *Positive- Ideal and Negative- Ideal Solutions:*
By using equations [3] and [4], positive-ideal and negative-ideal solutions are calculated. Since all chosen attributes are of benefit the positive-ideal solution consists of the largest value of each column, which is denoted by the symbol "*" in Table 4. The collection of the smallest values of each column in Table 4, which are denoted by "–", makes the negative-ideal solution.

Table 4

Positive and Negative Ideal Solutions

	GDP (in real terms, annual % change)	Unemployment (LFS, in % of workforce)	Current account balance (% of GDP)	Inflation (Consumer price index, annual % change).
A^*	0.1191	0.1417	-0.0286	0.1561
A^-	0.0465	0.0115	-0.1780	0.0290

Source: Authors.

Step 4. *Separation Measures:*
Separation measures from $_{A^*}$ and $_{A^-}$ is computed by using equations [5] and [6], respectively. Separation measures of all are given in Table 5.

Table 5

Separation Measures

	S^*	S^-
Croatia	0.1594	0.1438
The FYR of Macedonia	0.1297	0.1785
Iceland	0.1654	0.1189
Turkey	0.1241	0.1771
Albania	0.1595	0.1374
Bosnia Herzegovina	0.1185	0.1722
Montenegro	0.2055	0.0726
Serbia	0.0987	0.1762
Kosovo	0.1362	0.1762

Source: Authors.

Step 5. Similarities to Positive- Ideal Solution:
Equation [7] expresses all similarities to the positive-ideal solutions. The results are close to those in Table 6.

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Table 6

Similarities to Positive-Ideal Solution

Serbia	C_{SB}	0.641
Bosnia Herzegovina	C_{BIH}	0.592
Turkey	C_{TR}	0.588
The FYR of Macedonia	C_{MK}	0.579
Kosovo	C_{KOS}	0.564
Croatia	C_{HR}	0.474
Albania	C_{AL}	0.463
Iceland	C_{IS}	0.418
Montenegro	C_{MNE}	0.261

Source: Authors.

Step 6. *Preference Rank:*
Based on the descending order of C_i^*, the preference order is as follows: Serbia, Bosnia &Herzegovina, Turkey, The FYR of Macedonia, Kosovo, Croatia, Albania, Iceland, and Montenegro.

Conclusion

In this study, our aim is to make selection from among four candidate countries and five potential candidates using TOPSIS method.

The result shows that the EU is not only an economic union also political union. Because, when comparing candidate and potential candidates in this country group, we find that despite being the 15th major economy in the world, Turkey is still waiting to be admitted to the EU.

TOPSIS method seems to be promising for the selection of EU candidate country. Moreover, we would like to emphasize that this study is a heuristic; and in the future other methods could be used which might lead to different solutions and results.

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