The comparison of MCDM Methods including AHP, TOPSIS and MAUT with an Application on Gender Inequality Index

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Abstract

Gender Inequality Index is a major indicator presenting level of development of the countries as Human Development Index, which is calculated regularly every year by UN. In this study, an alternative calculation has been proposed for measuring gender inequality index which is an important barrier for the human development. Each indicator in the index integrated as MAUT- AHP and also AHP-TOPSIS and these methods carried out again for the alternative ranking member and candidate countries of the European Union. The main objective here is to represent that the indicators form gender inequality index can be reclassified with different weights for each indicator.

Keywords: Development Indexes, Gender Inequality Index, AHP, TOPSIS, MAUT

Introduction

Gender inequality index (GII) which highlights women's empowerment is one of development indices to strengthen the information having from human development index. Human Development Report produces four composite measures which are Human Development Index, Inequality-adjusted Human Development Index, Gender Inequality Index and the Multidimensional Poverty Index since 2010. Gender Inequality Index presents the loss in potential human development due to distinction between females and males. GII ranges between 0 and1 and higher GII values refers to higher levels of inequalities (HDR, 2015). It is a composite measure with three dimensions which are reproductive health, empowerment and the labor market. The maternal mortality ratio and the adolescent birth rate are the indicators of reproductive health. The share of parliamentary seats held by the woman and the share of population with at least some secondary school are dimensions for empowerment. And participation in the labor force is the measure for labor market (HDR, 2015).

Multi-Criteria Decision Analysis (MCDA) have a widespread applications area in the world. In recent years MCDA methods has been used by combining two or more methods to create more successful methods. Lai (1995) represented the relationship between AHP and MAUT and proved that AHP-MAUT is combined in a consistent structure. Supçiller and Çapraz (2011) realized supplier selection applications by using AHP-TOPSIS. Tyagia M. , Kumar P. , Kumar D. (2014) developed a hybrid model using AHP-TOPSIS for analyzing e-SCM performance. Zolfani, Jurgita and Inzinerine (2012) presented a hybrid model based on AHP -TOPSIS and perform personnel selection. Valim et. al. (2013) compared AHP and MAUT methods for suppliers selection for an industrial company. On the other hand, Safari and Ebrahimi(2014) ranked the countries in terms of Human Development Index by using modified similarity multiple criteria decision making techniques. In this study we developed and compared two hybrid models which based on AHP-TOPSIS and AHP-MAUT for ranking member and candidate of the European Countries in terms of Gender Inequality Index. It is concluded that AHP-MAUT hybrid model gives more reasonable results than AHP-TOPSIS model.

Research Methods:

In this study the methods commonly used in the literature TOPSIS&AHP and AHP&MAUT are integrated and proposed as an alternative methods doing fair classification for the indicators form gender inequality index.

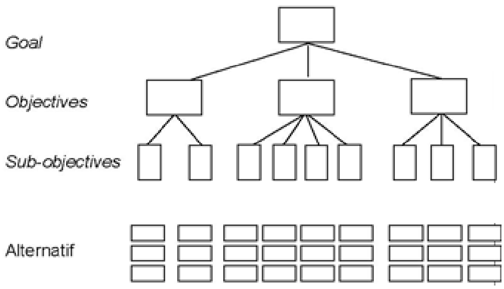
Methodology:

In this section we give brief explanations about the methods used in this study.

AHP:

The Analytic Hierarchy Process (AHP) introduced by Saaty is a multi-criteria decision-making technique to solve complex decision problems (1977 and 1994). This method uses a multi-level hierarchical structure of objectives, criteria, sub criteria, and alternatives (Figure 1). AHP is a preferable model due to its easy to use has been extensively studied and is used in a wide variety of decision situations by many researchers, in fields such as, business, industry, healthcare etc.

Figure 1: Hierarchical Structure of AHP



AHP methodology can be implemented in three steps. Each step needs to be performed to be resolved in a decision-making problem with AHP are described below. In the following m refers to the alternative numbers and n refers to the criteria numbers.

Step 1: It can be stated objective (goal) and in turn defined the criteria picked the alternatives.

Step 2: In this step firstly, elements can be compared to one another, two at a time, with respect to their importance on an element above them in the hierarchy and then structured the comparison matrix (a square matrix of size n×n). All values of each cells that are on the diagonal are mathematical inverses of each other ($a_{ii} = 1$ and $a_{ij} = 1/a_{ji}$). The preference strength is expressed on a ratio scale of 1-9 (Saaty, 1980).

$$A = \begin{bmatrix} 1 & a_{12} & \dots & a_{1n} \\ \frac{1}{a_{21}} & 1 & \dots & . \\ . & & & . \\ . & & & . \\ . & & & . \\ \frac{1}{a_{n1}} & . & \dots & 1 \end{bmatrix} \quad (1)$$

The *Standard Preference Scale* used in the AHP method is provided in Table 1 as follows. In the AHP method, the scale range 1–9 is assumed sufficiently representing human beings' perception.

Preference Level	Numerical Value
Equally Preferred	1
Equally to Moderately Preferred	2
Moderately Preferred	3
Moderately to Strong Preferred	4
Strongly Preferred	5
Strongly to Very Strongly Preferred	6
Very Strongly Preferred	7
Very Strongly to Extremely Preferred	8
Extremely Preferred	9

Table 1: Preference Scale for Pairwise Comparisons

Step 3: It has been normalized each matrix element by the sum of elements in each column and we calculate the sum for each row. B column vectors are utilized in the calculation of the equation (2). Priority vector which is specified below by W column vector is obtained by forming the arithmetic average of the each line of the B matrix.

$$W = \begin{bmatrix} w_1 \\ w_2 \\ . \\ . \\ . \\ w_n \end{bmatrix}, \; w_i = \frac{\sum_{j=1}^{n} b_{ij}}{n} \qquad (2)$$

Measuring consistency of the judgements, Saaty(1980) proposed Consistency Index (CI), which is a measure consistency of the subjective judgements. It is calculated given following formula below;

$$CI = \frac{maks.\ eigenvalue - n}{n-1} \qquad (3)$$

$$maks.eigenvalue = \sum_i wi.ci \qquad (4)$$

Consistency Index is used by comparing a value called *Random Consistency Index* (RI). There are different *Random Consistency Index* values used by different researchers in the literature. In this study, the values given in the following table are used.

Table 1: Random Consistency Index Values (Malczewski, 1999)

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0, 00	0, 00	0, 58	0, 90	1, 12	1, 24	1, 32	1, 41	1, 45	1, 49	1, 51	1, 48	1, 56	1, 56	1, 59

The consistency ratio (CR) is obtained by comparing CI with the set of numbers called random consistency index (RI) with the following formula given below.

$$CR = \frac{CI}{RI} \tag{5}$$

If Consistency Ratio is greater than 10%, test results are inconsistent (CR ≥ 10%), then the result from the AHP method will be of no use in decision making. The higher consistency ratio, the assessment result becomes more inconsistent.

TOPSIS Method:

The TOPSIS method was initially presented by Yoon and Hwang (Yoon and Hwang, 1981) and Lai, Liu and Hwang (Lai, Liu and Hwang, 1994). This method is a process of finding the best solution among all practical alternatives. TOPSIS is based on that the chosen alternative should have the shortest geometric distance from the positive ideal solution (PIS) (Assari, A. , Mahesh, T. , Assari, E. , 2012) and the longest geometric distance from the negative ideal solution (NIS). The TOPSIS method is expressed with six steps as follows:

Step 1: Firstly create an evaluation matrix consisting of m alternatives and n criteria, with the intersection of each alternative and criteria given as a_{ij}, therefore a matrix in form $(a_{ij})m\times n$

$$A_{ij} = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ . & & & . \\ . & & & . \\ . & & & . \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix} \tag{6}$$

Step 2: Calculate the normalized decision matrix. The normalized value r_{ij} is calculated as follows:

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{k=1}^{m} a_{kj}^2}} \quad i = 1, 2, \ldots, m, \; j = 1, 2, \ldots, n \quad R_{ij} = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ . & & & . \\ . & & & . \\ . & & & . \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix} \tag{7}$$

Step 3: Calculate the weighted normalized decision matrix. The weighted normalized value v_{ij} is calculated as follows;

$$V_{ij} = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & \cdots & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} & \cdots & w_n r_{2n} \\ . & & & . \\ . & & & . \\ . & & & . \\ w_1 r_{m1} & w_2 r_{m2} & \cdots & w_n r_{mn} \end{bmatrix} \tag{8}$$

Where w_j is the weight of the j^{th} criterion and

$$\sum_{j=1}^{n} w_j = 1$$

Step 4: Determine the ideal (A^*) and negative ideal (A^-) solutions.

$$A^* = \{(\max_i v_{ij} \mid j \in C_b), (\min_i v_{ij} \mid j \in C_c)\} = \{v_j^* \mid j = 1,2,\ldots,m\}$$

$$A^- = \{(\min_i v_{ij} \mid j \in C_b), (\max_i v_{ij} \mid j \in C_c)\} = \{v_j^- \mid j = 1,2,\ldots,m\} \tag{9}$$

Step 5: Calculate the separation measures using the m-dimensional Euclidean distance. Determine the worst alternative and the best alternative, respectively, are as follows:

$$S_i^* = \sqrt{\sum_{j=1}^{m}(v_{ij}-v_j^*)^2},\ j=1,2,...,m \tag{10}$$

$$S_i^- = \sqrt{\sum_{j=1}^{m}(v_{ij}-v_j^-)^2},\ j=1,2,...,m \tag{11}$$

Step 6: Calculate the relative closeness to the ideal solution.

(12)

Step 7: Rank the alternatives according to s_{iw} (i=1, 2………… . m)

MAUT (Multi Attribute Utility Theory):

Utility is a measure of desirability and gives to a uniform scale to compare and/or combine tangible and intangible criteria (Ang, Tang, 1984). Utility function is a device which quantifies the preferences of a decision-maker by assigning a numerical index to varying levels of satisfaction of a criterion (Mustafa, Ryan, 1990). For a single criterion (X), the utility of satisfaction of a consequence x' is denoted by $u(x')$. The utility is generally calculated as the sum of the marginal utilities that each criteria assigns to the considered action (Figueira, Greco, Ehrgott, 2005). Multi Attribute Utility Theory takes into consideration the decision maker's preferences in the form of the utility function which is defined over a set of attribute (Pohekar, Ramachandran, 2004). In this method both quantitative and qualitative criteria can be used. The most common method of multicriteria utility function is the additive model (Keeney, Raiffa, 1993).

There are two important MAUT categories discrete and continuous alternative problems. Discrete type alternative problems set of alternatives consist limited alternatives. Continuous alternative problems called multiple optimization problems feasible sets of alternatives usually consist of a very large number of infinitely many alternatives (Wallenius, J. et. al. , 2008)

The utility functions can be either additively separable or multiplicatively separable with respect to single attribute utility. Additively form;

$$U_i = \sum_{j=1}^{m} w_j\, U_{ij}\ for\ all\ i \tag{13}$$

where,

U_i = Utility value(overall) of alternative *i*

U_{ij} = Utility value for the alternative of *i* (criteria for the j)

n = Total number of criteria

m = Total number of alternatives

The multiplicative form of equation for then utility value is defined below(Keeney, Raiffa, 1976).

$$1 + ku(x_1, x_2, x_3 \dots x_n) = \prod_{j=1}^{n}(1 + kk_j\, u_j(x_j)) \qquad (14)$$

j **= attribute (alternative) index**

k **= scaling constant**

u **= overall utility function**

u_j = utility function for each operator

In this studying, It has been used the additive type model. In the MAUT method, it can be used six important steps(Alp İ. et. al. , 2015);

Step 1: Generate the criteria (C_1, C_2, ……, C_n) and alternatives

Step 2: Determination of the weight values (with AHP)

$$\sum_{i=1}^{m} w_j = 1$$

Step 3: Form the decision matrix

Step 4: Calculate the normalized utility values;

$u_i(x_i) = \frac{x - x_i^-}{x_i^+ - x_i^-}$ **(for criteria to be maximized)**

$u_i(x_i) = \frac{x_i^+ - x}{x_i^+ - x_i^-}$ **(for the criteria to be minimized)**

where;

$$x_i^+ = \mathit{the\ best\ value\ of\ the\ alternatives}$$

$$x_i^- = \mathit{the\ worst\ value\ of\ the\ alternatives}$$

Step 5: Calculate total utility

$$U_i = \sum_{j=1}^{m} w_j\, U_{ij}\ \mathit{for\ all}\ i$$

Step 6: Rank the alternatives, Choose an alternative which gain the most utility.

Findings:

In this article, we studied on Gender Inequality Index (GII) Indicators for the Candidate and Member countries of European Union. This index measures reflecting inequality in achievements between women and men in three dimensions: reproductive health, empowerment and the labor market as seen Table 2 given below.

Table 2: Explanations of Indicators used in the analysis

Indicators	Explanations
Maternal mortality ratio	(deaths per100, 000 live births)
Adolescent birth rate	(births per 1, 000 women ages 15–19)
Share of seats in parliament	(% held by women)
Population with at least some secondary education (for men)	(% ages 25 and older)
Population with at least some secondary education(for women)	(% ages 25 and older)
Labour force participation rate(for men)	(% ages 15 and older)
Labour force participation rate(for women)	(% ages 15 and older)

When examined GII calculations, it can be seen that all of the indicator's importance is in the same level. However, it has criticisms from some scholars and policy makers about indicators since they are not equal each other, as in the human development index (Safari, Ebrahimi, 2014). By thinking these critics, it has been created as an alternative method of ranking countries in terms of gender inequality index.

This study is compromised two important stages. Firstly by using analytical hierarchical process method, it can be achieved the comparing elements (indicators) to one another, two at a time, with respect to their importance with in the hierarchy and structured the comparison matrix (a square matrix of size n×n). Weights given below in Table 3 have been created randomly in order to set an assignment for the criteria.

Table 3 Comparison Matrix for the criteria of the GII

	C1	C2	C3	C4	C5	C6	C7
C1	1	2	3	4	5	6	7
C2	0, 5	1	2	3	4	5	6
C3	0, 33	0, 5	1	2	4	5	6
C4	0, 25	0, 33	0, 5	1	2	3	3
C5	0, 2	0, 25	0, 25	0, 5	1	2	3
C6	0, 17	0, 2	0, 2	0, 33	0, 5	1	2
C7	0, 14	0, 17	0, 17	0, 33	0, 33	0, 5	1

Table 4 represents normalized values for each element of the comparison matrix. The last column of the Table 4 called Priority vector (Criteria Weights) obtained by forming arithmetic average of each line.

Table 4: Normalized values for the comparison matrix

	C1	C2	C3	C4	C5	C6	C7	Criteria Weights
C1	0, 39	0, 45	0, 42	0, 36	0, 3	0, 27	0, 25	**0, 35**
C2	0, 19	0, 22	0, 28	0, 27	0, 24	0, 22	0, 21	**0, 23**
C3	0, 13	0, 11	0, 14	0, 18	0, 24	0, 22	0, 21	**0, 18**
C4	0, 1	0, 07	0, 07	0, 09	0, 12	0, 13	0, 11	**0, 1**
C5	0, 08	0, 06	0, 04	0, 04	0, 06	0, 09	0, 11	**0, 07**
C6	0, 06	0, 04	0, 03	0, 03	0, 03	0, 04	0, 07	**0, 04**
C7	0, 06	0, 04	0, 02	0, 03	0, 02	0, 02	0, 04	**0, 03**

According to the Table 4, Consistency Ratio (0. 03) has been calculated by using formula (5), which represents that AHP is reasonable for the analysis. Further, countries are listed with TOPSIS and MAUT method after defining weights with AHP.

In the TOPSIS method, initially evaluation matrix is formed consisting of 32 alternative countries and 7 criteria. Table 5 given below represents evaluation matrix for TOPSIS method partially.

Table 5: Evaluation matrix for TOPSIS Method

	C1	C2	C3	C4	C5	C6	C7
Denmark	5	5, 1	38	95, 5	96, 6	58, 7	66, 4
Netherlands	6	6, 2	36, 9	87, 7	90, 5	58, 5	70, 6
Germany	7	3, 8	36, 9	96, 3	97	53, 6	66, 4
Ireland	9	8, 2	19, 9	80, 5	78, 6	53, 1	68, 1
Sweden	4	6, 5	43, 6	86, 5	87, 3	60, 3	67, 9
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Serbia	16	16, 9	34	58, 4	73, 6	44, 5	60, 9
Turkey	20	30, 9	14, 4	39	60	29, 4	70, 8
The F. Y. R. Macedonia	7	18, 3	33, 3	40, 2	55, 6	43, 1	67, 5
Bulgaria	5	35, 9	20, 4	93	95, 7	47, 9	59

Table 6 represents weighted normalized evaluation matrix, which is calculated by multiplying criteria weights with each column of the Table 5.

Table 6: Weighted normalized evaluation matrix

	C1	C2	C3	C4	C5	C6	C7
Denmark	0, 07	0, 07	0, 8	6, 39	0, 55	0, 7	0, 47
Netherlands	0, 1	0, 1	0, 76	5, 38	0, 48	0, 7	0, 53
Germany	0, 14	0, 04	0, 76	6, 49	0, 56	0, 59	0, 47
Ireland	0, 23	0, 18	0, 22	4, 54	0, 37	0, 58	0, 49
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Romania	3, 04	2, 56	0, 08	5, 19	0, 5	0, 48	0, 45
Serbia	0, 72	0, 76	0, 64	2, 39	0, 32	0, 4	0, 39
Turkey	1, 12	2, 56	0, 12	1, 06	0, 21	0, 18	0, 53

The F. Y. Macedonia	0, 14	0, 89	0, 62	1, 13	0, 18	0, 38	0, 48
Bulgaria	0, 07	3, 45	0, 23	6, 06	0, 54	0, 47	0, 37

Table 7 represents the ideal (A^+) and negative ideal (A^-) solutions of weighted (with AHP) normalized decision matrix.

Table 7: The ideal and negative ideal solutions of weighted normalized values

A positive	3, 04	3, 45	1, 06	7, 00	0, 59	1, 01	0, 64
A negative	0, 03	0, 00	0, 06	1, 06	0, 14	0, 18	0, 35

Separation measures (S^+, S^-) are measured by using the m-dimensional Euclidean distance Formula (10)(11) thus it's determined the worst alternative and the best alternative. Finally the relative closeness to the ideal solution is obtained. Separation measures of each countries and relative closeness to the ideal values has been given at Table 8.

Table 8: Separation measures

	S^+	S^-	TOPSIS values	Ranking
Denmark	4, 56	5, 42	0, 543	13
Netherlands	4, 77	4, 43	0, 482	17
Germany	4, 54	5, 51	0, 548	12
Ireland	5, 06	3, 52	0, 41	21
Sweden	4, 83	4, 35	0, 474	19
United Kingdom	3, 43	6, 22	0, 645	3
Croatia	4, 52	4, 08	0, 475	18
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Serbia	5, 88	1, 8	0, 235	30
Turkey	6, 44	2, 79	0, 302	28
The F. Y. Macedonia	7, 09	1, 09	0, 133	32
Bulgaria	3, 29	6, 09	0, 65	2

After getting the ranking with TOPSIS, it has been performed MAUT method. Marginal Utility Scores, which is the identification of best and worst values in the MAUT method, is given as follows.

Table 9: Marginal Utility Scores

	C1	C2	C3	C4	C5	C6	C7
	Min.	**Min.**	**Max.**	**Max.**	**Max.**	**Max.**	**Max.**
Denmark	5	5, 1	37, 99	95, 54	96, 56	58, 7	66, 4
Netherlands	6	6, 17	36, 89	87, 68	90, 47	58, 5	70, 6
Germany	7	3, 8	36, 86	96, 29	97, 03	53, 6	66, 4
Ireland	9	8, 24	19, 91	80, 52	78, 56	53, 1	68, 1
Sweden	4	6, 53	43, 55	86, 54	87, 27	60, 3	67, 9
United Kingdom	8	25, 76	23, 53	99, 82	99, 9	55, 7	68, 7

Iceland	4	11, 49	41, 27	91	91, 58	70, 5	77, 4
Luxembourg	11	8, 35	28, 33	100	100	50, 7	64, 6
Belgium	6	6, 71	42, 38	77, 5	82, 88	47, 5	59, 3
France	12	5, 74	25, 73	78, 01	83, 21	50, 7	61, 6
Austria	4	4, 13	30, 33	100	100	54, 6	67, 7
Finland	4	9, 21	42, 5	100	100	55, 7	64
Slovenia	7	0, 62	27, 69	95, 78	98, 03	52, 3	63, 2
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Macedonia	7	18, 26	33, 33	40, 16	55, 6	43, 1	67, 5
Bulgaria	5	35, 9	20, 4	93	95, 7	47, 9	59

Total utility values have been calculated for each country after normalized values are obtained by multiplying with AHP coefficients (Table 10).

Table 10: Final Utility Scores

	C1	C2	C3	C4	C5	C6	C7	Total utility	Rankings
Denmark	0, 93	0, 87	0, 83	0, 93	0, 93	0, 71	0, 45	0, 88	4
Netherlands	0, 9	0, 84	0, 8	0, 8	0, 82	0, 71	0, 66	0, 84	7
Germany	0, 87	0, 91	0, 8	0, 94	0, 94	0, 59	0, 45	0, 85	6
Ireland	0, 8	0, 78	0, 29	0, 68	0, 59	0, 58	0, 54	0, 66	17
Sweden	0, 97	0, 83	1	0, 78	0, 75	0, 75	0, 53	0, 88	2
United Kingdom	0, 83	0, 29	0, 4	1	1	0, 64	0, 57	0, 64	19
…………	……	……	……	…. .	…. .	……	……	…. .	…. .
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Montenegro	0, 87	0, 59	0, 21	0, 74	0, 9	0, 33	0	0, 62	23
Romania	0	0, 14	0, 06	0, 77	0, 85	0, 47	0, 38	0, 21	32
Serbia	0, 57	0, 54	0, 71	0, 32	0, 49	0, 37	0, 18	0, 54	29
Turkey	0, 43	0, 14	0, 13	0	0, 23	0	0, 67	0, 24	31
Macedonia	0, 87	0, 5	0, 69	0, 02	0, 14	0, 33	0, 51	0, 58	26
Bulgaria	0, 93	0	0, 31	0, 89	0, 92	0, 45	0, 08	0, 55	28

Results and Discussion:

Gender inequality index (GII) which highlights women's empowerment is one of development indices to strengthen the information having from human development index. In this study we monitor development of the countries in terms of Gender Inequality index to highlight the importance of gender equality for the countries development. On the other hand, the main purpose of this study is to develop an alternative method to rank countries based on gender inequality index by taking into account the suggestions of critics defending not to give equal value of all indicators used in the ranking. In that reason, it is developed AHP-TOPSIS and AHP-MAUT hybrid models.

The weights obtained by AHP method is listed with TOPSIS and MAUT Method respectively. It is seem that ranking obtained by TOPSIS method is quite different according to the countries' level of development given report by UN while MAUT Method gives much more meaningful results. Correlation between total utility value and GII index values for 2014 is quite high (0. 94) obtained by MAUT Method while it is very low (0, 007) obtained with the TOPSIS method. It is reasonable to say MAUT gives more preferable results according to the correlation test. According to the ranking with AHP-MAUT hybrid model, Finland is most advanced country while Sweden is the second and Island is the third advanced country based on GII.

In this study, we have given random weight to the criteria in order to perform as an example. We will be attempted to ranking again based on expert opinion for further study.

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APPENDIX 1

	S^+	S^-	Topsis sıralaması	Sıralama
Denmark	4, 56	5, 42	0, 543	13
Netherlands	4, 77	4, 43	0, 482	17
Germany	4, 54	5, 51	0, 548	12
Ireland	5, 06	3, 52	0, 41	21
Sweden	4, 83	4, 35	0, 474	19
United Kingdom	3, 43	6, 22	0, 645	3
Iceland	4, 48	4, 93	0, 524	15
Luxembourg	4, 31	5, 99	0, 581	7
Belgium	5, 29	3, 31	0, 385	24
France	5, 16	3, 27	0, 388	23
Austria	4, 59	5, 99	0, 566	10
Finland	4, 42	6, 05	0, 578	9
Slovenia	4, 62	5, 41	0, 539	14
Spain	5, 86	2, 25	0, 278	29
Italy	5, 78	2, 55	0, 306	27
Czech Republic	4, 61	5, 95	0, 563	11
Greece	6, 32	1, 5	0, 192	31
Estonia	3, 93	6, 03	0, 606	4
Cyprus	5, 37	3, 05	0, 362	25
Slovakia	4, 14	5, 88	0, 587	6
Poland	5, 11	3, 41	0, 4	22
Lithuania	4, 48	4, 57	0, 505	16
Malta	5, 46	2, 42	0, 307	26
Portugal	6, 88	0, 96	0, 123	33
Hungary	4, 13	5, 71	0, 58	8
Latvia	4, 04	5, 86	0, 592	5
Croatia	4, 52	4, 08	0, 475	18
Montenegro	4, 68	3, 97	0, 459	20
Romania	2, 32	5, 74	0, 712	1
Serbia	5, 88	1, 8	0, 235	30
Turkey	6, 44	2, 79	0, 302	28
The F. Y. Macedonia	7, 09	1, 09	0, 133	32
Bulgaria	3, 29	6, 09	0, 65	2

APPENDIX 2

C1	C2	C3	C4	C5	C6	C7	Total utility	Rankings

Denmark	0, 93	0, 87	0, 83	0, 93	0, 93	0, 71	0, 45	0, 88	4
Netherlands	0, 9	0, 84	0, 8	0, 8	0, 82	0, 71	0, 66	0, 84	7
Germany	0, 87	0, 91	0, 8	0, 94	0, 94	0, 59	0, 45	0, 85	6
Ireland	0, 8	0, 78	0, 29	0, 68	0, 59	0, 58	0, 54	0, 66	17
Sweden	0, 97	0, 83	1	0, 78	0, 75	0, 75	0, 53	0, 88	2
United Kingdom	0, 83	0, 29	0, 4	1	1	0, 64	0, 57	0, 64	19
Iceland	0, 97	0, 69	0, 93	0, 85	0, 84	1	1	0, 88	3
Luxembourg	0, 73	0, 78	0, 55	1	1	0, 52	0, 36	0, 73	13
Belgium	0, 9	0, 83	0, 96	0, 63	0, 67	0, 44	0, 1	0, 81	9
France	0, 7	0, 85	0, 47	0, 64	0, 68	0, 52	0, 21	0, 66	16
Austria	0, 97	0, 9	0, 6	1	1	0, 61	0, 52	0, 86	5
Finland	0, 97	0, 76	0, 97	1	1	0, 64	0, 33	0, 89	1
Slovenia	0, 87	1	0, 53	0, 93	0, 96	0, 56	0, 29	0, 82	8
Spain	0, 97	0, 72	0, 83	0, 46	0, 48	0, 56	0, 42	0, 77	11
Italy	0, 97	0, 91	0, 6	0, 53	0, 62	0, 25	0, 11	0, 76	12
Czech Republic	0, 93	0, 88	0, 26	1	0, 99	0, 53	0, 55	0, 78	10
Greece	0, 93	0, 68	0, 33	0, 34	0, 36	0, 36	0, 26	0, 62	22
Estonia	0, 73	0, 54	0, 29	1	1	0, 65	0, 58	0, 65	18
Cyprus	0, 77	0, 86	0, 07	0, 61	0, 65	0, 65	0, 69	0, 63	20
Slovakia	0, 87	0, 57	0, 26	0, 99	0, 99	0, 53	0, 56	0, 68	15
Poland	1	0, 67	0, 36	0, 66	0, 72	0, 47	0, 38	0, 72	14
Lithuania	0, 73	0, 72	0, 4	0, 82	0, 89	0, 64	0, 5	0, 68	16
Malta	0, 8	0, 5	0, 09	0, 48	0, 58	0, 21	0, 45	0, 52	30
Portugal	0, 83	0, 66	0, 63	0, 14	0	0, 62	0, 44	0, 61	25
Hungary	0, 63	0, 67	0	0, 97	0, 98	0, 37	0, 13	0, 56	27
Latvia	0, 67	0, 63	0, 24	0, 98	0, 98	0, 62	0, 51	0, 63	21
Croatia	0, 67	0, 66	0, 47	0, 75	0, 88	0, 37	0, 05	0, 62	24
Montenegro	0, 87	0, 59	0, 21	0, 74	0, 9	0, 33	0	0, 62	23
Romania	0	0, 14	0, 06	0, 77	0, 85	0, 47	0, 38	0, 21	32
Serbia	0, 57	0, 54	0, 71	0, 32	0, 49	0, 37	0, 18	0, 54	29
Turkey	0, 43	0, 14	0, 13	0	0, 23	0	0, 67	0, 24	31
Macedonia	0, 87	0, 5	0, 69	0, 02	0, 14	0, 33	0, 51	0, 58	26
Bulgaria	0, 93	0	0, 31	0, 89	0, 92	0, 45	0, 08	0, 55	28