Araştırma Makale/Research Article

ÜLKELERİN KONUMLARININ DAHA İYİ YAŞAM ENDEKSİNE GÖRE BELİRLENMESİ: ENTROPİ TABANLI MULTİMOORA YAKLAŞIMI

DETERMINATION OF COUNTRIES' POSITION USING BETTER LIFE INDEX: THE ENTROPY BASED MULTIMOORA APPROACH

Serpil KILIÇ DEPREN [*] Seda BAĞDATLI KALKAN [**]

Geliş Tarihi: 03.10.2018 (Received) *Kabul Tarihi: 02.11.2018 (Accepted)*

ÖZ: Kişilerin yaşamlarını rahat bir şekilde sürdürebilmeleri için en önemli koşul refah düzeyinin belirli bir seviyede olmasıdır. Dolayısıyla, iyi bir refah düzeyi olan ülke yaşanılabilir ülke olarak tercih edilmektedir. Bu durum, ülkelerin ekonomileri üzerinde ciddi etkiler yaratmaktadır. Ülkelerin refah düzeyini belirlemek adına yapılan araştırmaların en önemlilerinden biri Ekonomik Kalkınma ve İşbirliği Örgütü (Organisation for Economic Co-operation and Development: OECD) tarafından her yıl düzenli olarak gerçekleştirilen Daha İyi Yaşam Endeksi (Better Life Index: BLI) araştırmasıdır. Bu araştırma ile 38 ülke ana kriterler ve alt kriterler bazında sıralanmakta ancak genel bir sıralama yapılmamaktadır. Bu çalışmanın amacı, OECD tarafından oluşturulan Daha İyi Yaşam Endeksi verilerini kullanarak ülkelerin sıralamalarını elde etmektedir. Çalışmada ilk olarak kriter ağırlıkları entropi ile belirlenmiş, daha sonrasında ise MULTIMOORA metodu ile ülkeler sıralanmıştır. Bu aşamadan sonra ise ülkelerin elde edilen sıralamaları ile İnsani Gelişme Endeksi (Human Development Index: HDI) sıralamaları arasındaki ilişki Spearman Sıra Korelasyon Katsayısı ile incelenmiş ve sonuçlar yorumlanmıştır.

Anahtar Kelimeler*: *Daha İyi Yaşam Endeksi, Entropi, MULTIMOORA, İnsani Gelişme Endeksi

ABSTRACT: The most significant requirement for people to maintain their lives comfortably, is to have a specific level of welfare. Therefore, a country having a high level of welfare is preferred as a livable country. This has significant influences on the economies of countries. One of most significant researches conducted for determining the welfare levels of countries is the Better Life Index (BLI) research conducted by Organization for Economic Co-operation and Development (OECD) every year on a regular basis. With this research, 38 countries are ranked based on main criteria and sub-criteria, but a general ranking is not made. The aim of this study is to rank the countries by using Better Life Index data created by OECD. In the study, the criterion weights were determined and then, the countries were ranked with MULTIMOORA method. Then, the relationship between ranking of countries and their Human Development Index (HDI)

[*] Assist. Prof. Dr., Yıldız Technical University, Faculty of Arts & Sciences, Department of Statistics, serkilic@yildiz.edu.tr

[**] Assist. Prof. Dr., İstanbul Commerce University, Department of Statistics, sbagdatli@ticaret.edu.tr

rankings were investigated with Spearman's Rank Correlation Coefficient and the results were interpreted.

Keywords: *Better Life Index, Entropy, MULTIMOORA, Human Development Index*

1. INTRODUCTION

In the globalized world, the people now prefer to continue their life in a place where they catch the welfare level which will satisfy them, not in a place where they were born. The most significant factor can be summarized as the accommodation, security, health, education, job status, etc. although the welfare levels varies from person to person. The significant migrations are on the agenda of countries specifically in terms of education and finding a job after education. These migrations have positive or adverse influences on the economic conditions of country. The countries carry out miscellaneous researches with the aim of determining their own welfare levels and comparing themselves with other countries. They reveal their strong and weak sides based on the results of these researches and thus, they can make amendments on their state policies. There are also researches conducted by some institutions on regular basis with respect to life satisfaction, welfare level, better life index, etc. as well as the researchers that the countries carry out for themselves. One of the most significant of these researches is the Better Life Index (BLI) research which is conducted by Organization for Economic Co-operation and Development (OECD) every year on a regular basis. In this research, the data of OECD member countries and some countries selected were used. The countries can display their general statuses and ranking by taking these research data into consideration.

In the literature, there are many researches such as development rankings, economic rankings, powerful country rankings of countries, etc. In these researches, the multi-criteria decision-making methods were generally used. In their study, Kaya et al. (2011) made the life quality ranking of European Union and candidate countries by using VIKOR method. The ranking was acquired for the years of 2003, 2005 and 2007 individually. In this study, 12 main indicators and related sub-indicators given in European life quality survey were used. At the end of study, it was determined that Spain had the best life quality in 2003 and 2007 while Sweden and Denmark had the best life quality in 2005. It was concluded that Turkey was ranked near last once every three years (Kaya, İpekçi Çetin, & Kuruüzüm, 2011).

In his study, Ozden (2012) measured the economic performance of European Union member countries and Turkey by using 8 economic indicators belonging to 2010 and ranked the countries based on these performances. At the end of analysis made, it was determined that Luxemburg had highest economic performance while Greece had lowest economic performance. It was concluded that Turkey was

ranked 24th among 28 countries (Özden, AB'ye Üye Ülkelerin ve Türkiye'nin Ekonomik Performanslarına Göre VIKOR Yöntemi ile Sıralanması, 2012). In their study, Orakçı and Ozdemir (2017) determined the human development indexes of European Union member countries and Turkey by using the indicators elected from Human Development Index and European Life Quality Survey. The Gray Relational Analysis and MOORA methods were used for determining the human development levels of countries. The effect levels of indicators were evaluated with Entropy and CRITIC weighting methods. At the end of study, it was found that top three countries having highest human development level were United Kingdom, Holland and Denmark based on MOORA-Reference point while top three countries having highest human development level were Luxemburg, Finland and Austria based on Gray Relational Analysis and MOORA-Ratio method (Orakçı & Özdemir, 2017). In their study, Sevgin and Kundakçı (2017) ranked the European Union member countries and Turkey according to their development levels by using 6 economic indicators belonging to 2013 based on TOPSIS AND MOORA methods. At the end of study, it was determined that Croatia, Bulgaria, Slovenia, Greece and Turkey were ranked last while Luxemburg, Switzerland and Denmark were ranked near the top (Sevgin & Kundakçı, 2017). In his study, Alpaykut (2017) ranked the provinces of Turkey based on the life satisfaction with TOPSIS method. In the study, the life index data of provinces was used. The Principal Components Analysis was used for weighting the variables to be used in the ranking. At the end of study, it was determined that Mardin, Sanlıurfa and Siirt were ranked last while Istanbul, Ankara and Izmir were ranked as top three (Alpaykut, 2017). In their study, Omürbek et al. (2017) determined the life quality of European Union member countries with ARAS and MOOSRA methods. They made the weights of criteria used, with entropy. At the end of study, the Finland came first according to both methods (Ömürbek, Eren, & Dağ, 2017).

In terms of business development potential in the construction sector of the European Union (EU) member countries, these countries were assessed and ranked by MULTIMOORA method. For this purpose, it was shown that Denmark, United Kingdom and Austria had the best conditions for business of them (Kildiene, 2013). Tian et al. proposed an integrated approach for failure mode and effect analysis based on fuzzy best-worst, relative entropy, and VIKOR methods. In this study, the applicability and effectiveness of proposed approach is validated through an illustrative example concerning risk analysis of a grinding wheel system. As a result, the proposed approach is valid and can provide valuable and effective information in assisting risk management decision-making (Tian, Wang, & Zang, 2018). Brauers et al. proposed a MULTIMOORA method for the evaluation of the constuction sector of 20 European countries during a recession. As a result of this study, the construction sector in each European country was not a forerunner to

anticipate on the relative economic upturn of 2010-2011. (Brauers, Zavadskas, & Kildiene, 2014).

The OECD offers the rankings of countries based on each sub-criterion used in the index. However, it does not make a general ranking by using all variables. The aim of this study is to acquire the rankings of countries by using Better Life Index data created by OECD. The Entropy based MULTIMOORA method was used for acquiring this ranking. The relationship between the rankings of countries and their Human Development Index (HDI) rankings was reviewed with Spearman's Rank Correlation Coefficient and the results were interpreted.

2. MATERIALS AND METHODS

The data of "Better Life Index" which is carried out by OECD every year on regular basis since 2013, were used in this study. The index is calculated for Brazil, Russian Federation and South Africa as well as 35 OECD member countries. In the study, the MULTIMOORA method was used for acquiring the rankings. Two approaches were used for acquiring the weights of criteria in this method. In the first method, the weights of criteria are evaluated by decision makers or experts subjectively for evaluating the alternatives (Özden, 2009). In the second approach named as objective approach, the weights of criteria are calculated by considering the quantitative properties of alternatives. One of objective methods is entropy approach.

The aim of study is to rank the countries from best to worst based on the scores obtained from entropy weights by using the data of 2017 Better Life Index. In the second stage of study, the relationship between the country rankings obtained by using HDI submitted in the report prepared by United Nations Development Program (UNDP) for determining the life standards of countries and country rankings obtained by using Entropy based MULTIMOORA was analyzed with Spearman's Rank Correlation Coefficient.

2.1. Data Source

In this study, the data of 2017 Better Life Index which was carried out by OECD, were used (OECD, 2017). In this index, 11 target criteria 24 sub-criteria which are considered by OECD to affect the life standards and life quality, were used. These criteria are shown in Table 1.

Table 1. *Better life Index Criteria*

Target Criteria	Code	Sub-Criteria	Optima
Housing	HO1	Dwellings with basic facilities (%)	**min**
	HO2	Housing expenditure (%)	**min**
	HO3	Rooms per person (rate)	**max**
Income	I1	Household net adjusted disposable income ($)	**max**
	I2	Household financial wealth ($)	**max**
Jobs	EM1	Job security (%)	**min**
	EM2	Employment rate (%)	**max**
	EM3	Long-term unemployment rate (%)	**min**
	EM4	Personal earnings (%)	**max**
Community	C1	Quality of support network (%)	**max**
Education	ED1	Educational attainment (%)	**max**
	ED2	Student skills (average score)	**max**
	ED3	Years in education (year)	**max**
Environment	EN1	Air pollution (microgram per cubic meter)	**min**
	EN2	Water quality (%)	**max**
Civic Engagement	C1	Stakeholder engagement for developing regulations (average score)	**max**
	C2	Voter turnout (%)	**max**
Health	HE1	Life expectancy (year)	**max**
	HE2	Self-reported health (%)	**max**
Life Satisfaction	L1	Life satisfaction (average score)	**max**
Safety	S1	Feeling safe walking alone at night (%)	**max**
	S2	Homicide rate (rate)	**min**
Work-Life Balance	W1	Employees working very long hours (%)	**min**
	W2	Time devoted to leisure and personal care (hour)	**max**

2.2. Entropy

The concept of entropy, widely used in physics, information theory, mathematics and engineering, was introduced by Claude E. Shannon in 1948. Entropy is a very useful approach for obtaining an objective weight in Multi-Criteria Decision Method (MCDM). The weights calculated with entropy are more accurate and credible than weights determined by subjective methods which are represented by Analytic Hierarchy Process (AHP) and Delphi method (Bai, Wang, Huang, Du, & Huang, 2018).

For the entropy method, the following steps are applied:

Step 1: Standardization of the decision matrix

The indicators is standardized by various methods to eliminate the effects of different measurement units and scales on the decision matrix. Suppose that there are *m* alternatives (*i*=1,2,...,*m*) and *n* criteria or attributes (*j*=1,2,…,*n*) in the following decision matrix.

Table 2. *Structure of the Decision Matrix*

Alternatives	**Criteria**			
	C_1	C_2	…	$\mathbf{C_n}$
$\mathbf{A_1}$	x_{11}	x_{12}	…	$\mathbf{x_{1n}}$
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
$\mathbf{A_m}$	x_{m1}	x_{m2}	…	$\mathbf{x_{mn}}$
	w_1	w_2	…	$\mathbf{w_n}$

According to the indicators of benefit and non-benefit / cost, criteria can be obtained by Equation (1):

$$x_{ij}^{*} = \begin{cases} \frac{x_{ij} - min_{\,i}\{x_{ij}\}}{max_{\,i}\{x_{ij}\} - min_{\,i}\{x_{ij}\}}, & \text{Benefit indicator} \\ \frac{max_{\,i}\{x_{ij}\} - x_{ij}}{max_{\,i}\{x_{ij}\} - min_{\,i}\{x_{ij}\}}, & \text{Non-benefit indicator} \end{cases} \quad (1)$$

where x_{ij}^{*} represents the evaluation value of alternative for criterion after standardized and $x_{ij}^{*} \in [0,1]$.

Step 2: Normalization of the decision matrix

$$y_{ij} = \frac{x_{ij}^{*}}{\sum_{i=1}^{m} x_{ij}^{*}} \quad (2)$$

Step 3: Calculation of the entropy value for each criterion

$$e_j = -k \sum_{i=1}^{m} y_{ij} \ln y_{ij} \quad (3)$$

where *k* is the entropy constant and is equal to $1/\ln m$.

Step 4: Calculation of the entropy weight for each criterion

$$w_j = \frac{1 - e_j}{n - \sum_{j=1}^{n} e_j} \qquad 0 \le w_j \le 1 \qquad \sum_{j=1}^{n} w_j = 1 \quad (4)$$

When y_{ij} are the same, the entropy of the jth criterion is the maximum. And if y_{ij} takes the value of 0, then $y_{ij} \ln y_{ij}$ will be 0. Also, it is used in Equation (4).

The larger the entropy weight, the more important this criterion becomes in decision making method (Wu, Sun, Liang, & Zha, 2011).

2.3. Multiplicative and Multi-Objective Ratio Analysis (MULTIMOORA)

Multi-Objective Optimization on Basis of Ratio Analysis (MOORA) method was developed by Brauers and Zavadskas (2006). The ratio system and the reference point approach are fundamental tools of this method. Consisting of MOORA and full multiplicative form was called MULTIMOORA, which was proposed by Brauers and Zavadskas (2010).

In the process of the ratio system of MOORA method, the following steps will be taken into consideration.

Step 1: Construction of the decision matrix

The details of this matrix were illustrated in Table 1.

Step 2: Normalization of the decision matrix

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

The transformation process between 0 and 1 of the criterion value is called normalization. The values of the decision matrix are required to transform from different units to only one unit.

Step 3: Determination of performance of the alternatives

$$y_{i}^{*} = \sum_{j=1}^{g} w_j x_{ij}^{*} - \sum_{j=g+1}^{n} w_j x_{ij}^{*} \quad (6)$$

g is the number of criteria to be maximized and (n-g) is the number of criteria to be minimized. If the criteria are not equally importance, y_i^* will be obtained from multiply x_{ij}^* by weight of the criteria.

Step 4: Ranking of the alternatives

When the alternatives are sorted by descending order, the best alternative is to be the highest performance value of them.

In addition to the ratio system, the reference points are determined that are chosen the point yielding the maximum or minimum value depending on whether the problem is a maximization or minimization problem. These points find the distances from each x_{ij}^* and then are expressed as:

$$w_j r_j - w_j x_{ij}^{*} \quad (7)$$

r_j is the reference point of the jth criterion and x_{ij}^* is the normalized decision matrix from the ratio system of MOORA. The optimal alternative can be calculated by Equation (8) that is Min-Max Metric of Tchebycheff:

$$\min_i \left\{ \max_j \left| w_j r_i - w_j x_{ij}^{*} \right| \right\} \quad (8)$$

The third part of MULTIMOORA method is the full multiplicative form for calculating the utility of the alternatives (U_i) which can be specified as:

$$U_i^{'} = \frac{A_i}{B_i} \quad (9)$$

where A_i and B_i are calculated separately for maximized decision criteria j=1,2,…,g and minimized decision criteria j=g+1,g+2,…,n, respectively. A_i and B_i can be obtained as follows:

$$A_i = \prod_{j=1}^{g} \left(x_{ij}^*\right)^{w_j}$$

$$B_i = \prod_{j=g+1}^{n} \left(x_{ij}^*\right)^{w_j} \quad (10)$$

A summary of the ranking of the above described three methods of MULTIMOORA is made and then the MULTIMOORA can be integrated into the final ranking. This ranking is based on the theory of dominance (Brauers & Zavadskas, 2011).

3. RESULTS

Descriptive statistics of the variables used in the analysis are given in Table 3.

Table 3. *Descriptive Statistics*

Criteria	N	Mean	Median	Std. Deviation	Min	Max	Skewness	Kurtosis
HO1	38	3,45	0,60	6,64	0,00	37,00	3,84	**17,86**
HO2	38	20,89	21,00	2,41	15,00	26,00	-0,14	**-0,27**
HO3	38	1,64	1,75	0,47	0,70	2,50	-0,15	**-0,85**
I1	38	25113,8	24902,5	8026,0	10872,0	44049,0	0,28	**-0,45**
I2	38	49362,8	39468,0	38708,2	2260,0	176076,0	1,16	**1,67**
EM1	38	5,48	4,00	5,11	1,50	26,50	2,69	**7,90**
EM2	38	67,74	69,00	8,21	43,00	86,00	-0,76	**1,59**
EM3	38	3,20	1,98	3,72	0,03	16,95	2,55	**6,98**
EM4	38	37435,9	38223,0	14257,0	11554,0	62636,0	0,00	**-1,13**
C1	38	90,03	90,50	4,59	76,00	98,00	-1,01	**1,38**
ED1	38	77,24	81,50	16,00	37,00	95,00	-1,33	**0,79**
ED2	38	486,76	496,00	33,51	391,00	529,00	-1,54	**2,05**
ED3	38	17,38	17,30	1,39	14,80	21,20	0,48	**0,35**
EN1	38	13,39	14,00	5,90	3,00	28,00	0,23	**-0,46**
EN2	38	82,26	84,00	10,87	54,00	99,00	-0,58	**-0,32**
C1	38	2,05	2,10	0,70	0,80	3,50	-0,02	**-0,80**
C2	38	70,03	69,50	11,67	49,00	91,00	0,01	**-0,76**
HE1	38	79,54	81,15	4,69	57,40	83,90	-3,15	**13,04**
HE2	38	67,45	70,00	13,98	33,00	88,00	-0,74	**0,27**
L1	38	6,53	6,65	0,78	4,80	7,50	-0,46	**-0,87**
S1	38	68,63	70,40	13,20	36,10	87,70	-0,73	**0,13**
S2	38	2,93	1,00	5,47	0,20	27,60	3,33	**11,98**
W1	38	8,72	6,23	7,80	0,16	33,77	1,62	**2,50**
W2	38	14,83	14,90	0,76	12,59	16,36	-0,92	**2,33**

In this study, criteria weights are determined using entropy approach. Weights of each criterion are given in Table 4.

Table 4. *Entropy Weights*

Criteria	Weights	Criteria	Weights
Dwellings with basic facilities	1.2%	Student skills	**3.3%**
Housing expenditure	4.6%	Years in education	**5.9%**
Rooms per person	5.5%	Air pollution	**3.5%**
Household net adjusted disposable income	6.5%	Water quality	**3.3%**
Household financial wealth	12.3%	Voter turnout	**6.8%**
Job security	1.7%	Life expectancy	**1.3%**
Employment rate	2.6%	Self-reported health	**4.0%**
Long-term unemployment rate	2.1%	Life satisfaction	**4.5%**
Personal earnings	6.5%	Feeling safe walking alone at night	**4.0%**
Quality of support network	2.6%	Homicide rate	**1.4%**
Stakeholder engagement for developing regulations	6.9%	Employees working very long hours	**2.5%**
Educational attainment	4.1%	Time devoted to leisure and personal care	**2.8%**

According to the Table 4, Household financial wealth has the highest weight with 12.3% while Dwellings with basic facilities has the lowest weight with 1.2%. Stakeholder engagement for developing regulations and Voter turnout criteria have the 2nd and 3rd highest weight with 6.9% and 6.8%, respectively. The weights of other criteria are between 1.3% and 6.5%. In overall point of view, the criteria which have the highest weights are Income and Civic Engagement with 18.9% and 13.7%, respectively. Community and Life Satisfaction criteria have the lowest weights with Quality of Support Network and Life Satisfaction with 2.6% and 4.5%, respectively.

In MOORA-Ratio, MOORA-Reference Point and MOORA-Full Multiplicative approaches are weighted with entropy weights. Ranking of these three approaches and MULTIMOORA final rankings are given in Table 5.

Table 5. *Comparison Between the Ranking of the MOORA methods and Final Ranking with MULTIMOORA*

Country	**MOORA - Ratio**		**MOORA – Reference Point**		**MOORA – Full Multiplicative**		**MULTI MOORA**
	Value	Rank	Value	Rank	Value	Rank	**Rank**
Germany	0.125	13	0.038	17	77.5	13	**13**
USA	0.177	1	0.004	1	92.8	3	**1**
Australia	0.136	7	0.038	16	79.2	10	**10**
Austria	0.118	15	0.037	14	71.1	15	**15**
Belgium	0.138	5	0.023	3	77.6	12	**3**
England	0.130	10	0.030	8	78.6	11	**8**
Brazil	0.063	35	0.054	35	40.1	35	**35**
Czech Republic	0.095	24	0.049	24	59.5	25	**24**
Denmark	0.136	6	0.033	10	82.0	8	**6**
Estonia	0.095	23	0.051	32	56.1	26	**26**
Finland	0.117	16	0.047	23	69.8	17	**17**
France	0.116	17	0.037	15	70.2	16	**16**
South Africa	0.029	38	0.051	31	36.2	38	**38**
Netherlands	0.135	8	0.028	6	91,6	4	**4**
Ireland	0.113	19	0.042	19	69.0	18	**19**
Spain	0.094	25	0.045	20	62.5	22	**25**
Israel	0.100	20	0.037	13	62.2	23	**23**
Sweeden	0.140	4	0.027	5	93.8	2	**5**
Switzerland	0.153	2	0.015	2	94.0	1	**2**
Italy	0.099	22	0.036	12	63.0	21	**12**
Iceland	0.129	11	0.036	11	89.2	5	**11**
Japan	0.114	18	0.025	4	68.4	19	**18**
Canada	0.145	3	0.029	7	85.5	7	**7**
Korea	0.091	26	0.046	21	63.3	20	**20**
Letonia	0.080	30	0.051	30	50.2	30	**30**
Luxembourg	0.135	9	0.033	9	87.2	6	**9**
Hungary	0.079	31	0.049	25	51.3	29	**29**
Mexico	0.062	36	0.055	36	40.5	34	**36**
Norway	0.125	12	0.050	27	81.9	9	**27**
Poland	0.085	27	0.052	33	52.0	28	**28**
Portugal	0.083	28	0.046	22	53.8	27	**22**
Russia	0.066	33	0.056	38	38.6	37	**33**
Chile	0.078	32	0.050	26	49.8	31	**31**
Slovakia	0.083	29	0.053	34	49.7	32	**32**
Slovenia	0.099	21	0.050	28	60.2	24	**21**
Turkey	0.061	37	0.055	37	39.0	36	**37**
New Zelland	0.121	14	0.040	18	74.3	14	**14**
Greece	0.065	34	0.051	29	48,7	33	**34**

According to the MOORA-Ratio approach, USA, Switzerland, Canada, Sweeden and Belgium are the 1st, 2nd, 3rd, 4th and 5th countries in ranking,

respectively. In addition to this, the worst 5 performer countries are South Africa, Turkey, Mexico, Brazil and Greece, respectively.

In the second approach, which is MOORA-Reference Point, USA and Switzerland are the top 2 countries in the ranking as similar to MOORA-Ratio approach. Belgium ranked third, followed by Japan (fourth) and Sweeden (fifth). Similar to the MOORA-Ratio approach, Turkey is at the 37th in the ranking. The bottom 5 countries are Russia, Turkey, Mexico, Brazil and Slovakia in the ranking.

According to the last approach, which is MOORA – Full Multiplicative approach, Switzerland is ranked as the first one, followed by Sweeden, USA, Netherlands and Iceland. As shown in Table 5, South Africa, Russia, Turkey, Brazil and Mexico are the worst countries of them.

The results of three approach are examined and final ranking is determined according to the MULTIMOORA approach. As a result, USA is ranked as the first amongst 38 countries, followed by Switzerland, Belgium, Netherlands and Sweeden, respectively. Among the bottom 5 countries, there are South Africa, Turkey, Mexico, Brazil and Greece in terms of MULTIMOORA.

After this step, relationship between the ranking of the countries with the Entropy based MULTIMOORA method and the HDI rankings was examined with the Spearman's Rank Correlation Coefficient. The results are shown in Table 6.

***Table 6**. Correlation Coefficient Between Entropy based MULTIMOORA and HDI Country Rankings*

			HDI	**Entropy based MULTIMOORA**
Spearman's rho	HDI	Correlation Coefficient	1.000	**,782****
		Sig. (2-tailed)		**.000**
		N	38	**38**
	Entropy based MULTIMOORA	Correlation Coefficient	,782**	**1.000**
		Sig. (2-tailed)	.000	
		N	38	**38**

When Table 6 is reviewed, it is seen that there is a statistical positive relationship of 78% between the rankings of countries acquired with Entropy based MULTIMOORA method and their HDI rankings.

4. CONCLUSIONS

The most significant requirement in today's circumstance for people to maintain their life happily is that the country where they live, shall have a prominent level of welfare. The countries having a prominent level of welfare are also satisfactory economically. Therefore, the persons prefer living the countries which will satisfy them materially and nonmaterially either in terms of education or business life after education. Under the circumstances in which the welfare level is such important, many institutions make researches for measuring their welfare

level. The OECD determined 11 target criteria and 24 sub-criteria which may be effective on welfare levels of countries. It ranked 38 countries based on each target criterion and sub-criterion, but it did not make a general ranking. In this study, a general ranking was made by using the entire criteria determined by OECD. With the aim of making this ranking, the weights of these criteria were determined with entropy and accordingly, the MULTOMOORA method was used for this aim.

When the country rankings obtained with Entropy based MULTIMOORA method were reviewed, it was seen that USA took on the top of ranking. When OECD rankings of USA were reviewed, it was seen that it took on the top in terms of housing and income criteria. When the entropy weights used in MULTIMOORA method were reviewed, it was seen that household financial wealth criterion had the highest weight. Thus, it proved the accuracy of method that USA took place on the top. In the same way, it was seen that Switzerland ranked second. When the OECD rankings for this country were reviewed, it was seen that was ranked second in terms of income criteria. It was seen that this country took on the top based on other criteria. The Belgium was ranked as third. When the OECD rankings of this country were reviewed, it was seen that it took place on the top in terms of housing and income criteria, but the civic engagement criterion had the highest ranking. The Netherland was ranked fourth. When the OECD rankings of this country were reviewed, it was seen that it took place on the top in terms of housing and income criteria, but the work-life balance criterion had the highest place in the ranking. Finally, Sweden was ranked fifth. It was seen that this country was ranked fifth in OECD ranking in terms of income criterion and it took on the top of ranking based on other criteria. In conclusion, it was seen that the countries taking among top five countries by Entropy based MULTIMOORA method were stable, specifically in terms of economy and policy and the life satisfaction of their citizens were high.

It was seen that South Africa was ranked last in the ranking made with the Entropy based MULTIMOORA method. This country was ranked last within OECD ranking in terms of housing criterion while it was ranked second in terms of income criterion. It was also ranked last in terms of other criteria. Since the South Africa's transition to democracy was in 1994, its economy continues developing in this regard. A vast majority of country population is at the poverty line and there are significant differences in the distribution of income. Therefore, it is an expectable result that it was ranked near last. When Turkey ranked second was reviewed, it was seen that it ranked last in the OECD ranking in terms of income criterion and many other criteria. It was an expectable result that Turkey's ranking was so low following the increase of terror attacks, the cross-border operations initiated in Syria and the political-economic problems which have arisen at the end of their reflections in the recent years. When Mexica which was the next country in

the ranking was reviewed, it was seen that it was ranked near last in the OECD ranking in terms of income criterion and many other criteria likewise Turkey. Although Mexica is one of most powerful economies of Latin America, it passes through a hard period following USA elections. Moreover, the high crime rate of country adversely affects the country rating. The Brazil which is the next country in the ranking, took near last in the OECD rating in terms of income and safety criteria. Pursuant to date published by Institute of Geography and Statistics in Brazil on November 29, 2017, 1% of Brazil having the highest income level acquired 36,3% times more income than the half of country population in 2016 (Republic of Turkey Ministry of Foreign Affairs, 2017). Thus, it is seen that there is a significant injustice in terms of distribution of income. Moreover, the economic and political instabilities also affect the country adversely. Finally when Greece was taken in hand, it was seen that it was ranked 31st in the OECD ranking in terms of income criterion and it was ranked near the last in terms of life satisfaction criterion. The problems seen in Greece in recent years such as corruption, increase of taxes, deduction of retirement salaries, etc. have been affecting the citizens of country adversely. In conclusion, it is seen that the countries coming near last are the countries having economic and political stability problem and they take place within the category of emerging economies except for Greece.

In the final stage of study, the relationship between ranking of countries obtained with Entropy based MULTIMOORA method and HDI rankings was investigated. The HDI investigates the development of a country both economically and socially. The development levels are revealed with this index and the life qualities of people living in these countries are tried to be determined. The HDI value is calculated by considering the welfare standard determined as the economic criterion and the entire of education and health standards determined as social criteria for detecting the development level. Thus, it has similar objects with Better Life Index created by OECD. Therefore, it was concluded that there was a statistical relationship of 78% between the ranking obtained with MULTIMOORA method and HDI ranking. Within the direction of these results, it is seen that the rankings obtained with Entropy based MULTIMOORA method yield accurate and reliable results both statistically and socio-economically.

REFERENCES

Alpaykut, S. (2017). Türkiye'de İllerin Yaşam Memnuniyetinin Temel Bileşenler Analizi TOPSIS Yöntemiyle Ölçümü Üzerine Bir İnceleme. *Jouranl Of Süleyman Demirel University Institude of Social Sciences*, 367-395.

Bai, L., Wang, H., Huang, N., Du, Q., & Huang, Y. (2018). An Environmental Management Maturity Model of Construction Programs Using the AHP-Entropy Approach. *Int. J. Environ. Res. Public Health* , 1317.

Brauers, W. K., Zavadskas, E. K., & Kildiene, S. (2014). Was the Construction Sector in 20 European Countries Anti-Cyclical during the Recession Years 2008-2009 as

measured by Multicriteria Analysis (MULTIMOORA)? *Procedia Computer Science*, 949-956.

Brauers, W., & Zavadskas, E. (2011). Multimoora optimization used to decide on a bank loan to buy property. *Technological and Economic Development of Economy*, 174-188.

Doğan, H. G., & Gürler, A. Z. (2013). Türkiye' de İnsani Gelişmişlik Endeksinin Analitik Olarak Değerlendirilmesi. *Iğdır Üniversitesi Fen Bilimleri Enstitüsü Dergisi, 3*(2), 69-76.

Genç, E. G. (2017). Üniversitelerin Ülke Sıralamaları ve İnsani Gelişme Endeksi: Panel Nedensellik Analizi. *Avrasya Ekonometri, İstatistik ve Ampirik Ekonomi Dergisi, 6*, 89-101.

Kaya, P., İpekçi Çetin, E., & Kuruüzüm, A. (2011). Çok Kriterli Karar Verme ile Avrupa Birliği ve Aday Ülkelerinin Yaşam Kalitesinin Analizi. *İktisat Fakültesi Ekonometri ve İstatistik Dergisi*, 80-94.

Kildiene, S. (2013). Assessment of Opportunities for Construction Enterprises, In: European Union Member States Using the MULTIMOORA Method. *11th International Conference on Modern Building Materials, Structures and Techniques, Procedia Engineering*, (s. 557-564). Lithuania.

OECD (2017). Available Online: http://www.oecdbetterlifeindex.org/ (accessed on 03.05.2018)

Orakçı, E., & Özdemir, A. (2017). Telafi Edici Çok Kriterli Karar Verme Yöntemleri İle Türkiye ve AB Ülkelerinin İnsani Gelişmişlik Düzeylernin Belirlenmesi. *Journal of Economics and Administrative Sciences*, 61-74.

Ömürbek, N., Eren, H., & Dağ, O. (2017). Entropi-ARAS VE Entropi-MOOSRA Yöntemleri İle Yaşam Kalitesi Açısından Ab Ülkelerinin Değerlendirilmesi. *Ömer Halis Demir Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 29-48.

Özden, Ü. H. (2009). *Türkiyede'ki Mevduat Bankalarının Performansları Çok Kriterli Karar Verme Yöntemleri Analiz.* Ankara: Detay.

Özden, Ü. H. (2012). AB'ye Üye Ülkelerin ve Türkiye'nin Ekonomik Performanslarına Göre VIKOR Yöntemi ile Sıralanması. *İstanbul Ticaret Üniversitesi Sosyal Bilimler Dergisi*, 455-468.

Republic of Turkey Ministry of Foreign Affairs. Available Online: http://www.mfa.gov.tr/brezilya-ekonomisi.tr.mfa (accessed on 06.05.2018).

Sevgin, H., & Kundakçı, N. (2017). TOPSIS VE MOORA Yöntemleri ile Avrupa Birliği'ne Üye Oalan Ülkerin ve Türkiye'nin Ekonomik Göstergelere Göre Sıralanması. *Anadolu University Journal of Social Sciences*, 87-107.

Tian, Z.-p., Wang, J.-g., & Zang, H.-y. (2018). An integrated approach for failure mode and effects analysis based on fuzzy best-worst, relative entropy, and VIKOR methods. *Applied Soft Computing*, 1-11.

Wu, J., Sun, J., Liang, L., & Zha, Y. (2011). Determination of weights for ultimate cross efficiency using Shannon entropy. *Expert Systems with Applications*, 5162-5165.