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Statistically Positioning of Countries in the Context of Happy Planet Index Data

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Abstract: *In the present study, the Happy Planet Index (HPI) 2016 data was analyzed for the EU, OECD and MENA countries, and the relative positions of these countries were attempted to be determined. Furthermore, the study aimed to determine the position of Turkey with respect to these countries. Statistical analysis results demonstrated that Bulgaria, Romania, Turkey, Hungary, Latvia, Portugal, Lithuania and Slovakia were similar EU countries based on the HPI variables, while Norway, Switzerland, Sweden, Iceland, Netherlands, Canada, Finland and Australia were the most similar countries among the OECD nations. In the analysis conducted for MENA countries, it was determined that Palestine, Egypt, Morocco, Tunisia, Iran, Syria and Tunisia were the most similar countries, while Zambia was the most different country. In the analysis conducted for both EU and OECD countries, it was found that the most divergent country was Luxembourg, and Zambia was the most different country among MENA countries, and the most significant source of this difference was the ecological footprint variable. Turkey was similar to Bulgaria, Romania, Hungary, Latvia, Mexico, Algeria and Lebanon in the Euclidean Distance Model graphs, thus, it was concluded that Turkey exhibited similar characteristics with the abovementioned countries based on the scrutinized variables.*

Keywords: *Happy Planet Index, Multivariate Statistical Method, Multidimensional Scaling Analysis.*

Mutlu Gezegen Endeksi Bağlamında Ülkelerin İstatistiksel Olarak Konumlandırılması

Öz: *Çalışmada Happy Planet Index (HPI) 2016 verileri EU, OECD and MENA ülkeleri bağlamında analiz edilerek ülkelerin birbirine göre konumları belirlenmeye çalışılmıştır. Ayrıca Türkiye'nin bu ülkelere göre konumunun saptanması hedeflenmiştir. İstatistiksel analiz sonuçlarına göre, HPI değişkenlerine göre EU ülkeleri için Bulgaristan, Romanya, Türkiye, Macaristan, Letonya, Portekiz, Litvanya, Slovakya'nın benzer ülkeler oldukları, OECD ülkeleri için Norveç, İsviçre, İsveç, İzlanda, Hollanda, Kanada, Finlandiya and Avustralya'nın birbirine en benzer ülkeler olduğu görülmüştür. MENA ülkeleri için yapılan analizde ise; Filistin, Mısır, Fas, İran, Suriye and Tunus'un en benzer ülkeler olduğu, Zambiya'nın da en farklı ülke olduğu saptanmıştır. Hem EU hem de OECD ülkeleri için yapılan analizde en farklı ülkenin Lüksemburg, MENA ülkeleri için ise Zambiya olduğu tespit edilmiş ve bu farklılığın kaynağı olan en önemli faktörün ekolojik ayak izi (ecological footprint) değişkeni olduğu görülmüştür. Türkiye'nin, Euclidean Distance Model grafiklerinde Bulgaristan, Romanya, Macaristan, Letonya, Meksika,*

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Cezayir and Lübnan ile yakın konumlandığı gözlenmiş, dolayısıyla ele alınan değişkenler açısından söz konusu ülkelerle benzer özellikler gösterdiği anlaşılmıştır.

Keywords**:** *Mutlu Gezegen Endeksi, Çok Değişkenli İstatistiksel Metot, Çok Boyutlu Ölçekleme Analizi.*

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I. Introduction

The economic well-being of nations has been measured by the economists for more than 50 years using the System of National Accounts (SNA) and the Gross Domestic Product (GDP), which is a broad measure. In principle, economists are concerned with the measurement of the household well-being in a community or a nation, as well as the natural environmental conditions that contribute to the well-being of humans. It may be argued that modern economics is more interested in monetary issues, neglecting the physical well-being of individuals. Current national income accounting systems and progress measures such as GDP fail to assess the actual "economic" state and real "wealth" of the nations (Anielski, 2001: 1-3). Increasingly, new requirements have been adopted to render comprehensive, sustainable and all-embracing measurements. One of such approaches is the concept of human development. The main proposals of the said approach could be summarized as follows (Bilbao-Ubillos, 2013: 400-401).

The debate was opened in a study by Nordhaus and Tobin (1972) titled "Is growth obsolete?" where two methods that aimed to measure well-being and provided alternatives to more conventional ones were presented: Measure of Economic Welfare and Sustainable Measure of Economic Welfare. Sustainable measure of economic welfare refers to the amount of consumption in any year that is consistent with sustained steady growth in per capita consumption at the rate of technological progress trends. Measure of economic welfare, albeit sustainable or actual, can be expressed in aggregate or in per capita terms (Nordhaus and Tobin, 1972: 24).

The Index of the Economic Aspects of the Welfare, developed by Xenophon Zolotas, was estimated for the USA (Zolotas, 1981). Zolotas considered personal consumption as the baseline and then subtracted half of the intermediate advertising expenditures from final consumption. Unlike Nordhaus and Tobin, Zolotas adjusted his welfare measure for environmental costs.

The Index of Sustainable Economic Welfare was developed to achieve a sustainable economic welfare measure based on GDP adjusted for unaccounted benefits, and finally deducted various undesirable or depreciation costs including social and environmental costs. This index was based on final consumption and was associated with the national accounts and it was later modified to accommodate the effects of welfare which are not measured by GDP and private consumption. The index was later renamed as the genuine progress index (Jaffeer, 2011: 181).

The Genuine Progress Index was created by a non-governmental organization called Redefining Progress in 1995 to provide a better economic progress index by deducting pollution and resource degradation, crime and other economic troubles while including unmeasured benefits such as volunteer work and parenting.

Later, a new Gross Domestic Welfare concept, which accounts for other factors like environment and peace, family spirit and solidarity, was proposed.

The Total Material Requirement (TMR) reflects the aggregate primary materials extracted from nature to support human activities. The TMR indicator includes both materials used for production and hidden flows, in other words, the extractions that are not used but have an environmental impact similar to trade and service activities.

Finally, in 2006, the New Economic Foundation developed the Happy Planet Index (HPI). The index was as an attempt to determine the amount of well-being achieved per unit of research consumption at the national level. The HPI is a completely new index that measures human well-being and development. Like previous indices, the HPI is a multi-dimensional that includes distinct variables, reflecting different aspects of the human condition. However, in contrast to the indices developed previously, it does not explicitly utilize income or income-adjusted variables, but used both objective and subjective data, combining basic inputs and ultimate outcomes (Marks et al., 2006: 8).

The HPI measures the sustainable well-being of all individuals. It reports the national well-being in terms of conducting long, happy, sustainable lives. Globally considered as the pillars of achievement, wealthy Western countries do not rank high on the HPI. Instead, several countries in Latin America and the Asia Pacific region lead the index due to their relatively high and fairly distributed life expectancy and well-being with a smaller ecological footprint. The HPI provides a guideline for nations, demonstrating that it is possible to live by maintaining human and ecological welfare.

For instance, the HPI Report (Marks et al., 2006) set the standards when it directly demonstrated that the countries with the wealthiest economies are not necessarily the happiest. Also, these countries were reported to be inefficient in delivering happiness. The report confirmed that there was no correlation between material consumption and happiness. Once the basic needs (food, shelter and health) are covered, further consumption occurs due to cultural pressures and values. On the other hand, it was determined that Social Capital (social networks and community) and intentional activities (i.e. socialization, exercise, participation in cultural life, interest in others, and engagement in meaningful work) are closely associated with happiness (Escobar-Tello and Bhamra; 2009: 1).

Rich western nations have high life expectancy and wellbeing scores; however, they tend to have score not so high on overall HPI due to the environmental costs of their economic performances. The USA has a fairly high Happy Life Years score, however since its Ecological Footprint is among the largest globally, it has a low overall Happy Planet Index score. Several other countries achieved a higher Happy Life Years score with a smaller Ecological Footprint. Top-ranking country, Costa Rica, was able to

achieve a slightly higher Happy Life Years score with a significantly smaller Ecological Footprint when compared to the USA. In 2016, Costa Rica was the leader in the Happy Planet Index ranking for the third time. Costa Ricans have higher wellbeing than the residents of several wealthy nations including the USA and the UK, and live longer than the citizens of the USA. This was achieved with a per capita Ecological Footprint which amounts to just one third of the ecological footprint of the USA. (Jeffrey et al, 2016: 3).

A. Happy Planet Index (HPI)

The HPI reflects the national performances on supporting the inhabitants of the particular country to conduct good lives, while making sure that other countries could follow the same path in the future, in other words, to achieve sustainable well-being for all. The HPI is one of the first global sustainable well-being measures. The index utilizes global data on the well-being, life expectancy, and Ecological Footprint that were experienced to generate an index to rank the countries based on efficiency in producing long, happy lives for their citizens, while maintaining the conditions for future generations to follow the same path (Abdallah et al., 2012: 3).

The Happy Planet Index was developed by Nic Marks, who was the founder of the Centre for Well-being at The New Economics Foundation (NEF). The HPI was initially published in July 2006 and the second edition was published in 2009 and the third edition was published in 2012. Progress is not only about the wealth. HPI measurement is based on both current and future well-being. The challenges encountered by both wealthy resource-intensive countries and deprived countries with high poverty could be distinct, however the final objective is the same: to conduct happy and healthy lives at the present and in the future (Singh, 2014: 802).

The HPI scores range between 0 and 100- where high scores can be achieved only by reaching all three goals included in the index: high life expectancy, high satisfaction in life, and low ecological footprint (Abdallah et al., 2009: 3). The HPI combines the well-being experience (measured by happy years in life, which is calculated by the multiplication of life expectancy by life satisfaction) and consumption of resources (measured by the ecological footprint) (Mally, 2011: 73).

The Happy Planet Index combines four elements that demonstrate the efficiency of the residents of different nations utilize the environmental resources to lead long, happy lives (Jeffrey et al, 2016: 1). HPI is calculated as follows:

$$HPI = \frac{\text{wb} \times \text{le} \times \text{io}}{\text{fp}}$$

wb depicts experienced well-being, *le* reflects life expectancy, *io* is the inequality of outcomes and *fp* denotes the ecological footprint in HPI equation. This simple indication provides a clear sense of the direction of a nation. The index is a vital tool that allows the decision makers to account for fundamental issues in crucial policy decisions.

For 2050, several targets were set for developed countries: mean Happy Planet Index value of 89, life expectancy of 87 years, the ecological footprint to sustain the achieved life standard as 1.7 gha/1 person. For developing countries these targets were set for 20 years later than the developed countries. However, the effort to ensure the same conditions for a long, happy and meaningful life for future generations remains constant for all nations (Gonda and Rozborilova, 2013: 246).

II. DATA SET and METHOD

The Happy Planet Index 2016 results, calculated by the NEF, reveal the degrees at which the countries across the world provide long, happy lives for their populations. In the abovementioned index that included 140 countries, the top three ranking countries based on the highest HPI score were Costa Rica, Mexico and Colombia. The three countries with the lowest score were Chad, Luxembourg and Togo in the index. Turkey ranked 98th, the US ranked 108th, Canada 85th, Britain 34th, Germany 49th, while France ranked 44th in the index.

The present study aimed to determine the comparative positions, similarities and differences between EU, OECD and MENA countries with Multidimensional Scaling Analysis, a multivariate statistical analysis, using the Happy Planet Index 2016 dataset. Furthermore, the similarities between Turkey and the members of above organizations and the position of Turkey with respect to these countries were also investigated. Thus, variables such as Average Life Expectancy, Happy Life Years, Footprint, Inequality of Outcomes, and GDP per Capita that are used in HPI calculations were analyzed in the present study.

A. Multidimensional Scaling (MDS) Analysis

MDS analysis is a multivariate analysis where the items (unit, individual or observation) are visualized based on their distances on a multidimensional space. In MDS analysis, the items are represented as points on a multidimensional space where the points corresponding to similar items are grouped together, while the points that represent dissimilar items are scattered (Machado, et.al, 2011: 614).

For different types of MDS, there are different measurement procedures that are reflected as different correlation types between the items on the multidimensional space. Thus, MDS can be divided into metric and non-metric MDS types (Kruskal and Wish, 1991: 22). In order to assess the goodness-of-fit, the stress values can be used as follows:

$$Stress = \left[\frac{\sum\sum_{i<k} (d_{ij} - \hat{d}_{ij})^2}{\sum\sum_{i<k} (\hat{d}_{ij})^2} \right]^{1/2} \qquad \textit{(Eq.1)}$$

d_{ij} depicts the distances between the points in the configuration and the disparities $\hat{d}_{ij}$ are obtained by regressing d_{ij} on observed distances, δ_{ij}. This stress statistics usually reffered as Standard Residual Sum of Squares. When the stress statistic is equal to 0, it means that there is a perfect fit between configuration and observed distances (Kruskal and Wish, 1991: 25). In order to assess goodness-of-fit, the reference stress values for comparison can be seen in Table 1.

Table 1: Stress Values

Minimum Stress	Goodness of Fit
0.20	Poor
0.1	Fair
0.05	Good
0.025	Excellent
0	Perfect

Source: Timm (2002)

The variables found in the Happy Planet Index 2016 dataset that was utilized in the present study were Average Life Expactancy, Happy Life Years, Ecological Footprint, Inequality of Outcomes and GDP per Capita. Average life expectancy reflects the average number of years an individual is expected to live in each country based on the United Nations data. Inequality of outcomes is the inequalities observed among individuals that reside in a country based on the length of their lives, and their self-perception about happiness obtained via the national distribution of life expectancy and wellbeing data. Inequality of outcomes is expressed as a percentage. Ecological footprint reflects the average impact on the environment that each resident in a country is responsible for based on the Global Footprint Network data. Ecological footprint is expressed with a standardized unit: global hectares (gha) per person.

III. Results

In the present study, it was aimed to scrutinize the Average Life Expactancy, Happy Life Years, Footprint, Inequality of Outcomes, GDP per Capita variables that are used to calculate HPI in EU countries and to determine the comparative positons of nations and to identify their similarities and dissimilarities based on these variables.

A. EU Countries

The analysis of 2016 data with Multidimensional Scaling (MDS) identified that the stress value for two dimensions was 0.077. This value represents the difference between the actual form in the multidimensional space and the form predicted in the reduced-dimension space. The calculated stress value indicates the goodness of fit between the actual form and the predicted form was good.

Table 2: Stimulus Coordinates for the AB Countries

		Dimension	
Stimulus Number	Stimulus Name	1	2
1	Bulgaria	2,2632	-0,4881
6	Romania	2,0962	-0,2318
7	Turkey	1,8589	-0,2909
18	Hungary	1,6637	-0,1623
20	Latvia	1,2278	-0,9933
24	Portugal	1,0047	0,5107
4	Lithuania	0,9836	-1,0508
25	Slovakia	0,8815	-0,1377
17	Greece	0,8396	0,4646
2	Croatia	0,7305	0,1664
23	Poland	0,6629	0,0290
13	Estonia	0,6078	-0,7652
5	Malta	0,2816	0,4288
3	Cyprus	0,1221	0,3680
11	Czech Republic	0,0584	0,1186
26	Slovenia	-0,1263	0,156
8	Italy	-0,2761	0,7646
27	Spain	-0,2938	0,8678
29	United Kingdom	-0,6458	0,3514
16	Germany	-0,7847	0,2786
15	France	-0,8086	0,4926
19	Ireland	-0,9485	0,1996
10	Belgium	-1,0273	-0,1800
9	Austria	-1,2835	0,2574
14	Finland	-1,292	0,2671
12	Denmark	-1,3061	0,1933
22	Netherland	-1,5744	0,5831
28	Sweden	-1,8156	0,1015
21	Luxembourg	-3,1000	-2,2990

Country coordinates determined based on the variables are presented in Table 2. Table 2 demonstrates that in the primary dimension, Bulgaria, Romania, Turkey,

Hungary, Latvia, Portugal, Lithuania, Slovakia, Greece, Croatia and Poland had the higher values with their positive loading and values over 1 or close to 1. Thus, at the primary level, these countries were similar and closely related in terms of the five variables. It could be argued that these countries, and especially Bulgaria and Romania, were the most important decomposers in the primary dimension. Again, in the same dimension, it was observed that Belgium, Austria, Finland, Denmark, Netherland, and Sweden were with a negative loading over 1. Luxembourg was the most distinctive country with a negative value of above 3. Since the loadings of other countries, especially Cyprus, Czech Republic and Slovenia were close to 0, it could be interpreted that these were not significant countries at the primary level. In the second dimension, there were no countries with a positive loading and over 1, Luxembourg was over 1 and with a negative loading. Other variables were close to 0 and negatively loaded. Therefore, it could be interpreted that there was no country with a significant decomposing feature in the second dimension. Based on these findings, it was observed that Turkey, which is not an EU member, was a decomposer and significant country in the primary dimension.

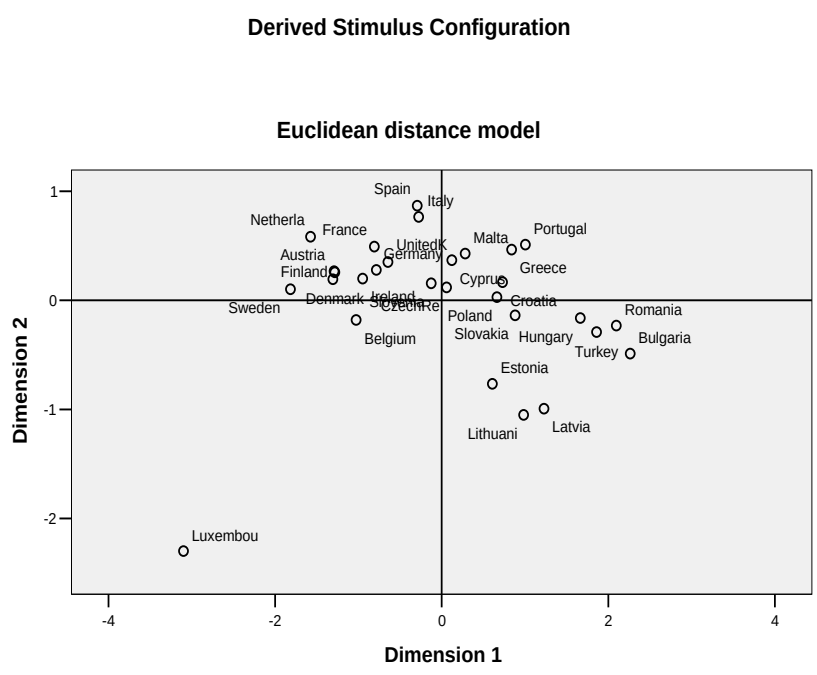

Figure 1: Euclidean Distance Model for the AB Countries

The two-dimensional graphical representation of relative positions of EU countries based on the scrutinized HPI is shown in Figure 1. It could be observed in Figure 1 that

Bulgaria, Romania, Turkey, Hungary, Latvia, Portugal, Lithuania and Slovakia were the most similar countries based on the abovementioned variables. The most different country seems to be Luxembourg. Especially the ecological footprint was a significant factor on the differentiation of Luxembourg. Belgium, Austria, Finland, Denmark, Netherland and Sweden differ from the general tendency, although they form a group. The ecological footprint variable also has an impact on that fact. These countries were among the EU countries with the highest ecological footprint following Luxembourg.

A dissimilarity matrix was constructed between countries based on the five variables to determine with which countries Turkey shared similar features. As a result, it was determined that Turkey was similar to the following EU countries: Bulgaria, Romania and Hungary. The most dissimilar country was Luxembourg. Based on the dissimilarity matrix, Luxembourg already differentiates from all other EU countries.

B. OECD Countries

The analysis of OECD country data revealed a stress value of 0.106 for both dimensions. It was observed that the goodness of fit between the actual form and the predicted form was fair based on the calculated stress value.

Table 3: Stimulus Coordinates for the OECD Countries

		Dimension	
Stimulus Number	Stimulus Name	1	2
19	Luxembourg	2,6016	-2,5263
23	Norway	1,8673	0,4338
31	Switzerland	1,7746	0,4121
1	Australia	1,3885	-0,5114
30	Sweden	1,3671	0,0655
13	Iceland	1,2486	0,427
21	Netherland	1,1469	0,592
4	Canada	0,9459	-0,2995
8	Finland	0,8131	0,1733
2	Austria	0,7808	0,1517
6	Denmark	0,7274	0,1106
15	Israel	0,585	0,3007
22	NewZealand	0,512	0,31
3	Belgium	0,4658	-0,2576
14	Ireland	0,4218	0,063
17	Japan	0,3577	0,568
9	France	0,3268	0,4036

10	Germany	0,2448	0,1745
33	United Kingdom	0,1226	0,2217
34	United States of America	0,0248	-0,7789
29	Spain	-0,1529	0,7617
16	Italy	-0,2546	0,6536
28	South Korea	-0,3439	0,1207
27	Slovenia	-0,3642	0,0131
5	Czech Republic	-0,5873	0,1052
24	Poland	-1,1828	-0,0329
7	Estonia	-1,2405	-0,783
11	Greece	-1,4227	0,2255
26	Slovakia	-1,4779	-0,1292
25	Portugal	-1,585	0,4551
18	Latvia	-1,9823	-1,1276
20	Mexico	-2,1157	0,277
12	Hungary	-2,3942	-0,1762
32	Turkey	-2,6189	-0,3968

The country coordinates determined based on the variables are presented in Table 3. According to Table 3, in the primary dimension, Luxembourg, Norway, Switzerland, Sweden, Iceland, Netherland, Canada and Finland and Australia were with positive loading, and with values over 1 or very close to 1. In the primary level, these countries were similar in terms of the five scrutinized variables and were quite close to each other. Furthermore, these countries were the most significant decomposers in the primary dimension. The most important variable in this distinction was the ecological footprint. Especially Luxemburg with the highest positive loading was the most significant decomposer country. In the primary dimension, Latvia, Mexico, Hungary and Turkey were the most different countries with their high and negative loading. Other countries with loads close to zero, especially the United Kingdom, USA and Spain were not significant at the primary level. There were no countries in the second dimension with positive loading of more than 1. However, Luxembourg and Latvia were with an over 1 negative loading. Other variables were close to 0 and with negative loading. Therefore, there was no significant country in the second dimension. Turkey exhibited similar feature with Latvia, Mexico and Hungary based on HPI variables.

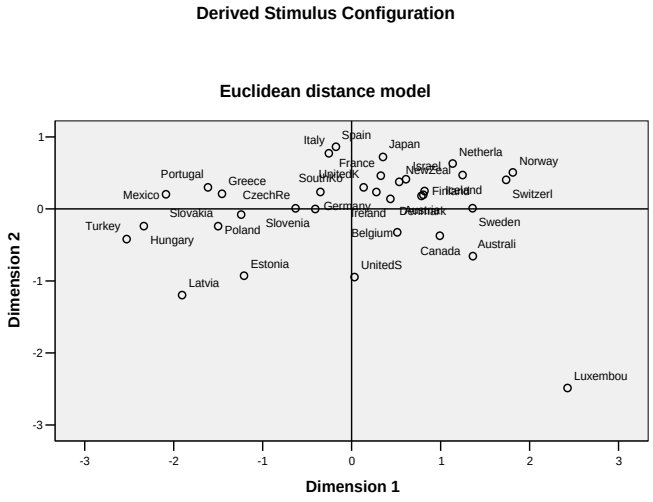

Figure 2: Euclidean Distance Model for the OECD Countries

A two-dimensional comparative graphical representation of OECD countries based on the scrutinized variables is shown in Figure 2. According to Figure 2, Norway, Switzerland, Sweden, Iceland, Netherland, Canada, Finland and Australia were the most similar countries based on the HPI variables. Luxembourg was the most distinctive country based on its position on the grapg. Latvia, Mexico, Hungary and Turkey formed a group, however they differed from the general trend.

C. MENA Countries

As a result of the analysis conducted for MENA countries, stress value was calculated as 0.046 for the two dimensions. The calculated stress value indicated that the goodness of fit between the actual form and the predicted form was excellent.

Table 4: Stimulus Coordinates for the MENA Countries

		Dimension	
Stimulus Number	Stimulus Name	1	2
13	Zambia	2,2649	1,1574
10	Syria	1,2635	-0,1179
4	Iraq	0,7339	0,2321
9	Palestin	0,6117	-0,4046
2	Egypt	0,611	-0,1257

7	Morocco	0,459	-0,3481
11	Tunisia	0,2062	-0,4074
1	Iran	0,0409	-0,2231
3	Algeria	-0,1474	0,2687
12	Turkey	-0,4726	-0,0951
6	Lebanon	-0,6271	-0,498
8	Oman	-2,1588	0,7625
5	Israel	-3,08	0,3367

MENA country coordinates determined based on the variables were as shown in Table 4. According to Table 4, Zambia, Syria and Iraq had positive loading of more than 1, or very close to 1 in the primary dimension. These countries were similar in terms of the five variables. Furthermore, these countries were the most significant and decomposer countries in the primary dimension. Zambia, which had the highest positive loading, was the most significant decomposer country. In the primary dimension, Israel and Oman were the most different countries with their high and negative loading. Other countries with loadings close to 0, especially in Iran, Algeria and Tunisia, were not significant in the primary dimension. In the secondary dimension, Zambia and Oman had positive loading of above or close to 1. Therefore, these countries were significant and decomposer countries in the second dimension. Other variables had usually close to 0 and negative loadings. In the second dimension, there was no significant country except those mentioned above.

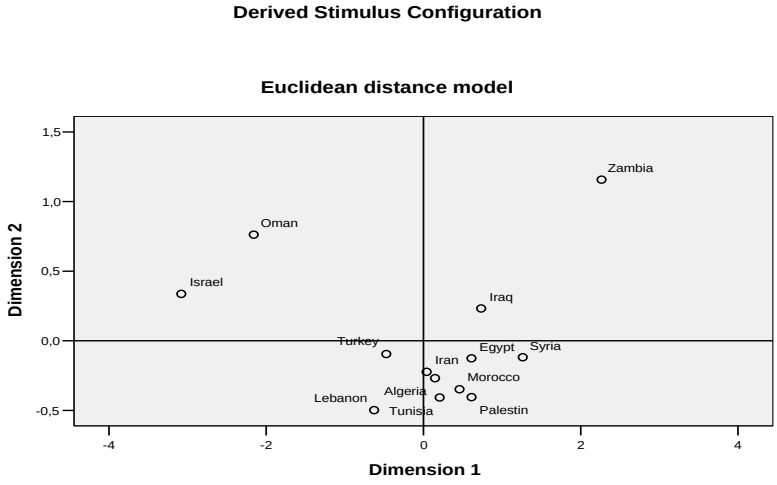

Figure 3: Euclidean Distance Model for the MENA Countries

A two-dimensional graphical comparative representation of the positions of MENA countries is presented in Figure 3. According to Figure 3, based on HPI variables, Palestine, Egypt, Morocco, Iran, Syria and Tunisia were the most similar countries. Zambia was significant as the most different country due to its position on the graph. Israel and Oman formed a group, however they differed from the general trend. Turkey, Algeria and Lebanon could also be considered in the same group.

IV. Conclusions

In the present study, analyzes were conducted for three different communities, namely the EU, OECD and MENA countries. Furthermore, an attempt was made to determine the position of Turkey with respect to the member countries. The results of the analysis conducted for the EU member countries demonstrated that Bulgaria, Romania, Turkey, Hungary, Latvia, Portugal, Lithuania and Slovakia had similar scores. Luxembourg was the most different country. It can be argued that the ecological footprint was a significant factor in this differentiation. It was conceived that non-EU member Turkey was important with respect to the positioning of the abovementioned countries and had similar HPI characteristics with Bulgaria, Romania and Hungary.

The results of the analysis conducted on OECD countries demonstrated that Norway, Switzerland, Sweden, Iceland, Netherland, Canada, Finland and Australia were the most similar countries and Luxembourg was the most different country among OECD nations as well. Based on HPI variables, Turkey was similar to Latvia, Mexico and Hungary. Ecological footprint was also a significant factor in the analysis results. Based on HPI variables, Palestine, Egypt, Morocco, Tunisia, Iran, Syria and Tunisia were the most similar MENA countries, while Zambia was the most different country. Turkey can be considered in the same group with Algeria and Lebanon.

Considering the analysis variables, it was observed that the results were consistent with expectations. In general, variables such as geographical location, ecological similarity, socio-economic level were effective on the determined similarities as expected. It was the most important finding of the present study that ecological footprint variable was an effective factor in positioning the countries based on HPI scores. It was also striking that Turkey was found to be similar to Bulgaria, Romania, Hungary, Latvia, Mexico, Algeria and Lebanon in general.

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