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# MULTIVARIATE ANALYSIS OF COUNTRIES ACCORDING TO SUBDIMENSIONS OF HUMAN DEVELOPMENT AND GENDER INEQUALITY INDICES

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**Abstract**

Human Development Index (HDI) is an index aiming to measure human development by taking into account a long and healthy life, access to knowledge and a decent standard of living. The *2013 Human Development Report* presents HDI values and ranks, the Inequality-adjusted HDI the Gender Inequality Index (GII) and the Multidimensional Poverty Index. The aim of this study is to evaluate countries according to their similarities and differences using the indicators contained in the 2013 human development report. A figure created in two dimensional space was used by evaluation. Locations of Turkey, OECD and Eurasian countries are analyzed and interpreted elaborately. Multidimensional scaling is a statistical technique provides visual representation of the objects using proximity patterns. The most recent data of countries were analyzed by Multidimensional Scaling analysis (MDS). Stress value obtained from metric multidimensional scaling application was found in desired range. Also it was determined that we can trust the interpretations made of the map. To begin with, comparison by country groups was made, then remarkable points were interpreted on the basis of country. As examination of the map obtained from MDS application with HDI and GII indexes, it was remarked that OECD countries were grouped on the left hand side and Eurasian countries were grouped on the right hand side. Turkey, a member of OECD, located far away from other OECD countries and located closer to Eurasian countries. According to HDI and GII indexes Mexico is closest country to Turkey. Also Mexico is the country, which is perceived similar to Turkey.

**Keywords:** Human Development Index, Gender Inequality Index, Multidimensional Scaling

## 1. Introduction

The high level of national income increase in a country is not sufficient for that country to be named as a developed country. Upon seeing that social problems cannot be resolved in many economically developed countries, the requirement of better establishing the relation in between economic growth and human development had emerged (Seker, 2011). Human development is being defined as the process enabling the individuals to live their lives in the manner they value through enrichment of their opportunities and increasing their capacities and to use the basic human rights (Uygur and Yildirim, 2011, p.31).

Human Development Index (HDI) included in Human Development Reports, being issued in each year and obtained by using the data at national level is a complex index

established on three basic dimensions and making human development as a brief measure (Klugman *et al.* 2011, p.3). HDI being one of the indexes intending to measure human development included in Human Development Reports being issued by United Nations Development Program (UNDP) since 1990 consists of three principal components. These are long and healthy life (health), knowledge (education) and a decent standard of living (income). The indicators used to measure these three dimensions are lifetime expectancy by birth, mean years of schooling, expected years of schooling and Gross National Income (GNI) per capita. HDI, which is calculated by including developed and developing countries, enables the opportunity to see the position of the country among other countries as well as the opportunity of seeing the current status of the countries and the changes they show as per years. Calculation of HDI requires converting the dimension indicators measured in different units to a unitless scale changing from zero to one. Minimum and maximum values are being determined in order to convert the indicators to indexes in between 0 and 1. Maximum value is the highest observed value within the time series (1980-2012). Minimum values had been set as 20 years for life expectancy at birth, 0 years for education variables and 100 dollars for GNP per capita (UNDP, 2013a, p.2).

Sub-indexes are able to be calculated with the following equation by using the minimum and maximum values determined for health, education and income dimensions.

$$Dimension\ Index = \frac{Actual\ Value - Minimum\ Value}{Maximum\ value - Minimum\ Value} \quad (1)$$

The definitions of indicators used in the calculation of dimension indexes consisting HDI and calculation manner of indexes are being provided below.

***Long and Healthy Life (Health):*** Life expectancy at birth (years); the average number of years expected for a newborn individual to live in case of being subjected to mortality speed peculiar to age in a specific period along his life.

$$Life\ Expectancy\ Index(I_{Healt\,h}) = \frac{Actual\ Value - 20}{83.6 - 20} \quad (2)$$

***Knowledge (Education):*** In the human development report issued in 2010, indicators measuring access to information had changed. According to that, knowledge had been measured:

* Average year of adult education being the average of school years of individuals of age 25 and over along their lives, and

* Expected school attendance period for children in the age of starting school, in other words, in case the tendency regarding rates of starting to school of children of a specific age remain the same along their lives, it had been started to be measured with the expectation for education period of a child in the age of starting to school (UNDP HDR Turkey, 2013).

$$Mean\ Years\ of\ Schooling\ Index\ (MYSI) = \frac{Actual\ Value - 0}{13.3 - 0} \quad (3)$$

$$Expected\ Years\ of\ Schooling\ Index\ (EYSI) = \frac{Actual\ Value - 0}{18 - 0} \quad (4)$$

$$Education\ Index\ (I_{Education}\ ) = \frac{\sqrt{MYSI * EYSI} - 0}{0.971 - 0} \quad (5)$$

As there are two indicators in the education dimension of HDI, sub-index values are being calculated for both indicators and the geometrical average of obtained sub-indexes are being taken. Education dimension index is being obtained as making the calculations by using the geometrical average of two sub-indexes as current value in the 5 numbered equation.

***A Decent Standard Of Living (Income):*** While a good life standard was being calculated in the previous years as GDP (USD) per capita in Purchasing Power Parity, it had been started to be calculated as GNI per capita adapted to Purchasing Power Parity along with the report issued in 2010. Income index is being calculated through the 6 numbered equation below.

$$Income\ Index\ (I_{Income}) = \frac{\ln(Actual\ Value) - \ln(100)}{ln(87.478) - \ln(100)} \quad (6)$$

In the reports before 2010, HDI had been calculated as the arithmetical average of dimension indexes. In HDI calculations after that year, geometrical average of normalized indexes being individually calculated in three basic dimensions had started to be used. This approach decreases the substitution of dimensions, and for instance a one percent decrease in the expected lifetime at birth has the same effect on HDI as one percent decrease in education or income (HDR Turkey, 2010a, p.2).

HDI is obtained through the calculation of geometrical average of sub-indexes specifying three different dimensions.

$$HDI = I_{Health}^{1/3} . I_{Education}^{1/3} . I_{Income}^{1/3} \quad (7)$$

As the minimum and maximum values being used in the calculation of dimension indexes enable the sub-indexes to remain in between 0 and 1, HDI also gets values changing in between 0 and 1. While values of index which are close to 0 indicate lower development level in humanistic aspect, its values which are close to 1 specify that the human development level is high (Unal, 2008, p.91.). The countries within the HDI ranking are being classified in four groups as being very high, high, medium and low human development depending on the quartile of the distribution of HDI as per development levels (UNDP, 2013b, p.140).

In the report issued by United Nations Development Program, Inequality Adjusted Human Development Index, Gender Inequality Index and Multidimensional Poverty Index are also included as well as HDI. These indexes and basic indicators used in the calculation of indexes are indicated in Table 1.

**Table 1. Measuring Human Development**

| **Components of Human Development** | | | | | |
|---|---|---|---|---|---|
| **Empirical Measure** | **Health** | **Education** | **Material Goods** | **Political** | **Social** |
| **Average Level** | Human Development Index | | | Empowerment Indicators | |
| **Deprivation** | Multidimensional Poverty Index | | | | |
| **Inequality** | Gender Inequality Index | | | | |
| | Inequality adjusted HDI | | | | |

**Source:** United Nations Development Report, 2010, s.85

Besides these, indexes enabling a more general analysis by combining the all the indicators specifying the position and role of women in social life are also being composed. In such indexes, the position of women are being determined as comparing with men and making a comparison in between the countries is being possible within the frame of values taken by the countries. One of the most significant of these referred criteria is Gender Inequality Index indicating inequality in between women and men as per various criteria (Deniz and Hobikoglu, 2012, p.123).

First global gender indexes had been issued in Human Development Report in 1995. As different from HDI, in the first reports issued in order to measure gender inequality it is being focused on the same variables with HDI. However, the indexes of *Gender Related Development Index* focusing on inequality in between women and men and *Gender Empowerment Measure*

which examines the active participation of women in economic and politic life and their participation in decision making had also been used. In order to remove the criticism made against the conceptual and methodological limitations of these indexes and to resolve some problems defines by different researchers in the past years, *Gender Inequality Index* –being a new measure- had been started to be issued along with the report issued in year 2010. Gender Inequality Index had been designed in order to reveal how much the national human development success is being damaged in respect of social gender inequality and to provide experimental grounds for policy analysis and advocacy efforts (UNDP HDR Turkey, 2010c, p.1).

Gender Inequality Index catches the loss of success in the dimensions determined depending on gender inequality. Index value is in between 0 and 1. Gender Inequality Index measures the inequality in between women and men under 3 dimensions. These are: h*ealth, empowerment* and *labour market*. In order to measure these three dimensions, five indicators in total are being used as one being in labor dimension. The health dimension is being measured with the indicators of maternal mortality ratio and adolescent fertility rate, empowerment dimension is being measured with the indicators of the female and male shares of parliamentary seats and the population of each gender having at least secondary education, and the last dimension of labour market dimension is being measured with the indicators of participation rate of women in labour market. Gender Inequality Index indicates the loss in potential human development arising from inequality in between the gains of women and men in these dimensions.

In the calculation of Gender Inequality Index, first the indexes are calculated by combining the indicators within the dimensions through geometrical average for each gender group ($G_F$, $G_M$). In order to create an equally distributed gender index, the harmonic average of female and male indexes is calculated $HARM(G_F, G_M)$). Three basic dimensions of the index are individually calculated for female and male and arithmetical average of values obtained for female and male in each dimension is found, and then in order to obtain a reference standard value in measure inequality, the geometrical average of arithmetic average calculated for each dimension is calculated ($G_{F,\bar{M}}$). In the last phase, the equally distributed gender inequality and reference standard value are compared, and thus the Gender Inequality Index in the 8 numbered equation is obtained.

$$1 - \frac{HARM(G_F, G_M)}{G_{\bar{F},\bar{M}}} \tag{8}$$

Another index issued in the report is Multidimensional Poverty Index. Poverty in basic terms defines the condition of "absence" and being “deprived” of basic financial potential that will meet the requirements, and depending on deficiency-scarcity of income, it is being defined as the sense of being unable to benefit from goods and services required to maintain minimum level of living and developing social deprivation along with this condition (Topgul, 2013, p.279). In the Human Development Report issued in 1997, different dimensions of poverty had been addressed and tried to measured, and Human Poverty Index –obtained by using country averages in order to reflect combined deprivation in health, education and life standard- had been started to be issued. Along with the report issued in 2010, Multidimensional Poverty Index (MDPI) had started to be calculated in order to quantitatively analyze the problem of poverty. MDPI reflects both the effect and intensity of multidimensional deprivation. This measure enables comparison both in between countries, regions and worldwide and within the countries in respect of ethnical groups, rural/urban positions and other key household and specification of society as well as being used to generate an extensive picture of people living in poverty (UNDP HDR Turkey, 2010b, p.2). Multidimensional Poverty Index defines the poverties overlapping on household at three dimensions as in HDI, and it indicates the average number of poor people and deprivation of poor houses. According to Multidimensional Poverty Index, being an index intending to reveal the deprivation encountered by societies in a specific period, for an household to be “multidimensional poor” it shall show deprivation specifications for more than one criteria (TOBB, 2011, p.45).

In the reports issued as from 1990, changes had been made from time to time in the indicators and formulas used for the calculation of indexes. In case of change of method in the calculation of HDI, HDI values for past years can be able to be calculated (Dogan and Tatli, 2014).

In the following figure, change of retroactively re-calculated HDI as per years is being seen in the report issued in 2013 for Turkey. When the change of retroactively calculated HDI value within years for Turkey is examined, it is being seen that it indicated a regular increase trend. HDI value of Turkey for 2012 is 0.722 and with this value it ranks 90th in between 187 countries, and it had been among the group of countries within high human development class.

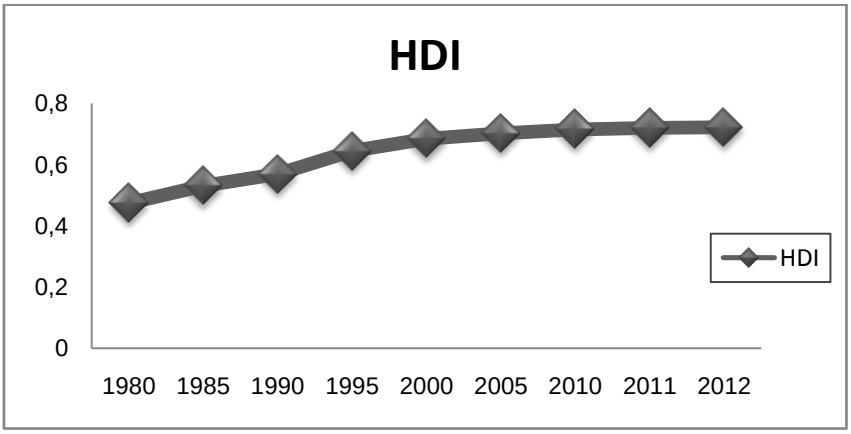


**Figure 1. Trends in Turkey's Human Development Index 1980-2012**

**Table 2. Turkey's HDI trends based on consistent time series data, new component indicators and new methodology**

| | Life expectancy at birth | Expected years of schooling | Mean years of schooling | GNI per capita | HDI value |
|---|---|---|---|---|---|
| **1980** | 56.5 | 7.4 | 2.9 | 5872 | 0.474 |
| **1985** | 60.1 | 8.3 | 4 | 6583 | 0.53 |
| **1990** | 63.1 | 8.8 | 4.5 | 7960 | 0.569 |
| **1995** | 66.1 | 9.5 | 4.8 | 8539 | 0.645 |
| **2000** | 69.5 | 10.6 | 5.5 | 9675 | 0.684 |
| **2005** | 72.1 | 11.7 | 6.1 | 11320 | 0.702 |
| **2010** | 73.7 | 12.9 | 6.5 | 12440 | 0.715 |
| **2011** | 74 | 12.9 | 6.5 | 13344 | 0.72 |
| **2012** | 74.2 | 12.9 | 6.5 | 13710 | 0.722 |

In Table 2, the change of indicators used in the calculation of HDI as per time for Turkey is shown. When the table is examined, it is possible to see the development obtained by Turkey.

## 2. Literature Review

As the result of literature review carried out regarding implementation project, it had been observed that the studies may be separated roughly to two groups. A part of the studies addresses only Turkey, and they focus on the acts of Turkey in time or its current condition as per any one or at most two of the indexes. Within the scope of study, in works in which only one index is included, it had been observed that relevant index had been included on the basis of its components. This approach ensures reaching more detailed interpretations. Moreover, in some studies Turkey is being analyzed as being separated geographical regions and thus it is being

searched whether there exists any different in between the regions or not. The following selected studies may be provided as a sample for this group.

Tuyluoglu and Karali (2006) had interpreted the HDI values calculated by United Nations Development Program in respect of Turkey, and they had compared and assessed the HDI values calculated for Turkey by the data of Turkish Statistical Institute and HDI values arising from United Nations Development Program.

Unal (2008) realized in order to reveal the regional differences of Turkey as per HDI value, had used average income per person, average life and education variables, and consequently he had concluded that significant differences exist among regions in Turkey and that the regions in the west of Turkey had higher index values compared to regions in its east.

Deniz and Hobikoglu (2012) had analyzed the current condition and future view of employment of women in Turkey. Moreover, they had examined the position of Turkey within the frame of gender based development index and had made comments on improvement policies intended for the future.

And in some studies, they had searched the position in other words international position of Turkey within various country groups (i.e. Organization for Economic Cooperation and Development (OECD), developing countries member states of European Union (EU)) in respect of relevant indexes (mostly in respect of only Human Development Index). The selected studies which may be provided as a sample for this group had ben summarized below.

Karabulut *et al.* (2009) had examined the HDI values of 30 countries which are full members of OECD and which are within category of industrialized countries and had examined the index values composed as the result of calculations made by them by using sub-index values composing this index. According to index values composed as the result of the performed analysis; while all the OECD countries except Turkey are in the category of countries having high human development level, Turkey had been in the category of countries having middle human development level as per indexes other than education index.

Gurses (2009) had explained the concept of “human development” and had assessed the international position of Turkey in respect of human development and its performance in years. Consequently, he had determined that the Human Development Reports indicate that Turkey is in a regular but unstable development trend, and that education and schooling index values of Turkey –being a country in the middle development category- were lower when compared with countries of the same and/or lower income level.

Tekbudak and Tatlidil (2011) had intended to determine the distance covered by Turkey in human development in a period 30 years and to compare Turkey with other OECD countries. In the direction of purpose, they had applied Multidimensional Scaling (MDS) analysis by using three sub dimensions of HDI as variable. As the result of the analysis, they had concluded that despite Turkey’s HDI values had properly increased within 30 years, its position had remained unchanged against OECD countries.

Erol (2011) had calculated HDI through Principal Components Analysis in order to determine the human development level of some selected developing countries. The result of analysis made in order to assess the selected developing countries’ human development structure by the developed index value had been in conformity with 2010 HDI.

Ongel *et al.* (2011) had examined the status of human development index data of 5 Central Asia countries (Kazakhstan, Turkmenistan, Uzbekistan, Tajikistan, Kyrgyzstan) for the year 2010 and had examined their change as per years in period after independence, and had concluded that high increases in GDP per person within 20 years period had not reflected on HDI in Central Asia countries.

Tas and Ozcan (2012) had examined the values of various variables for Turkey and world without including statistical analysis. In the study, the structure of poverty in Turkey had been examined and it had been specified that the rate of poverty in the country had increased at a high level such as 17.5% when the definition of poverty covering food and non-food expenses is adopted. As the result of study, it had been suggested that it is required to structure economic growth in favor of poor by having the national economic policies focus more on agriculture.

Nartgun *et al.* (2013) had made comparisons considering the HDI 2011 values of member states of EU, membership candidate states such as Turkey and countries applying for

membership. As the result of the study, it had been concluded that Turkey had lower HDI values than candidate states and candidate for nomination countries of EU and that the Turkey's education index value was lower than the index values of these countries.

Gokce and Ozkoc (2013) had separated the countries to two groups –through development indicators- as candidate countries which also includes Turkey and EU member states, and had examined the inclusion states of the countries in these groups through Discriminant Analysis and MDS.

Tireli *et al.* (2013) the relationship and interaction level in between poverty, education, health and employment had been assessed and presented over the date of two international institutions. As the result of the study, it had been observed that there is a significant relationship in between multidimensional poverty and pure death, pure birth, GDP per employed person, life expectancy as from birth, literacy and enrolment to secondary school.

Dogan and Tatli (2014) had defined the dimensions of human development and had examined the human development levels of developed and developing countries in the world. In this study, other indexes described in Human Development Report had also been introduced, and the place of Turkey in the world in the context of human development and human poverty had been examined based on international comparison dimension. In the light of findings obtained as the result of the study, it had been specified that it was required for Turkey to effectively implement economic policies -increasing income- and social policies –increasing average life and education quality- in order to be included in very developed human development category and in order to decrease multidimensional poverty rate.

As specified in the introduction section; HDI issued by United Nations Development Program considers mainly developments in three dimensions regarding the countries and ensures the combined measurement of developments in these three dimensions. In the 2013 human development report, there exists Social Gender Inequality Index and Multidimensional Poverty Index along with HDI. In the phase of literature review, no study had been found searching the Turkey's international position by including in analysis the relevant three index on the basis of their sub-dimensions. In this study, the place of Turkey within OECD and Eurasia Countries on the relevant issues had been examined by Multidimensional Scaling

## 3. Methodology

MDS is a multivariable analysis technique intending to reveal the relations in between observations based on distance values in between such observation when the relations in between observations are not known (Kalayci, 2005, p.379). MDS is a descriptive technique, and thus it can be said to be static.

The purpose of MDS is to reveal the geometric position of observations by using the distance values in between n number of observations. These observations shown on K dimensioned space are tried to be expressed in a space of lower dimension. The purpose in here is to ensure clarity by passing to a more simple structure from a complex structure. It had been observed that the form obtained in this manner had k>1 dimension, and thus the analysis had been named as "Multidimensional Analysis" (Tatlidil, 1996, p.353). Thus the similarities and differences in between objects are expressed more simply.

As it will be understood from its definition and purpose, MDS is similar to Cluster Analysis from among Q type multivariable analysis techniques and similar to Principal Components Analysis and Factor Analysis from among R type analysis techniques (Tatlidil, 1996, p.353).

MDS is an analysis technique being widely used in social sciences as being sociology, medicine, psychology, marketing research and educational sciences. It reveals similarities as well as differences. MDS does not require distribution assumption regarding data (Ozdamar, 2002, p.488). Moreover, the data may have measured as per different measurement levels. The basis in the analysis is the distance values in between observations rather than variable values. These distance values are very various, and they differentiate as per scale type.

If the data had been obtained through *interval or ratio scale* (Sharma, 1996, p.219) Euclid, Mahalanobis, Quadratic Euclidean, Chebychef, Block, Minkowski distances may be

calculated; if the data is *dichotomous (binary)* then Euclid, Quadratic Euclidean, Size Difference, Pattern Difference, Lance-Williams distances may be calculated; if the data are *counting values (nominal)* Chi square, Phi chi square distances may be calculated.

MDS ensures to determine with any regression method the MDS indication distances ($d_{ij}$) which will represent the distances in between observations ($\delta_{ij}$) calculated depending on measurement levels of variables with minimum level of fault (Ozdamar, 2002, 489).

In this analysis, the distance values in between n observations are n(n+1)/2 units. In order to obtain a proper and less dimensioned geometrical indication as per these original distances, it is tried to obtain an indication coordinate system which will be very close to original distances. The measure measuring the conformity in between original distances and indication distances is named “stress measure”. Indication distances have various calculation methods. For instance, if the scale of data is interval or ratio linear regression may be used:

$$d_{ij} = a + b\delta_{ij} + e$$

If a weaker scale is in subject, these data are first put in an order in a proper manner, and by these ordered values configuration distances are determined as per monotonic regression (Ozdamar, 2002, p.489).

Depending on the type of data, MDS is divided to two as being “metric MDS” and “non-metric MDS”. When the data is measured with interval or ratio scale “metric” MDS technique is applied, when they are measured with a weaker scale “non-metric” MDS technique is applied. The basis of metric MDS had been composed by Richardson, and developed by Torgerson. Torgerson had enabled the composition of metric MDS analysis by using linear function in mapping original data. In metric MDS technique, it is assumed that the elements in distances matrix are measured with ratio scale (Manly, 1994, p.176). The input of analysis, in other words the scales of variables are interval or ratio. As a result of this, the output in other words the points on graphical arrangement had been measured with ratio scale.

$\delta_{ij}$ values being the elements of positive distances matrix are able to be expressed as n points in the space. Each of the $d_{ij}$ indicating the distances in between points are equal to $\delta_{ij}$, and $\delta_{ij}$ ensure the following inequality.

$$\delta_{ij} \leq \delta_{ik} + \delta_{kj} \tag{9}$$

The establishment of geometric model of observation enabling this condition is the basis of MDS analysis. This model shall be expressed with as minimum dimension as possible in respect ease of understanding. Thus, an operation is applied in order to reduce the number of dimensions in scaling: The subspace is defined, the equality of $\delta_{ij}$ to $d_{ij}$ is accepted, an L value indicating the proximity of prediction distances to real distances is determined.

$$L = \sum_{i}^{n}\sum_{j}^{n}(d_{ij} - \hat{d}_{ij})^2 \tag{10}$$

R dimensioned (r<k) sub space in which this L value will be minimum (L*) is determined (Tatlıdil, 1996, p.356). Moreover, new dimension determination statistics had been composed by making small changes on this formula. The following expressions may be provided as an example for these:

$$L' = \sum_{i}^{n}\sum_{j}^{n} w_{ij}(d_{ij} - \hat{d}_{ij})^2 \qquad V = \sum_{i}^{n}\sum_{j}^{n}\left(d_{ij}{}^2 - \hat{d}_{ij}^2\right) \tag{11}$$

And the theoretical basis of the method is provided below:

If the equation of Q=X'X will be written as the lines in X' data matrix with n*p dimension indicates the coordinates of the points, the element of Q matrix with n-n dimension on i. line and j. column becomes $q_{ij}$.

$$q_{rs} = \sum x_{rs} x_{sj} \quad ; j, r, s = 1, \dots, n \tag{12}$$

When this value is obtained the square of Euclidean distance is obtained as follows:

$$d_{rs}^2 = \sum_{j=1}^{p} (x_{rj} - x_{sj})^2 = q_{rr} + q_{ss} - 2q_{rs} \tag{13}$$

The problem in MDS is the expression in other words formation of X in a correct manner while $d_{rs}^2$ values are provided rather than composition of distances matrix. Not having a direction and location restriction in the expression manner, gives rise to the problem that the figure to be obtained will be numerous, in other words it will not be possible to reach a single solution. Thus, some restrictions shall be imposed. The most significant restriction had been provided below.

$$\sum_{r=1}^{n} x_{rj} = 0 \tag{14}$$

The sum of elements of Q at any row or column is zero. If sum is made in order as per r, s, r and s in the euclidean distance expression, and if it will be defined as A= $\sum q_{rr}$= İz (Q), the following equations are obtained (Tatlidil, 1996, p.357-358).

$$\sum_{r} d_{rs}^2 = A + nq_{ss} \qquad \sum_{s} d_{rs}^2 = nq_{rr} + A \qquad \sum_{r}\sum_{s} d_{rs}^2 = 2nA \tag{15}$$

When some elementary operations are made on these expressions, then it is understood that Q symmetric matrix may be easily found from the sum of squares of the distances in between points.

$$Q = T\Lambda T' = T\Lambda^{1/2}\Lambda^{1/2}T' = X'X \tag{16}$$

Various algorithms had been developed based on the above mathematical basis, and the solution is being obtained by these algorithms.

The algorithms used in MDS analysis technique searches the similarities of observations and makes grouping. Groupings may be ensured by making double, triple or multiple comparisons. It is being known that most commonly used algorithm while obtaining double comparisons Alscal (AlternatingLeastSquareScaling). Alscal is an algorithm suggested by Takane, Young and Leeuw, and giving equal weight to each observation (Bulbul and Kose, 2010, p.83).

As a measure of conformity of obtained figure with the real figure, tolerance rates developed by Kruskal are being used (Tatlidil, 1996, p.362).

**Table 3. Kruskal Tolerance Rates**

| Tolerance Rates | Assessment of Fit |
|---|---|
| $S_k \geq 0.20$ | Poor |
| $S_k = 0.10$ | Medium |
| $S_k = 0.05$ | Good |
| $S_k = 0.00$ | Perfect |

Non-metric MDS technique requires less assumption and exhibits a more flexible structure. Thus, it is preferred more.

And the relation of MDS with other basic multiple variable analysis techniques can be summarized as follows: When MDS is used as dimension reduction technique, and if the data are quantitative, then the alternative method is Factor analysis. If MDS will be used to determine the groups composed by similar observations, the alternative method is grouping analysis. Examination of results by applying MDS to data to which factor analysis may be applied in order to determine data reduction and factor structures will be an incorrect use of technique (Ozdamar, 2002, p.490). Moreover, in the MDS analysis, there is no such thing as labeling in other words naming the obtained dimensions (Hair *et al.* 1998, p.511).

In this study the similarities/differences in between countries are being searched, and as the variables used is at the level of ratio scale, metric MDS had been applied to data.

## 4. Statistical Analysis

The data used in the study had been obtained from United Nations Development Reports. When data regarding the variables to be used within the scope of research is examined, it had been determined that values of some countries could be obtained. Analysis had been realized after missing observation elimination operation. Data had been analyzed by SPSS 21 and Stata 11 programs.

In the first phase of the study, MDS had been applied to OECD countries and Eurasia countries sub dimensions of Human Development Index and Gender Inequality Index. The 2 dimensional structure of the map to be obtained as the result of implementation will provide ease of interpretation. Thus it had been required for the map to be prepared as 2 dimensional in the analysis phase. As the result of realization of MDS analysis based on distances in between countries as per variables the stress value of 0.09 being defined in methodology section had been found. The calculated stress value being smaller than 0.10 is an indicator that the conformity in between original distances and indication distances on two dimensional map is good.

Two dimensional map obtained in the first phase of the analysis section is being provided in Figure 2.

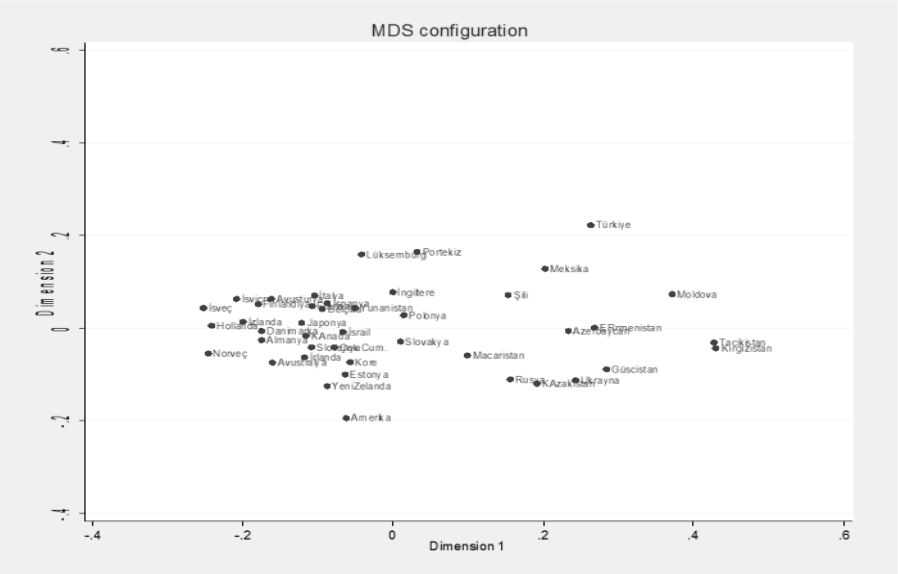


**Figure 2. Two Dimensional Plot of OECD and Eurasia Countries**
**Notes:** Please see appendix for country names in English

When the figure composed as the result of analysis implementation is examined, it had been seen that while OECD countries are mainly on the left of map, the Eurasia countries are mainly on the right of the map.

It had drawn attention that Turkey –being a member of OECD- is pretty far positioned from the other OECD countries, and that it is relatively closer positioned to Eurasia countries. It is being observed that the country which is positioned the closest to Turkey as per sub dimensions of Human Development and Gender Inequality indexes is Mexico. As per the findings of this analysis realized on the basis of sub-dimensions of Human Development and Gender Inequality indexes, the country which is the most similar (perceived) to Turkey in respect of the examined subject is Mexico. Averages had been calculated on the basis of sub-dimensions, and it had observed that Turkey is significantly lower in respect of average value of education dimension when compared with other dimensions. The OECD country closest to Turkey after Mexico is Chili.

When the positions of Eurasia countries on the map are examined, it had drawn attention that Russia was positioned more different than other Eurasia countries. While the Eurasia country closest to Russia had been Kazakhstan, the closest OECD country had been Hungary. And the Eurasia countries positioned closest to Turkey had been Moldova, Armenia and Azerbaijan. The close positioning of Tajikistan and Kyrgyzstan, and Azerbaijan and Armenia among Eurasia countries are among the findings reached.

In the second phase of analysis section, MDS analysis only for Eurasia countries had been performed by using Human Development Index, Gender Inequality and Multidimensional Poverty Indexes. In this phase the reason of including only Eurasia countries as scope is lack of comparable data regarding each of indicators for developing countries and having data restrictions also for other countries. The map to be obtained as the result of analysis had again required to be 2 dimensioned. The stress value of the implementation had been found as 0.05. As specified in the methodology section, this value is the indicator of a good conformity. There exists a good conformity in between original distances and indication distances. When the two dimensional figure is examined, it had been observed that Georgia had been positioned pretty far from other Eurasia countries. While Moldova, Tajikistan and Kyrgyzstan had been positioned on the left of map, Armenia, Ukraine, Azerbaijan, Kazakhstan, Russia and Georgia had been positioned on the right of the map. Moreover, the close positioning of Armenia and Ukraine is among attractive findings reached as the result of the analysis.

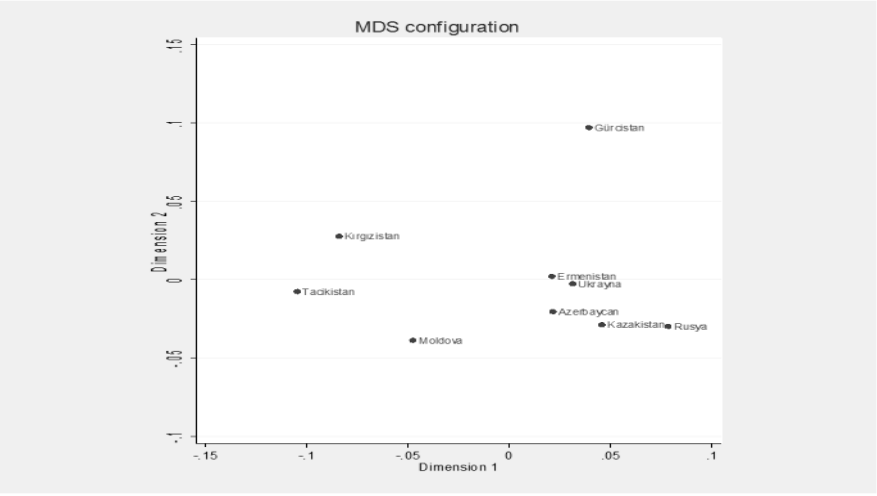


**Figure 3. Two Dimensional Plot of Eurasia Countries**
**Notes:** Please see appendix for country names in English

It had been determined that the inclusion of poverty index in the scope of analysis did not affect the results very much. Russia and Kazakhstan had again positioned close in parallel to the findings in figure 2. While Armenia is close to Azerbaijan in Figure 2, it is close to Ukraine

in Figure 3. And Azerbaijan had been positioned in the middle of partial country groups of Armenia-Ukraine and Russia-Kazakhstan. Except the different position of Georgia, it can be said that basic findings of Figure 2 and Figure 3 are similar.

## 5. Conclusion

HDI issued by United Nations Development Program considers mainly developments in three dimensions regarding the countries and ensures the combined measurement of developments in these three dimensions. The three basic dimensions of human development are long and healthy life, information and humane living conditions. In the 2013 human development report, Inequality Adjusted Human Development Index, Gender Inequality Index and Multidimensional Poverty Index are available along with HDI.

The purpose of this study is to assess the countries as per their similarities and difference by using the indicators provided in 2013 human development report. This assessment had been performed by the assistance of a figure composed in two dimensional space as the result of MDS analysis implementation from among multi variable analysis techniques. MDS is a statistical technique used to reveal the geometric positions and interrelations of objects by using distance values in between objects.

The data of OECD and Eurasia countries had been examined within the scope of study. Stress value obtained regarding implementation of MDS had been found at the required interval. Thus, it had been determined that the interpretations to be made by the map obtained as the result of MDS may reliable.

While assessing the obtained findings, first a comparison had been made on the basis of country groups and then attracting conditions on the basis of countries had been interpreted. When the figure composed as the result of MDS implementation -in which the HDI and Gender Inequality Index sub-dimensions are used- is examined, it had been observed that while the OECD countries are intensely positioned on the left of the map, the Eurasia countries are intensely positioned on the right of the map. It had been observed that Turkey –being a member of OECD- is pretty far positioned from the other OECD countries, and that it is relatively closer positioned to Eurasia countries. As per the indexes within the scope of analysis, it had been observed that the closest positioned country to Turkey in other words the country which is perceived as the most similar was Mexico. Averages had been calculated on the basis of sub-dimensions, and it had observed that Turkey is significantly lower in respect of average value of education dimension when compared with other dimensions. Different positioning of Russia compared to other Eurasia countries is among the attracting findings. In the second phase of statistical analysis section, analyses had been deepened only for Eurasia countries; and Multidimensional Poverty Index had been included in the scope of analysis as well as Human Development and Gender Inequality Indexes. Stress value obtained as the result of MDS analysis implementation had shown that there was a good conformity in between indication distances and original distances. When the generated two dimensional configuration map is examined, it had been observed that Georgia exhibited a pretty different structure than other Eurasia countries. It had been determined that the findings of Russia and Kazakhstan in the first phase of analysis section had been closely positioned. According to three main indexes, Ukraine and Armenia being perceived as the most similar countries is among attracting findings.

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**APPENDIX**

Almanya: Germany
Amerika: U.S.A.
Avustralya: Australia
Avusturya: Austria
Azerbaycan: Azerbaijan
Belçika: Belgium
Çek Cumhuriyeti: Czech Republic
Danimarka: Denmark
Ermenistan: Armenia
Estonya: Estonia
Finlandiya: Finland
Gürcistan: Georgia
Hollanda: Netherlands
İngiltere: England
İrlanda: Ireland
İspanya: Spain
İsrail: Israel
İsveç: Sweden
İsviçre: Switzerland
İtalya: Italy
İzlanda: Iceland
Japonya: Japan
Kanada: Canada
Kazakistan: Kazakhstan
Kore: (South) Korea
Kırgızistan: Kyrgyzstan
Lüksemburg: Luxembourg
Macaristan: Hungary
Meksika: Mexico
Moldova: Moldova
Norveç: Norway
Polonya: Poland
Portekiz: Portugal
Rusya: Russia
Şili: Chile
Slovakya: Slovakia
Slovenya: Slovenia
Tacikistan: Tajikistan
Türkiye: Turkey
Ukrayna: Ukraine
Yeni Zelanda: New Zealand
Yunanistan: Greece