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THE ANALYSIS OF THE WELL-BEING LEVELS OF OECD COUNTRIES WITH GREY RELATIONAL ANALYSIS

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Abstract

In recent years, the definition and measurement of the well-being levels of nations have been among the most studied topics by researchers. After World War II, national income was used for this purpose; however, due to the impact of globalization, the inadequacy of this approach was identified, and a human-oriented development approach was adopted. Thus, the Human Development Index (HDI), first introduced in 1990, was presented as an important indicator. The need to define and measure well-being in more detail based on changing conditions resulted in the calculation of the Better Life Index (BLI) by the Organization for Economic Cooperation and Development (OECD) in 2011. In the present study, BLI 2017 data for 35 OECD member countries and 3 non-member states were analyzed with Gray Relational Analysis (GRA). In Multicriteria Decision Making (MCDM) analyses, determination of the weight is an important and critical issue that directly affects the results. Therefore, four objective weight determination methods, including mean-weights (MW) and standard deviation (SD), entropy, and CRITIC, were used in the study. Countries were ranked based on gray coefficient scores determined in the analysis. Thus, it was determined that the countries with the highest scores included Norway, Australia, USA, Canada, Iceland, Switzerland, Denmark, and, Sweden while the countries with the lowest scores were South Africa, Turkey, Mexico, Greece, and.

Keywords: *Multicriteria decision-making, Better Life Index, Grey relational analysis, Objective weights, OECD countries.*

OECD ÜLKELERİNİN REFAH DÜZEYLERİNİN GRİ İLİŞKİSEL ANALİZ İLE DEĞERLENDİRİLMESİ

Özet

Son yıllarda ülkelerin refah düzeyinin tanımlanması ve ölçümü araştırmacılar tarafından ilgi ile çalışılan konular arasındadır. II. Dünya Savaşından sonra bu amaçla milli gelir kullanılmış, ancak sonraki dönemlerde küreselleşme sürecinin de etkisiyle bu anlayışın yetersizliği fark edilmiş ve insan merkezli bir kalkınma yaklaşımına geçilmiştir. Bu bağlamda 1990'da hesaplanan İnsani Gelişme Endeksi (HDI) önemli bir gösterge olarak sunulmuştur. Zaman içinde değişen koşullarla refahın tanımı ve ölçümünün daha detaylı bir biçimde yapılması gerekliliği, 2011'de Ekonomik İşbirliği ve Kalkınma Örgütü (OECD) tarafından Daha İyi Yaşam Endeksi (BLI)'nın hesaplanması sonucunu doğurmuştur. Bu çalışmada OECD üyesi 35 ülke ve üye olmayan 3 ülke için hesaplanan BLI 2017 verileri Gri İlişkisel Analiz (GRA) kullanılarak değerlendirilmiştir. Çok Kriterli Karar Verme (MCDM) analizlerinde ağırlık belirlemede oldukça önemli ve sonuçları direkt etkileyen kritik bir konudur. Bu nedenle araştırmada Eşit ağırlık (MW) and Standart sapma (SD), Entropy and CRITIC olmak üzere dört farklı objektif ağırlık belirleme metodu kullanılmıştır. Ülkeler analiz sonucu elde edilen gri katsayı skorlarına göre sıralanmıştır. Sonuç olarak en yüksek skorlara sahip olan ülkelerin Norveç, Avustralya, ABD, Kanada,İzlanda, İsviçre, Danimarka ve İsveç olduğu en düşük skorlara sahip olan ülkelerin Güney Afrika, Türkiye, Meksika ve Yunanistan olduğu saptanmıştır.

Anahtar Kalimeler: *Çok Kriterli Karar Verme, Daha İyi Yaşam Endeksi, Gri İlişkisel Analiz, Objektif Ağırlıklar, OECD Ülkeleri.*

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1. INTRODUCTION

Well-being is a broad concept that includes developments and advances in the living environment, health, income, social relationships, marriage, family life, etc. The research on the concept focuses on national well-being and quality of life, which include several parameters such as freedoms, coping mechanisms, sustainability, systemic functions, happiness, and life satisfaction.

In the description of well-being, both objective (income, education, health, etc.) and subjective indicators (happiness, satisfaction, etc.) are used. While subjective indicators are related to the emotions that emerge as a result of individual experiences, objective indicators include the factors that sustain the subjective indicators. Mixed indicators, on the other hand, include both objective and subjective elements (Gökdemir and Veenhoven, 2014: 339-341). The objective approach is rooted in social statistics tradition, which dates back to the 19th century. The subjective approach was based on survey research, which was introduced in the 1960s (Veenhoven, 2002: 33).

The objective indicators used to determine national development levels include Gross National Product (GNP), Gross Domestic Product (GDP), Measure of Economic Welfare (MEW), Index of Sustainable Economic Welfare (ISEW), Genuine Progress Indicator (GPI), Index of Economic Well -Being (IEW), Human Development Index (HDI), Index of Social Progress (ISP), Index of Social Health (ISH) and Social Development Index (SDI). Mixed indicators used to determine the well-being, happiness, and satisfaction levels of individuals and their longevity include Better Life Index (BLI), Happy Life Expectancy (HLE), The Happy Planet Index (HPI), and Gross National Happiness (GNH). Subjective indicators such as the World Values Survey (WVS) and Eurobarometer Survey rank the countries based on scale questions on happiness or life satisfaction levels of the participants (Veenhoven, 2002: 337-363).

Especially after World War II, the development level of nations was analyzed based on economic development and international comparisons were conducted based on only the increase in national income. However, the inadequacy of this income-oriented development approach was identified especially in the globalization process, and a human-oriented development approach that considers humans at the center of development was adopted. This approach still considers the increase in individual income as a significant factor for development; however, it argues that the improvement in income alone is not sufficient to measure the actual well-being of individuals (Gürses, 2009: 340). This led to the introduction of various indices that included factors such as education, health, gender, poverty, social and political status, and provision of social services based on the above-mentioned human-oriented approach. In this context, HDI is one of the most important objective indicators based on the concept of the capability approach of Amartya Sen, developed by the United Nations Development Program (UNDP) and calculated since 1990. BLI, a mixed indicator, is another important index that suggested a different approach to the description and measurement of well-being.

In the 2000s, novel changes introduced the need for a more comprehensive index that could measure well-being and include global threats such as climate change, income, health, and the quality of life of the societies. Thus, in 2008, Joseph Stiglitz, Amartya Sen, and Jean-Paul Fitoussi joined forces to establish The Commission on the Measurement of Economic Performance and Social Progress. This commission reported the main problems

of the GDP method used to measure well-being (Akar, 2014: 4). In their study, Stiglitz et al. reported that "To define what well-being means a multidimensional definition has to be used. Based on academic research and several concrete initiatives developed around the world, the Commission has identified the following key dimension that should be taken into account. At least in principle, these dimensions should be considered simultaneously." These key dimensions included material living standards (income, consumption and wealth), health, education, personal activities including work, political voice, and governance, social connections and relationships, environment (present and future conditions), insecurities of both economic and physical nature (Stiglitz et al., 2009: 14).

Accordingly, OECD calculated the BLI on May 24, 2011, to obtain a broader description and measurement of well-being. The index, first calculated for 34 OECD member countries, was calculated for 36 countries including non-OECD members Brazil and Russian Federation, in 2012. In 2019, it was calculated to include data from 35 OECD member countries as well as non-members Brazil, Russian Federation, Colombia, and South Africa. The 11 factors included in the index and related sub-factors could be observed in Table 1. The OECD BLI compares the factors that affect well-being instead of ranking them. All 11 factors are equally weighted in the composite index. The index, however, discerns the current material living conditions and living standards and sustainability of these criteria (Kerenyi, 2011: 519-521).

The current and future well-being levels are distinguished in the theoretical framework of the BLI. The current well-being is calculated based on the achievements in two comprehensive realms: material living conditions (income and wealth, jobs and earnings, housing conditions) and quality of life (health status, work-life balance, education and skills, social connections, civic engagement and governance, environmental quality, personal security, and subjective well-being). The future well-being is determined based on certain key resources that affect the well-being in the long-term and that are in turn constantly affected by current developments, which could be measured by various types of capital indicators.

Thus, the present study aimed to calculate the national scores for the scrutinized countries based on the BLI, which is a significant indicator for the measurement of well-being. Four weighting methods were used in Gray Relational Analysis (GRA) and the findings were compared and analyzed. Thus, GRA and various weighting methods were integrated. The literature review revealed no studies where BLI was used with GRA conducted with different weighting methods. Thus, it was suggested that the study would contribute to the literature.

This study includes five sections. In the second section, certain important studies are summarized. In the third section, the study dataset and methodology are introduced. In the fourth section, empirical findings, and in the fifth section, general analysis and conclusions are presented.

2. LITERATURE

The indicators used to determine the well-being of individuals and national development levels could be categorized under objective, subjective and mixed indicators. GDP and HDI are among the important objective indicators used for this purpose. World Values Survey (WVS), Eurobarometer Survey, etc. could be considered as subjective indicators that help to determine the life satisfaction levels of the participants. HPI, which was introduced in 2006 and BLI developed by OECD in 2011 for a broader definition and measurement of well-being

are among the most important mixed indicators. Important studies that addressed these indicators are summarized in the following paragraphs.

Kaya et al. (2011) analyzed the quality of life in 27 EU and EU candidate countries with VIKOR. Three VIKOR analyses were conducted for 2003, 2005, and 2007 on EU countries, Norway, and EU candidate countries including Croatia, Macedonia, and Turkey-based on quality of life indicators. The general analysis demonstrated that Spain, Sweden, and Denmark had the best quality of life in 2003 and 2007. It was observed that Turkey had almost the worst quality of life in three years.

Balešentis et al. (2011) utilized the MULTIMOORA method to compare the well-being levels of the EU member states. It was determined that Ireland, the Netherlands, Denmark, Austria, France, Cyprus, Finland, Germany, and Belgium had the highest levels of well–being in 2009. The lowest well-being levels among EU members were observed in the Czech Republic, Lithuania, Slovakia, Bulgaria, Poland, Hungary, Estonia, Latvia, and Romania

In a study by Reig-Martı´nez (2013), Wellbeing Composite Index (WCI) was calculated for 42 European Economic Space, North African, and the Middle Eastern nations. Various Data Envelopment Analysis (DEA) models were used as an aggregate tool for seven selected socio-economic variables corresponding to the well-being dimensions of income per capita, the environmental burden of disease, income inequality, gender gap, education, life expectancy at birth and effective governance. It was determined that the best performers were Nordic countries and Switzerland, and Mauritania, Libya, and Syria were at the bottom of the ranking.

Ivaldi et al. (2016) developed a composite well-being index, the European Well-being Index (EWI), which aimed to measure well-being in the EU 27 countries using factorial analysis with the social indicator approach. EWI ranks the nations based on their score and displays their strengths and weakness based on specific index components. Thus, the countries with the highest scores, namely Finland, Sweden, Denmark, and the Netherlands, reported high scores in almost all index dimensions. The second-tier nations that included Austria, Luxembourg, and Germany exhibited satisfactory scores in all dimensions. The third-tier nations included France, the United Kingdom, and Spain. Greece, Romania, and Bulgaria were in the last tier and the economies of these countries were worse than the others. The above-mentioned study also compared EWI scores with the GDP and HDI with the Spearman rank correlation coefficient. The Spearman coefficient between the EWI and the GDP was 0.897 and the same coefficient between the EWI and the HDI was 0.842.

Önay (2016) analyzed BLI with TOPSIS and MOORA Ratio System and MOORA Reference Point Approach methods. These methods are used to rank countries. Due to this reason, it is assumed that any criterion is not more significant when compared to the other criteria and weights are not used. Despite ranking variations, certain countries usually dominate top-tier rankings. The US, Switzerland, and Canada are usually the top three nations in the rankings determined by these methods. The US, Switzerland, Canada, Luxembourg, and Sweden could be given as examples for top-tier nations. Also, Mexico and Brazil are usually located at the bottom of the rankings.

In a previous study, Orakçı and Özdemir (2017) used HDI and the indicators derived from the Europe Quality of Life Survey to investigate the human development levels in Turkey and EU countries. GRA and MOORA methods were used to determine the human development levels, and the findings were compared. The

effectiveness of the indicators was analyzed with Entropy and CRITIC objective weighting methods. Using GRA and MOORA, it was determined that Luxemburg, Finland, and Austria were the top three countries in human development and with MOORA, the UK, Netherlands, and Denmark were the top three nations. Turkey was the 26th nation on the list with GRA and 23rd with MOORA.

Ömürbek et al. (2017) employed ARAS and MOORA methods to analyze the quality of life in EU countries. The entropy method was used to determine the weights of the criteria. It was determined that pollution was the most important factor in the quality of life in EU countries. Findings obtained with both methods emphasized that Finland had the best quality of life.

Peiro´-Palomino and Picazo-Tadeo (2018) developed a composite well-being indicator for 35 OECD countries, South Africa, Russia, and Brazil for the 2013–2016 periods, based on the data for 10 well-being dimensions included in the OECD BLI. In the first stage, countries were ranked based on the well-being indicator, constructed with the Data Envelopment Analysis. In the second stage, well-being tiers were identified with hierarchical cluster analysis, revealing the fact that well-being was highly polarized. It was determined that the United States and Switzerland were in the top-tier, followed by Luxembourg, Canada, and Japan. Chile, Turkey, Mexico, and the three non-OECD countries in the sample, namely Russia, South Africa, and Brazil, were in the bottom-tier.

Depren and Kalkan (2018) analyzed the 2017 BLI data for 38 countries with the MULTIMOORA method. Criterion weight was determined with the Entropy method, and the nations were ranked. In the final stage, the correlation between the national rankings and HDI rankings was analyzed with the Spearman rank correlation coefficient. The findings obtained with the MULTIMOORA approach demonstrated that the national rankings were as follows: the USA, Switzerland, Belgium, Netherlands, and Sweden. Furthermore, the bottom 5 countries included South Africa, Turkey, Mexico, Brazil, and Greece, respectively. The correlation analysis conducted in the final stage demonstrated that there was a statistically positive correlation (78%) between the rankings of countries obtained with the Entropy-based MULTIMOORA method and HDI rankings.

Türe (2019) aimed to determine the well-being scores for 34 OECD countries with a methodology that combined GRA and entropy formula. The quality of life and physical condition indicators derived from the OECD Regional Well-Being Database included the most current data within 15 years (2000-2014). Thus, it was determined that Iceland, Australia, Norway, and Switzerland had the highest well–being levels. Located at the other end of the spectrum, Hungary, Greece, Turkey, and Mexico exhibited relatively lower well–being levels.

3. DATASET and METHODOLOGY

Better Life Index data, calculated by OECD for 2017, was used in the study. BLI encourages citizens to participate in the debate on social well-being measurement and to improve their knowledge and engagement in policy-making processes that determine their lives (OECD, 2019). The index includes data from 35 OECD member countries and Russian Federation, Brazil, and South Africa. The index also includes 11 criteria: housing, income, jobs, community, education, environment, civic engagement, health, life satisfaction, safety and work-life balance, and 24 sub-criteria associated with these criteria. Index criteria are presented in Table 1, and in the following section, the criteria were detailed (Kerenyi, 2011: 523-533; OECD, 2013: 23; Mizobuchi, 2013: 9-10; OECD, 2017: 1-8; OECD, 2019: 1-8).

Table 1: Better Life Index Criteria

Criteria	Sub-criteria	Code	
Housing	Dwellings with basic facilities (%)	**HOU1**	min
	Housing expenditure (%)	**HOU2**	min
	Rooms per person (rate)	**HOU3**	max
Income	Household net adjusted disposable income ($)	**I1**	max
	Household net wealth ($)	**I2**	max
Jobs	Labour market insecurity (%)	**J1**	min
	Employment rate (%)	**J2**	max
	Long-term unemployment rate (%)	**J3**	min
	Personal earnings ($)	**J4**	max
Community	Quality of support network (%)	**COM**	max
Education	Educational attainment (%)	**EDU1**	max
	Student skills (average score)	**EDU2**	max
	Years in education (year)	**EDU3**	max
Environment	Air pollution (microgram per cubic meter)	**ENV1**	min
	Water quality (%)	**ENV2**	max
Civic Engagement	Stakeholder engagement for developing regulations (average score)	**CE1**	max
	Voter turnout (%)	**CE2**	max
Health	Life expectancy (year)	**HEA1**	max
	Self-reported health (%)	**HEA2**	max
Life Satisfaction	Life Satisfaction (average score)	**LS**	max
Safety	Feeling safe walking alone at night (%)	**S1**	max
	Homicide rate (rate)	**S2**	min
Work-Life Balance	Employees working very long hours (%)	**WLB1**	min
	Time devoted to leisure and personal care (hour)	**WLB2**	max

Housing: Access to housing and the quality of available housing contribute to the satisfaction of basic individual needs. Housing is the most important material need. Housing costs (overhead expenses) are the most significant among household expenditures. Living under unhygienic conditions could have a major impact on the life of individuals, in other words, they could get ill more easily.

Income: Income and wealth include economic resources that individuals could use in the present or in the future to fulfill various requirements and desires, and these resources could protect individuals against various vulnerabilities and risks. Income is a means to pay for recurring and ad hoc expenses. The higher the income of the individual, the greater they could afford the limits of their well-being.

Jobs: Employment provides an adequate source of income for individuals, and it contributes to individual well-being. In general, nations with higher employment levels tend to be wealthier and politically more stable. Unemployment is among the most destructive life experiences for an individual.

Community: The frequency of contact with other community members is a crucial determinant of individual well-being. Sharing time with colleagues, loved ones, and acquaintances give pleasure to individuals. Furthermore, a social network could also provide emotional support, which is beneficial for other areas of life. This indicator is a measure of perceived social network support.

Education: Education and acquisition of various skills are both a basic need and the ambition of all human beings and are instrumental in achieving several economic and non-economic well-being outcomes. These concepts have serious effects on individual well-being. The social environment of an individual is determined partially by the contact of the individual with former classmates. It should also be noted that high qualifications are inversely correlated with criminal tendencies.

Environment: The quality of the natural human habitats where individuals live, work, and commute are important, and it also affects the health of the individuals and the activities they conduct in this environment. The environment has a decisive impact on individual well-being.

Civic Engagement: Civic engagement is the political voice of individuals in the society and allows them to have an impact on political decisions that would affect their lives and on the discussions that would determine the well-being of the society. Similarly, good governance is required to convert the individual ideas into policies that would support the desire of individuals to conduct better lives.

Health: Physical and mental health is indispensable for individual well-being and allows individuals to conduct several personal and social activities that, in turn, contribute to their well-being. The studies conducted in several countries reported that health is the prominent factor that affects living conditions, except employment.

Life Satisfaction: Psychologists argued that the best indicator of life satisfaction could be subjective self-assessment. Self-assessment may be associated with the general life experiences of the individual. Self-perceptions of individuals about their lives are crucial for satisfaction with their lives. This indicator takes individuals' self-assessments about their lives as a whole.

Safety: Personal safety is a basic requirement for the well-being of individuals. The crime could seriously deteriorate the sense of security and endanger national property in society.

Work-Life Balance: Work-life balance is an important factor in individual well-being by promoting family life. In general, the time individuals spend in activities such as leisure, personal care, and other non-work activities promote individual health and productivity. However, spending little time at work could reduce the individual income to a level where the individuals could no longer sustain their quality of life. On the other hand, too much work could lead to a reduction in individual well-being. It could lead to sickness and destroy the individual's social relations.

3.1. Grey Relational Analysis

Grey System theory was introduced in 1982. The systems that lack information such as structural messages, operation mechanisms, and behavioral documents are called Grey Systems. In Grey Systems, "grey" means weak, incomplete, undefined, etc. The goal of Grey Systems and related applications is to bridge the gap between social and natural sciences. Thus, it could be argued that the Grey System theory is an interdisciplinary approach that includes various specialization fields. It was observed that the Grey System theory successfully stood the test of time since 1982. Grey Systems are implemented in the disciplines of agriculture, ecology, economy, meteorology, medicine, history, geography, industry, earthquake, geology, hydrology, irrigation strategy, military affairs, sports, traffic, management, positive sciences, environment, biological protection, the judicial system, etc. (Deng, 1989: 1).

The grey relation analysis (GRA), a branch of the grey system theory, was based on the determination of the distance between sequences based on the geometrical shape created by their curves (Liu et al., 2013: 8). Grey relation analysis entails the measurement of varying correlations between two systems or between two elements of a system over time. The grey relation analysis measures the correlations between elements based on the degree of similarity or difference based on the developmental trends between these elements. This method is used as a classification, ranking, and decision-making technique in the solution of multi-criteria decision making (MCDM) problems alone or in conjunction with other methods. However, in cases where the sample size is small, and the sample distribution is unknown, representative indicators should be selected with GRA (Feng and Wang, 2000: 135-136).

In the GRA method, advantages include the fact that the results are based on original data, simple and straightforward calculations are conducted, and it is considered as one of the best decision-making methods. The GRA procedures are summarized as follows in step1-5 (Wu, 2002: 211-212):

"Step 1: Generate the referential series of $x_0 = (x_0(1), x_0(2), ..., x_0(j), ..., x_0(n))$ with *j* entities, and x_i is the compared series of $(x_i(1), x_i(2), ..., x_i(j), ..., x_i(n))$ where $i = 1,2,3,..., m.$ The compared series x_i can be represented in a matrix form:

$$X_i = \begin{bmatrix} x_1(1) & x_1(2) & ... & x_1(n) \\ x_2(1) & x_2(2) & ... & x_2(n) \\ ... & ... & ... & ... \\ x_m(1) & x_m(2) & ... & x_m(n) \end{bmatrix} \quad (1)$$

Step 2: Normalize the data set. Data can be treated by one of the three types; i.e., larger-is-better, smaller-is-better, and nominal-is-best. For larger-is-better transformation, $x_i(j)$ can be transformed to $x_i^*(j)$: The formula is defined as:

$$x_i^*(j) = \frac{x_i(j) - \min_j x_i(j)}{\max_j x_i(j) - \min_j x_i(j)} \quad (2)$$

where $\max_j x_i(j)$ is the maximum value of entity *j* and $\min_j x_i(j)$ is the minimum value of entity *j*. For smaller-is-better, the formula to transform $x_i(j)$ to $x_i^*(j)$ is

$$x_i^*(j) = \frac{\max_j x_i(j) - x_i(j)}{\max_j x_i(j) - \min_j x_i(j)} \tag{3}$$

For nominal-is-best, if the target value is $x_{0b}(j)$ and $\max_j x_i(j) \geq x_{0b}(j) \geq \min_j x_i(j)$, then the formula is

$$x_i^*(j) = \frac{|x_i(j) - x_{0b}(j)|}{\max_j x_i(j) - x_{0b}(j)} \tag{4}$$

At the same time, the referential series x_0 should be normalized as well by one of Eqs. (2) – (4). In this case, $x_0(j)$ is used to replace $x_i(j)$. Therefore, the normalized referential series x_0 becomes $x_0^* = (x_0^*(1), x_0^*(2), ..., x_0^*(j), ..., x_0^*(n))$. After the original data set is normalized by one of the three types of data transformations, the matrix shown in Eq. (1) can be revised as:

$$X_i^* = \begin{bmatrix} x_1^*(1) & x_1^*(2) & ... & x_1^*(n) \\ x_2^*(1) & x_2^*(2) & ... & x_2^*(n) \\ ... & ... & ... & ... \\ x_m^*(1) & x_m^*(2) & ... & x_m^*(n) \end{bmatrix} \tag{5}$$

Step 3: Compute the distance of $\Delta_{0i}(j)$, the absolute value of the difference between x_0^* and x_i^* at the *j*-th point. The formula is

$$\Delta_{0i}(j) = |x_0^*(j) - x_i^*(j)| = \begin{bmatrix} \Delta_{01}(1) & \Delta_{01}(2) & ... & \Delta_{01}(n) \\ \Delta_{02}(1) & \Delta_{02}(2) & ... & \Delta_{02}(n) \\ ... & ... & ... & ... \\ \Delta_{0m}(1) & \Delta_{0m}(2) & ... & \Delta_{0m}(n) \end{bmatrix} \tag{6}$$

Step 4: Apply the grey relational equation to compute the grey relational coefficient $\gamma_{0i}(j)$ using the following equation:

$$\gamma_{0i}(j) = \frac{\Delta_{\min} + \xi\Delta_{\max}}{\Delta_{0i}(j) + \xi\Delta_{\max}} \tag{7}$$

where $\Delta_{\max} = \max_j \max_j \Delta_{0i}(j)$, $\Delta_{\min} = \min_j \min_j \Delta_{0i}(j)$ and $\xi \in [0,1]$.

Step 5: Compute the degree of the grey coefficient Γ_{0i}. If the weights (W_i) of criteria are determined, the degree of the grey coefficient Γ_{0i} is computed as:

$$\Gamma_{0i} = \sum_{j=1}^{n} [W_i(j) \times \gamma_{0i}(j)] \quad (8)$$

For decision-making processes, if any alternative has the highest Γ_{0i} value, then it is the most important alternative. Therefore, the priorities of alternatives can be ranked by Γ_{0i} values" (Wu, 2002: 211-212).

3.2. Classification of the Weighting Methods

Various weighting methods were developed in the literature to assign weights to study criteria. In the multi-criteria evaluation method, assigning criteria weights is an important process since the final MCDM results significantly depend on these weight assignments. Tervonen et al. (2009) reported that the most difficult task in MCDM is assigning weights to criteria (Zardari et al., 2015: 23). Weighting methods could be addressed in three categories: subjective weighting method, objective weighting method, and combined weighting method. Assigning criteria weights with the subjective weighting method is only based on the preferences of decision-makers. On the contrary, the objective weights are calculated with mathematical methods based on the initial data analysis. Combined weighting methods have been gradually implemented in the evaluation and comparison of complex systems (Wang et al., 2009: 2271-2273).

In previous MCDMs, the following common weighting methods were used: Direct rating, ranking method, point allocation, pairwise comparison, ratio method, swing method, graphical weighting, Delphi method, simple multi-attribute ranking technique (SMART) and SIMOS method. Furthermore, AHP, SWARA, and MACBETH methods have been frequently used in the literature to determine the criterion weight. The common objective weighting methods are as follows: Entropy method, Criteria Importance Through Inter-Criteria Correlation (CRITIC), Mean Weight (MW), Standard Deviation (SD), and statistical variance procedure methods (Zardari et al., 2015: 25-33). In this context, certain objective weighting methods implemented in the present study are discussed below:

3.2.1. Mean-Weight and Standard Deviation methods

Mean Weight (MW) method entails the objective derivation of the weights with the equation $w_i = 1/n$, where n is the number of criteria. The method is based on the assumption that all criteria have equal significance. MW could be used in MCDM when the decision-maker provides no information, or the provided information is not sufficient to make a decision.

Standard Deviation (SD) method is similar to the Entropy method where small weights are assigned to an attribute when there are similar attribute values across alternatives. Where w_i is the weight of criteria and σ_i is the standard deviation, in the SD method, the criteria weights are determined based on their SDs using the following equations (Zardari et al., 2015: 34-35):

$$w_i = \sigma_j / \sum_{j=1}^{n} \sigma_j \qquad \sigma_j = \sqrt{\frac{\sum_{i=1}^{m} (x_{ij} - \overline{x_{ij}})^2}{m}} \quad (9)$$

3.2.2. Entropy method

Entropy was originally used in thermodynamics, specifically in statistical mechanics, and extended to cover quantum mechanics. Recently, it was introduced as a fundamental approach in information theory, similar to its earlier statistical form (Segal, 1960: 623). Several objective entropy weighting methods were proposed by scholars. The Shannon Entropy Method (EM) measures the uncertainty in the information devised with the probability theory. Information entropy is a measure of uncertainty, introduced by Shannon in the article titled "Mathematical Theory of Communication" (Shannon, 1948). It has been widely used in several fields including engineering, management, etc. since its introduction (Wu et al., 2011: 5163). Entropy could be used to analyze decision-making units (DMUs). The following steps in the determination of the criteria weights are based on the concept of entropy (Wu et al., 2011: 5163; Wang and Lee, 2009: 8982; Depren and Kalkan, 2018: 358):

Step 1: Assume that there are m alternatives $A_i\ (i=1,2,3,...,m)$ that would be analyzed for n selection criteria $C_j\ (j=1,2,3,...,n)$; thus, the decision-making matrix can be defined as follows:

$$D=\begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \tag{10}$$

First, we defined the similarity between x_{ij} and its ideal value d_{ij}, and $d_{ij} \in [0,1]$

$$d_{ij}=\begin{cases} \dfrac{x_{ij}-\min_i\{x_{ij}\}}{\max_i\{x_{ij}\}-\min_i\{x_{ij}\}}, & \text{positive indicators} \\ \dfrac{\max_i\{x_{ij}\}-x_{ij}}{\max_i\{x_{ij}\}-\min_i\{x_{ij}\}}, & \text{negative indicators} \end{cases} \tag{11}$$

Step 2: Based on the definitions given in Step 1, the entropy of the *i*th criterion could be defined as follows:

$$e(d_i)=-k\sum_{j=1}^{n} f_{ij}\ln f_{ij} \tag{12}$$

where $f_{ij}=d_{ij}/\sum_{i=1}^{n} d_{ij}$, $k=1/\ln m.$

If $f_{ij}\ (i=1,2,3,...,n)$ are the same, the entropy of the *i*th criterion is at maximum level, i.e., e(*di*) = 1. And if $f_{ij}=0$ is assumed, then $f_{ij}\ \ln f_{ij}=0.$

$$w_j=\frac{1-e_i}{n-\sum_{j=1}^{n} e_i} \tag{13}$$

The weight formulated above is a parameter that could define the significance of a criterion. The smaller the entropy, the greater the entropy-based weight; thus, the more information the specific criterion provides, and the more significant the criterion in the decision-making process.

3.2.3. CRITIC method

The CRITIC (Criteria Importance Through Intercriteria Correlation) is an objective weighting method that aims to determine objective relatively significant weights in MCDM problems. Diakoulaki et al. (1995) introduced the CRITIC method that included correlation analysis to identify inter-criteria contrasts. The determined weights include both contrast intensity and conflict intrinsic to the structure of the decision problem. The method was based on the analytical analysis of the evaluation matrix conducted to reveal all information available in the criteria (Diakoulaki et al., 1995: 764).

Consider an initial decision matrix, $X = [x_{ij}]_{\mathrm{m\times n}}$, where x_{ij} is the performance measure of *i*-th alternative for *j*-th criterion, *m* is the number of alternatives, and *n* is the number of criteria. The first step in the application of the CRITIC method is to normalize the initial decision matrix using the following equation:

$$r_{ij} = \frac{x_{ij} - x_j^{\min}}{x_j^{\max} - x_j^{\min}}, \text{ positive indicator}$$

$$r_{ij} = \frac{x_j^{\max} - x_{ij}}{x_j^{\max} - x_j^{\min}}, \text{ negative indicator} \qquad (14)$$

where: $x_j^{\max} = \max(x_{ij}, i = 1,..m)$ and $x_j^{\min} = \min(x_{ij}, i = 1,..m)$.

In the determination of criteria weights, both the standard deviation for the criterion and its correlation with other criteria were included. Thus, the weight of the *j*-th criterion w_j was obtained as follows:

$$w_j = \frac{C_i}{\sum_{i=1}^{m} C_i} \qquad (15)$$

where C_j is the quantity of information contained in *j*-th criterion determined as:

$$C_j = \sigma_j \sum_{i=1}^{m} (1 - r_{ij}) \qquad (16)$$

where σ_j is the standard deviation of the *j*-th criterion and r_{ij} is the correlation coefficient between the *j*-th and *i*-th criteria.

Based on the above-mentioned analysis, it could be concluded that a higher C_j value implies a higher level of information obtained with the given criterion; and thus, the relative significance of the criterion for a given decision-making problem would be higher (Madıć and Radovanovıć, 2015: 199-200).

4. EMPIRICAL FINDINGS

In the study, BLI 2017 data for 35 OECD countries, including Turkey and Brazil, Russian Federation, and South Africa, were analyzed. The 11 criteria, included in the index, namely housing, income, jobs, community, education, environment, civic engagement, health, life satisfaction, safety and work-life balance, and 24 sub-criteria associated with the above-mentioned criteria were presented in Table 1. Here, certain descriptive statistics calculated for these criteria are presented in Table 2.

Table 2: Descriptive statistics for the criteria

Criteria	Mean	Std. Dev.	Min.	Max.	Range
HOU1	3,45	6,64	0,00	37,00	37,00
HOU2	20,89	2,41	15,00	26,00	11,00
HOU3	1,64	0,47	0,70	2,50	1,80
I1	25113,84	8026,04	10872,00	44049,00	33177,00
I2	49362,79	38708,20	2260,00	176076,00	173816,00
J1	5,48	5,11	1,50	26,50	25,00
J2	67,74	8,21	43,00	86,00	43,00
J3	3,20	3,72	0,03	16,95	16,92
J4	37435,95	14256,99	11554,00	62636,00	51082,00
COM	90,03	4,59	76,00	98,00	22,00
EDU1	77,24	16,00	37,00	95,00	58,00
EDU2	486,76	33,51	391,00	529,00	138,00
EDU3	17,38	1,39	14,80	21,20	6,40
ENV1	13,39	5,90	3,00	28,00	25,00
ENV2	82,26	10,87	54,00	99,00	45,00
CE1	2,05	0,70	0,80	3,50	2,70
CE2	70,03	11,67	49,00	91,00	42,00
HEA1	79,54	4,69	57,40	83,90	26,50
HEA2	67,45	13,98	33,00	88,00	55,00
LS	6,53	0,78	4,80	7,50	2,70
S1	68,63	13,20	36,10	87,70	51,60
S2	2,93	5,47	0,20	27,60	27,40
WLB1	8,72	7,80	0,16	33,77	33,61
WLB2	14,83	0,76	12,59	16,36	3,77

In the study, criteria weights for GRA were determined with four weighting methods. These approaches were objective weighting methods and included MW, SD, EM, and CRITIC methods. As discussed in the Classification of the Weighting Methods section, the assignment of the criteria weights with the subjective weighting method reflects only the preferences of the decision-makers. In contrast, objective weight is based on mathematical methods that employ the initial data analysis. Thus, the more prevalent objective weighing method was

employed in the present study to obtain more reliable and rational outcomes. Furthermore, we aimed to determine the impact of various weighting methods on ranking. Weight values calculated for the study criteria are presented in Table 3.

Table 3: Criteria weights

		Weights (wj)			
Criteria	**Code**	**MW**	**SD**	**EM**	**CRITIC**
Housing	**HOU1**	0,042	0,032	0,012	0,029
	HOU2	0,042	0,039	0,046	0,067
	HOU3	0,042	0,047	0,055	0,037
Income	**I1**	0,042	0,043	0,065	0,033
	I2	0,042	0,040	0,122	0,038
Jobs	**J1**	0,042	0,037	0,017	0,035
	J2	0,042	0,034	0,026	0,029
	J3	0,042	0,039	0,021	0,042
	J4	0,042	0,050	0,065	0,036
Community	**COM**	0,042	0,037	0,026	0,036
Education	**EDU1**	0,042	0,049	0,041	0,050
	EDU2	0,042	0,043	0,033	0,037
	EDU3	0,042	0,039	0,059	0,039
Environment	**ENV1**	0,042	0,042	0,035	0,042
	ENV2	0,042	0,043	0,033	0,034
Civic Engagement	**CE1**	0,042	0,046	0,069	0,067
	CE2	0,042	0,050	0,068	0,064
Health	**HEA1**	0,042	0,032	0,013	0,028
	HEA2	0,042	0,046	0,040	0,051
Life Satisfaction	**LS**	0,042	0,051	0,045	0,042
Safety	**S1**	0,042	0,046	0,040	0,036
	S2	0,042	0,036	0,015	0,038
Work-Life Balance	**WLB1**	0,042	0,042	0,025	0,049
	WLB2	0,042	0,036	0,028	0,040

The review of the data presented in Table 3 demonstrated that in the MW method, all criteria were considered to be of equal significance due to the nature of the method, and weights were assigned so that the total would be 1. In the SD method that is based on the standard deviations of the criteria, the criteria with the highest weights were LS (Life satisfaction), J4 (Personel earnings), and CE2 (Voter turnout), respectively. The most significant criteria based on the EM method included I2 (Household net wealth), CE1 (Stakeholder engagement for developing regulations), and CE2 (Voter turnout). Based on the CRITIC method, the most significant criteria were CE1 (Stakeholder engagement for developing regulations), HOU2 (Housing expenditure), and CE2 (Voter turnout). The review of these methods demonstrated that the SD method assigned higher weights to life

satisfaction, jobs, and civic engagement criteria. In the EM method, only income and civic engagement ranked higher, while housing, and civic engagement criteria were the factors with the highest weight in the CRITIC method. Thus, it was determined that all objective methods assigned different weights to different criteria due to their calculation infrastructures. It was estimated that these differences would affect the gray coefficient scores calculated with GRA; and, thus, the country ranking.

The dataset and decision matrix for the decision problem was constructed as presented in Appendix 1 in the first GRA step. Furthermore, the dataset included the calculated referential series in this step. The normalized decision matrix obtained in the second step with the normalization operation conducted with Equation 2 or 3 based on the criterion status is presented in Appendix 2. The absolute value table that reflects the absolute values of the differences between normalized referential series and normalized alternative values determined in the third step is presented in Appendix 3. In the fourth step, grey relational coefficients were calculated with Equation 7 and presented in Appendix 4. In this step, $\xi = 0.5$ value proposed in the literature was employed in the calculations. Finally, the country ranking was obtained with the weights calculated with various methods and Equation 8 and presented in Table 3 in the fifth step. The GRA results calculated with four weighting methods are presented in Table 4.

Table 4: Country ranking conducted with the GRA method using different weight methods

Countries	**GRA with MW**		**GRA with SD**		**GRA with EM**		**GRA with CRITIC**	
	Grey coeff.	**Rank**	**Grey coeff.**	**Rank**	**Grey coeff.**	**Rank**	**Grey coeff.**	**Rank**
Australia	0,744	3	0,744	3	0,711	2	0,740	2
Austria	0,658	16	0,651	16	0,591	17	0,638	17
Belgium	0,672	15	0,669	15	0,638	12	0,667	14
Canada	0,743	4	0,744	2	0,686	5	0,731	4
Chile	0,529	33	0,520	33	0,479	33	0,523	33
Czech Republic	0,614	21	0,604	22	0,536	25	0,601	22
Denmark	0,738	7	0,735	7	0,676	6	0,721	5
Estonia	0,612	22	0,604	21	0,545	22	0,612	20
Finland	0,716	10	0,712	9	0,641	11	0,696	10
France	0,634	19	0,622	19	0,570	18	0,619	19
Germany	0,686	13	0,677	13	0,615	14	0,667	13
Greece	0,511	34	0,500	35	0,458	37	0,502	36
Hungary	0,549	30	0,537	31	0,481	32	0,545	30
Iceland	0,749	2	0,741	4	0,673	7	0,716	6
Ireland	0,677	14	0,669	14	0,602	15	0,655	15
Israel	0,602	25	0,596	24	0,538	24	0,593	24
Italy	0,564	28	0,551	28	0,505	28	0,550	28
Japan	0,629	20	0,617	20	0,560	20	0,601	23

Korea	0,606	24	0,595	25	0,546	21	0,609	21
Latvia	0,537	32	0,533	32	0,489	29	0,536	31
Luxembourg	0,698	11	0,697	11	0,658	9	0,687	11
Mexico	0,500	36	0,495	36	0,468	35	0,509	35
Netherlands	0,717	9	0,711	10	0,653	10	0,700	9
New Zealand	0,694	12	0,690	12	0,629	13	0,678	12
Norway	0,763	1	0,760	1	0,687	4	0,748	1
Poland	0,577	26	0,568	26	0,509	26	0,568	26
Portugal	0,558	29	0,542	29	0,486	30	0,536	32
Slovak Republic	0,569	27	0,561	27	0,506	27	0,565	27
Slovenia	0,635	18	0,625	18	0,562	19	0,626	18
Spain	0,609	23	0,598	23	0,544	23	0,591	25
Sweden	0,722	8	0,717	8	0,663	8	0,713	8
Switzerland	0,742	5	0,737	6	0,690	3	0,714	7
Turkey	0,497	37	0,490	37	0,463	36	0,501	37
United Kingdom	0,658	17	0,649	17	0,598	16	0,641	16
United States	0,739	6	0,741	5	0,761	1	0,732	3
Brazil	0,509	35	0,504	34	0,469	34	0,515	34
Russia	0,543	31	0,538	30	0,484	31	0,546	29
South Africa	0,411	38	0,410	38	0,405	38	0,426	38

The analysis of the calculated gray coefficient results with the MW technique demonstrated that the top 5 countries with the highest scores included Norway, Iceland, Australia, Canada, and Switzerland, respectively. Furthermore, Turkey ranked 37th, while the countries with the lowest scores included South Africa, Turkey, and Mexico, respectively. When the SD method was applied, the top 5 countries with the highest GRA scores included Norway, Canada, Australia, Iceland, and US. The 3 countries with the lowest GRA scores were South Africa, Turkey, and Mexico, while Turkey was ranked 37sth. In the EM method, the country with the highest score was the US, followed by Australia, Switzerland, Norway, and Canada. The countries with the lowest coefficients were South Africa, Greece, and Turkey, and Turkey ranked 36th. Based on the GRA scores obtained with CRITIC, Norway, Australia, the US, Canada, and Denmark were the countries with the highest gray coefficients, respectively. In this method, Turkey ranked 37th. South Africa, Turkey, and Greece were the countries with the lowest scores.

5. CONCLUSIONS

In the current article, BLI 2017 data for 35 OECD member and 3 non-OECD member countries were analyzed with GRA. In the study, four objective weight determination methods were used. Based on the weight determination techniques adopted in the study, various findings were obtained. It was observed that the countries with the lowest performances included South Africa, Turkey, Greece, Mexico, Brazil, and, Chile and the

findings were almost similar to all 4 weight determination techniques. These findings were consistent with the expectations and other study findings in the literature. The common characteristics of these countries at the bottom of the ranking were that they were politically and economically underdeveloped countries. Especially in Latin American countries, historical social and economic conflicts have led to certain obstacles to social peace. Factors such as high-income inequality, corruption, unemployment, and high crime rates could be considered among the reasons for low well-being levels in these countries.

It was determined that the highest-ranking countries exhibited similar socio-economic characteristics. It would be more rational to analyze the country rankings based on the criteria for which the highest weights were assigned with the weighting methods. The life satisfaction, jobs and civic engagement criteria were the criteria with the highest weight load in the SD method. Therefore, the country ranking in SD-based GRA included the countries with the best scores on these criteria such as Norway, Canada, Australia, Iceland, and the US. Since the EM method assigns high weight loads to income and civic engagement, the highest-ranking nations included the US, Australia, Switzerland, Norway, and Canada. It was not surprising that these countries had higher income levels when compared to the others. In the CRITIC method, civic engagement and housing were the factors with the highest weight loads, and the top-ranking nations were Norway, Australia, the US, Canada, and Denmark.

The analysis of GRA scores determined with all four methods revealed that Norway was the first country in the rankings with all weighting methods except EM. Since in the EM, the highest weight is assigned to the income factor, the US ranked first with this method. Australia ranked second with the three methods except for the SD and MW method. Canada ranked second with the SD method. Furthermore, Australia ranked third with the MW and SD methods. The findings obtained with the SD and MW method ranked Australia the third, while the EM-based method ranked Switzerland the third nation. The US ranked third with the CRITIC method.

The fact that Scandinavian and Nordic countries, which lead the world in several prominent criteria, scored the highest points as anticipated. Findings reported by Balešentis et al. (2011), Reig-Martinez (2013), Ivaldi et al. (2016), and Önay (2016) were consistent with the findings of the present study. These countries are leaders in the world rankings due to their high per capita income, low unemployment, and crime rates, better educational opportunities, better income distribution, and social state policies when compared to other nations.

The review of the Turkish ranking demonstrated that the country ranked 37th with the MW, SD and CRITIC GRA scores, and 36th with the EM-based based GRA score. The rankings determined with the 4 different methods were considered reasonable considering the political and economic structure of Turkey. GRA results were consistent with the expectations. Thus, the data presented in Appendix 1 could be compared with the mean OECD figure presented in Table 1 for Turkey. Based on the data, although the civic engagement score of Turkey was close to the OECD mean, the mean income, jobs and life satisfaction scores were well below the OECD mean.

The OECD mean household net wealth criterion, which is a sub criterion of income, was $49.363, while this value was $4.429 for Turkey. Similarly, while the OECD personal earnings mean score, which is a sub criterion of jobs, was $37.436, the same value was $22.848 for Turkey. Especially in income and jobs, the deep gap between Turkish and OECD mean figures was significant. The OECD mean life satisfaction score was 6.53 and the same was 5.5 for Turkey. Therefore, this unfortunately allowed Turkey to fall behind in the ranking. These findings

were consistent with the findings reported by Peiro´-Palomino and Picazo-Tadeo (2018), Depren and Kalkan (2018), and Türe (2019).

However, based on the results reported in recent studies, the ranking of Turkey will be better. One of the criteria that will contribute to this development is the better fulfillment of basic housing needs with the support provided by TOKI. Furthermore, Turkey would have ranked better, presumably due to the recent increase in per capita income, lower unemployment and crime rates when compared to the countries that were ranked lower than Turkey. However, the momentum of increase should continue. Thus, it is necessary to improve income distribution, educational opportunities, social state policies, per capita income, and employment opportunities in Turkey.

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APPENDIX 1: Decision matrix and referential series

	min	min	max	max	max	min	max	min	max	max	max	max	max	min	max	max	max	max	max	max	max	min	min	max
Countries	HOU1	HOU2	HOU3	I1	I2	J1	J2	J3	J4	COM	EDU1	EDU2	EDU3	ENV1	ENV2	CE1	CE2	HEA1	HEA2	LS	S1	S2	WLB1	WLB2
Referential	0	15	2,5	44049	176076	1,5	86	0,03	62636	98	95	529	21,2	3	99	3,5	91	83,9	88	7,5	87,7	0,2	0,16	16,36
Australia	1,1	20	2,3	33417	57462	4,3	72	1,36	52063	94	80	502	21,2	5	92	2,7	91	82,5	85	7,3	63,6	1	13,2	14,35
Austria	1	21	1,6	32544	59574	2,7	72	1,94	48295	92	85	492	17,1	16	93	1,3	75	81,3	70	7	80,7	0,4	6,78	14,55
Belgium	2,3	21	2,2	29968	104084	4,8	62	3,98	49587	92	75	503	18,2	15	84	2,2	89	81,1	75	6,9	70,7	1	4,31	15,77
Canada	0,2	22	2,5	29850	85758	3,9	73	0,81	48403	93	91	523	16,7	7	91	3	68	81,5	88	7,3	80,9	1,4	3,73	14,41
Chile	9,4	18	1,9	16588	21409	8,1	62	2,02	28434	84	65	443	17,3	16	69	1,5	49	79,1	57	6,7	51,1	4,5	10,06	14,9
Czech Republic	0,6	24	1,4	21103	24258	1,8	72	1,71	23722	89	93	491	17,3	20	87	2,6	59	78,7	61	6,6	68,3	0,8	5,77	15,06
Denmark	0,6	24	1,9	28950	73543	2,3	75	1,35	52580	95	81	504	19,7	9	94	2,1	86	80,8	72	7,5	83	0,7	2,2	15,87
Estonia	6,9	18	1,6	18665	16967	4	72	2,13	23621	90	89	524	15,8	8	82	2,8	64	77,7	51	5,6	67,2	3,1	2,69	14,9
Finland	0,5	23	1,9	29374	27972	2,7	69	2,33	42127	95	88	523	19,8	6	94	2,3	69	81,6	70	7,5	82,9	1,4	3,91	15,17
France	0,5	21	1,8	31137	59479	5	65	4,33	42992	88	78	496	16,5	13	82	2,1	75	82,4	68	6,4	69,6	0,6	7,76	16,36
Germany	0,1	20	1,8	33652	57358	2	75	1,68	46389	92	86	508	18,3	14	93	2,1	72	80,7	65	7	75,9	0,4	4,6	15,55
Greece	0,5	24	1,2	17002	18117	17,4	52	16,95	25124	82	72	458	16,9	18	69	1,9	64	81,1	74	5,2	61,8	1	7,3	14,67
Hungary	4,3	18	1,2	16821	23289	4,8	67	2,42	21711	84	83	474	16,6	19	76	1,2	62	75,7	56	5,3	50,7	1,2	3,05	15,06
Iceland	0	24	1,6	30453	64398	2,6	86	0,26	55984	98	78	481	19,3	3	99	1,6	79	82,5	76	7,5	87	0,9	15,06	14,15
Ireland	0,1	21	2,1	25439	43493	2,1	65	4,72	51681	96	80	509	18,7	7	82	0,8	65	81,5	82	7	75,5	0,6	4,66	15,28
Israel	4,4	20	1,2	24036	61805	2,6	69	0,46	34023	87	87	472	15,8	21	67	0,9	72	82,1	84	7,2	70,2	1,7	15,04	13,93
Italy	0,6	23	1,4	26063	64019	8,1	57	6,82	35397	91	60	485	16,4	18	71	1,5	75	82,6	66	5,9	58,3	0,8	3,9	14,89
Japan	6,4	22	1,9	28641	97595	1,5	74	1,24	39113	90	94	529	16,4	14	86	1,3	53	83,9	35	5,9	70,6	0,3	21,81	14,85
Korea	4,2	15	1,4	21723	33495	2,4	66	0,03	32399	76	87	519	17,4	28	78	2,4	77	82,1	33	5,9	63,9	1,1	20,84	14,7
Latvia	12,9	23	1,2	15269	17105	6,8	69	3,73	22389	86	89	487	17,9	11	77	2,4	59	74,6	46	5,9	60,7	6,6	2,09	13,83
Luxembourg	0	20	2	41317	74141	3,2	66	1,9	62636	92	79	483	15,1	12	85	1,5	91	82,4	70	6,9	72	0,6	3,76	15,15
Mexico	4,2	21	1	13891	4750	4,6	61	0,08	15311	80	37	416	14,8	16	67	3,5	63	75	66	6,6	45,9	17,9	29,48	12,74
Netherlands	0	20	1,9	28783	90002	2,1	75	2,56	52833	90	77	508	18,7	14	93	1,3	82	81,6	76	7,4	81,2	0,6	0,45	15,9
New Zealand	0,3	26	2,4	24366	52718	4,9	76	0,72	39397	95	77	506	17,8	5	90	2,5	77	81,7	88	7,3	64,8	1,3	15,02	14,87
Norway	0	17	2,1	35739	20347	2,7	74	0,59	53643	94	82	504	18,1	5	96	1,9	78	82,4	78	7,5	87,7	0,6	3,17	15,56
Poland	2,7	23	1,1	18906	14997	4,3	65	2,14	25921	89	91	504	17,7	22	80	2,6	55	77,6	58	6	66,3	0,8	6,68	14,42
Portugal	1	21	1,7	20519	31877	6,5	65	6,14	24529	87	47	497	17,1	10	87	1,2	56	81,2	46	5,2	72,1	1	8,2	14,89
Slovak Republic	1,4	24	1,1	20265	10846	6,7	65	5,46	23508	91	92	463	15,9	21	82	2,9	60	76,7	66	6,1	60,1	0,8	5,04	15,01
Slovenia	0,3	18	1,5	20505	20048	4	66	4,26	34965	91	87	509	18,1	16	89	2,8	52	80,9	65	5,8	84,7	0,6	4,46	14,75
Spain	0,1	22	1,9	23129	35443	17,3	60	9,49	37333	95	58	491	17,9	11	73	1,6	70	83	72	6,4	83,1	0,6	4,55	15,93
Sweden	0	20	1,8	30553	90708	5,7	76	1,17	42816	92	83	496	19,2	6	95	2	86	82,3	80	7,3	75,9	1	1,11	15,18
Switzerland	0	21	1,9	36378	128415	1,8	80	1,94	60124	94	87	506	17,5	15	96	2,6	49	83	80	7,5	84	0,5	6,91	15,02
Turkey	6,5	20	1	17067	4429	13	51	2,24	22848	86	39	425	17,9	20	63	2,1	85	78	66	5,5	60,6	1,7	33,77	12,59
United Kingdom	0,4	24	2	28408	83405	2,6	74	1,32	42835	93	81	500	16,8	11	85	2,9	69	81	70	6,7	77,4	0,2	12,68	14,92
United States	0,1	18	2,4	44049	176076	3,8	69	0,65	60154	90	90	488	17,1	10	84	3,2	68	78,8	88	6,9	74,1	4,9	11,45	14,44
Brazil	6,7	20	0,8	12227	7102	4,9	64	3,37	14024	90	49	395	15,9	10	72	2,2	79	74,7	70	6,6	37,3	27,6	7,15	14,45
Russia	13,8	19	1	16657	2260	3,6	70	1,64	22101	90	95	492	16,1	15	54	0,8	65	71,3	43	6	52,2	11,3	0,16	14,9
South Africa	37	18	0,7	10872	17042	26,5	43	15,57	11554	88	43	391	15,3	22	69	1,6	73	57,4	67	4,8	36,1	10	18,68	14,73

APPENDIX 2: Normalized decision matrix

	min	min	max	max	max	min	max	min	max	max	max	max	max	min	max	max	max	max	max	max	max	min	min	max
Countries	HOU1	HOU2	HOU3	I1	I2	J1	J2	J3	J4	COM	EDU1	EDU2	EDU3	ENV1	ENV2	CE1	CE2	HEA1	HEA2	LS	S1	S2	WLB1	WLB2
Referential	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Australia	0,970	0,545	0,889	0,680	0,318	0,888	0,674	0,921	0,793	0,818	0,741	0,804	1,000	0,920	0,844	0,704	1,000	0,947	0,945	0,926	0,533	0,971	0,612	0,467
Austria	0,973	0,455	0,500	0,653	0,330	0,952	0,674	0,887	0,719	0,727	0,828	0,732	0,359	0,480	0,867	0,185	0,619	0,902	0,673	0,815	0,864	0,993	0,803	0,520
Belgium	0,938	0,455	0,833	0,576	0,586	0,868	0,442	0,767	0,745	0,727	0,655	0,812	0,531	0,520	0,667	0,519	0,952	0,894	0,764	0,778	0,671	0,971	0,877	0,844
Canada	0,995	0,364	1,000	0,572	0,480	0,904	0,698	0,954	0,721	0,773	0,931	0,957	0,297	0,840	0,822	0,815	0,452	0,909	1,000	0,926	0,868	0,956	0,894	0,483
Chile	0,746	0,727	0,667	0,172	0,110	0,736	0,442	0,882	0,330	0,364	0,483	0,377	0,391	0,480	0,333	0,259	0,000	0,819	0,436	0,704	0,291	0,843	0,705	0,613
Czech Republic	0,984	0,182	0,389	0,308	0,127	0,988	0,674	0,901	0,238	0,591	0,966	0,725	0,391	0,320	0,733	0,667	0,238	0,804	0,509	0,667	0,624	0,978	0,833	0,655
Denmark	0,984	0,182	0,667	0,545	0,410	0,968	0,744	0,922	0,803	0,864	0,759	0,819	0,766	0,760	0,889	0,481	0,881	0,883	0,709	1,000	0,909	0,982	0,939	0,870
Estonia	0,814	0,727	0,500	0,235	0,085	0,900	0,674	0,876	0,236	0,636	0,897	0,964	0,156	0,800	0,622	0,741	0,357	0,766	0,327	0,296	0,603	0,894	0,925	0,613
Finland	0,986	0,273	0,667	0,558	0,148	0,952	0,605	0,864	0,599	0,864	0,879	0,957	0,781	0,880	0,889	0,556	0,476	0,913	0,673	1,000	0,907	0,956	0,888	0,684
France	0,986	0,455	0,611	0,611	0,329	0,860	0,512	0,746	0,615	0,545	0,707	0,761	0,266	0,600	0,622	0,481	0,619	0,943	0,636	0,593	0,649	0,985	0,774	1,000
Germany	0,997	0,545	0,611	0,687	0,317	0,980	0,744	0,902	0,682	0,727	0,845	0,848	0,547	0,560	0,867	0,481	0,548	0,879	0,582	0,815	0,771	0,993	0,868	0,785
Greece	0,986	0,182	0,278	0,185	0,091	0,364	0,209	0,000	0,266	0,273	0,603	0,486	0,328	0,400	0,333	0,407	0,357	0,894	0,745	0,148	0,498	0,971	0,788	0,552
Hungary	0,884	0,727	0,278	0,179	0,121	0,868	0,558	0,859	0,199	0,364	0,793	0,601	0,281	0,360	0,489	0,148	0,310	0,691	0,418	0,185	0,283	0,964	0,914	0,655
Iceland	1,000	0,182	0,500	0,590	0,357	0,956	1,000	0,986	0,870	1,000	0,707	0,652	0,703	1,000	1,000	0,296	0,714	0,947	0,782	1,000	0,986	0,974	0,557	0,414
Ireland	0,997	0,455	0,778	0,439	0,237	0,976	0,512	0,723	0,786	0,909	0,741	0,855	0,609	0,840	0,622	0,000	0,381	0,909	0,891	0,815	0,764	0,985	0,866	0,714
Israel	0,881	0,545	0,278	0,397	0,343	0,956	0,605	0,975	0,440	0,500	0,862	0,587	0,156	0,280	0,289	0,037	0,548	0,932	0,927	0,889	0,661	0,945	0,557	0,355
Italy	0,984	0,273	0,389	0,458	0,355	0,736	0,326	0,599	0,467	0,682	0,397	0,681	0,250	0,400	0,378	0,259	0,619	0,951	0,600	0,407	0,430	0,978	0,889	0,610
Japan	0,827	0,364	0,667	0,536	0,548	1,000	0,721	0,928	0,540	0,636	0,983	1,000	0,250	0,560	0,711	0,185	0,095	1,000	0,036	0,407	0,669	0,996	0,356	0,599
Korea	0,886	1,000	0,389	0,327	0,180	0,964	0,535	1,000	0,408	0,000	0,862	0,928	0,406	0,000	0,533	0,593	0,667	0,932	0,000	0,407	0,539	0,967	0,385	0,560
Latvia	0,651	0,273	0,278	0,133	0,085	0,788	0,605	0,781	0,212	0,455	0,897	0,696	0,484	0,680	0,511	0,593	0,238	0,649	0,236	0,407	0,477	0,766	0,943	0,329
Luxembourg	1,000	0,545	0,722	0,918	0,414	0,932	0,535	0,889	1,000	0,727	0,724	0,667	0,047	0,640	0,689	0,259	1,000	0,943	0,673	0,778	0,696	0,985	0,893	0,679
Mexico	0,886	0,455	0,167	0,091	0,014	0,876	0,419	0,997	0,074	0,182	0,000	0,181	0,000	0,480	0,289	1,000	0,333	0,664	0,600	0,667	0,190	0,354	0,128	0,040
Netherlands	1,000	0,545	0,667	0,540	0,505	0,976	0,744	0,850	0,808	0,636	0,690	0,848	0,609	0,560	0,867	0,185	0,786	0,913	0,782	0,963	0,874	0,985	0,991	0,878
New Zealand	0,992	0,000	0,944	0,407	0,290	0,864	0,767	0,959	0,545	0,864	0,690	0,833	0,469	0,920	0,800	0,630	0,667	0,917	1,000	0,926	0,556	0,960	0,558	0,605
Norway	1,000	0,818	0,778	0,750	0,104	0,952	0,721	0,967	0,824	0,818	0,776	0,819	0,516	0,920	0,933	0,407	0,690	0,943	0,818	1,000	1,000	0,985	0,910	0,788
Poland	0,927	0,273	0,222	0,242	0,073	0,888	0,512	0,875	0,281	0,591	0,931	0,819	0,453	0,240	0,578	0,667	0,143	0,762	0,455	0,444	0,585	0,978	0,806	0,485
Portugal	0,973	0,455	0,556	0,291	0,170	0,800	0,512	0,639	0,254	0,500	0,172	0,768	0,359	0,720	0,733	0,148	0,167	0,898	0,236	0,148	0,698	0,971	0,761	0,610
Slovak Republic	0,962	0,182	0,222	0,283	0,049	0,792	0,512	0,679	0,234	0,682	0,948	0,522	0,172	0,280	0,622	0,778	0,262	0,728	0,600	0,481	0,465	0,978	0,855	0,642
Slovenia	0,992	0,727	0,444	0,290	0,102	0,900	0,535	0,750	0,458	0,682	0,862	0,855	0,516	0,480	0,778	0,741	0,071	0,887	0,582	0,370	0,942	0,985	0,872	0,573
Spain	0,997	0,364	0,667	0,369	0,191	0,368	0,395	0,441	0,505	0,864	0,362	0,725	0,484	0,680	0,422	0,296	0,500	0,966	0,709	0,593	0,911	0,985	0,869	0,886
Sweden	1,000	0,545	0,611	0,593	0,509	0,832	0,767	0,933	0,612	0,727	0,793	0,761	0,688	0,880	0,911	0,444	0,881	0,940	0,855	0,926	0,771	0,971	0,972	0,687
Switzerland	1,000	0,455	0,667	0,769	0,726	0,988	0,860	0,887	0,951	0,818	0,862	0,833	0,422	0,520	0,933	0,667	0,000	0,966	0,855	1,000	0,928	0,989	0,799	0,645
Turkey	0,824	0,545	0,167	0,187	0,012	0,540	0,186	0,869	0,221	0,455	0,034	0,246	0,484	0,320	0,200	0,481	0,857	0,777	0,600	0,259	0,475	0,945	0,000	0,000
United Kingdom	0,989	0,182	0,722	0,529	0,467	0,956	0,721	0,924	0,612	0,773	0,759	0,790	0,313	0,680	0,689	0,778	0,476	0,891	0,673	0,704	0,800	1,000	0,627	0,618
United States	0,997	0,727	0,944	1,000	1,000	0,908	0,605	0,963	0,951	0,636	0,914	0,703	0,359	0,720	0,667	0,889	0,452	0,808	1,000	0,778	0,736	0,828	0,664	0,491
Brazil	0,819	0,545	0,056	0,041	0,028	0,864	0,488	0,803	0,048	0,636	0,207	0,029	0,172	0,720	0,400	0,519	0,714	0,653	0,673	0,667	0,023	0,000	0,792	0,493
Russia	0,627	0,636	0,167	0,174	0,000	0,916	0,628	0,905	0,206	0,636	1,000	0,732	0,203	0,520	0,000	0,000	0,381	0,525	0,182	0,444	0,312	0,595	1,000	0,613
South Africa	0,000	0,727	0,000	0,000	0,085	0,000	0,000	0,082	0,000	0,545	0,103	0,000	0,078	0,240	0,333	0,296	0,571	0,000	0,618	0,000	0,000	0,642	0,449	0,568

APPENDIX 3: Absolute value matrix

	min	min	max	max	max	min	max	min	max	max	max	max	max	min	max	max	max	max	max	max	max	min	min	max
Countries	HOU1	HOU2	HOU3	I1	I2	J1	J2	J3	J4	COM	EDU1	EDU2	EDU3	ENV1	ENV2	CE1	CE2	HEA1	HEA2	LS	S1	S2	WLB1	WLB2
Australia	0,030	0,455	0,111	0,320	0,682	0,112	0,326	0,079	0,207	0,182	0,259	0,196	0,000	0,080	0,156	0,296	0,000	0,053	0,055	0,074	0,467	0,029	0,388	0,533
Austria	0,027	0,545	0,500	0,347	0,670	0,048	0,326	0,113	0,281	0,273	0,172	0,268	0,641	0,520	0,133	0,815	0,381	0,098	0,327	0,185	0,136	0,007	0,197	0,480
Belgium	0,062	0,545	0,167	0,424	0,414	0,132	0,558	0,233	0,255	0,273	0,345	0,188	0,469	0,480	0,333	0,481	0,048	0,106	0,236	0,222	0,329	0,029	0,123	0,156
Canada	0,005	0,636	0,000	0,428	0,520	0,096	0,302	0,046	0,279	0,227	0,069	0,043	0,703	0,160	0,178	0,185	0,548	0,091	0,000	0,074	0,132	0,044	0,106	0,517
Chile	0,254	0,273	0,333	0,828	0,890	0,264	0,558	0,118	0,670	0,636	0,517	0,623	0,609	0,520	0,667	0,741	1,000	0,181	0,564	0,296	0,709	0,157	0,295	0,387
Czech Republic	0,016	0,818	0,611	0,692	0,873	0,012	0,326	0,099	0,762	0,409	0,034	0,275	0,609	0,680	0,267	0,333	0,762	0,196	0,491	0,333	0,376	0,022	0,167	0,345
Denmark	0,016	0,818	0,333	0,455	0,590	0,032	0,256	0,078	0,197	0,136	0,241	0,181	0,234	0,240	0,111	0,519	0,119	0,117	0,291	0,000	0,091	0,018	0,061	0,130
Estonia	0,186	0,273	0,500	0,765	0,915	0,100	0,326	0,124	0,764	0,364	0,103	0,036	0,844	0,200	0,378	0,259	0,643	0,234	0,673	0,704	0,397	0,106	0,075	0,387
Finland	0,014	0,727	0,333	0,442	0,852	0,048	0,395	0,136	0,401	0,136	0,121	0,043	0,219	0,120	0,111	0,444	0,524	0,087	0,327	0,000	0,093	0,044	0,112	0,316
France	0,014	0,545	0,389	0,389	0,671	0,140	0,488	0,254	0,385	0,455	0,293	0,239	0,734	0,400	0,378	0,519	0,381	0,057	0,364	0,407	0,351	0,015	0,226	0,000
Germany	0,003	0,455	0,389	0,313	0,683	0,020	0,256	0,098	0,318	0,273	0,155	0,152	0,453	0,440	0,133	0,519	0,452	0,121	0,418	0,185	0,229	0,007	0,132	0,215
Greece	0,014	0,818	0,722	0,815	0,909	0,636	0,791	1,000	0,734	0,727	0,397	0,514	0,672	0,600	0,667	0,593	0,643	0,106	0,255	0,852	0,502	0,029	0,212	0,448
Hungary	0,116	0,273	0,722	0,821	0,879	0,132	0,442	0,141	0,801	0,636	0,207	0,399	0,719	0,640	0,511	0,852	0,690	0,309	0,582	0,815	0,717	0,036	0,086	0,345
Iceland	0,000	0,818	0,500	0,410	0,643	0,044	0,000	0,014	0,130	0,000	0,293	0,348	0,297	0,000	0,000	0,704	0,286	0,053	0,218	0,000	0,014	0,026	0,443	0,586
Ireland	0,003	0,545	0,222	0,561	0,763	0,024	0,488	0,277	0,214	0,091	0,259	0,145	0,391	0,160	0,378	1,000	0,619	0,091	0,109	0,185	0,236	0,015	0,134	0,286
Israel	0,119	0,455	0,722	0,603	0,657	0,044	0,395	0,025	0,560	0,500	0,138	0,413	0,844	0,720	0,711	0,963	0,452	0,068	0,073	0,111	0,339	0,055	0,443	0,645
Italy	0,016	0,727	0,611	0,542	0,645	0,264	0,674	0,401	0,533	0,318	0,603	0,319	0,750	0,600	0,622	0,741	0,381	0,049	0,400	0,593	0,570	0,022	0,111	0,390
Japan	0,173	0,636	0,333	0,464	0,452	0,000	0,279	0,072	0,460	0,364	0,017	0,000	0,750	0,440	0,289	0,815	0,905	0,000	0,964	0,593	0,331	0,004	0,644	0,401
Korea	0,114	0,000	0,611	0,673	0,820	0,036	0,465	0,000	0,592	1,000	0,138	0,072	0,594	1,000	0,467	0,407	0,333	0,068	1,000	0,593	0,461	0,033	0,615	0,440
Latvia	0,349	0,727	0,722	0,867	0,915	0,212	0,395	0,219	0,788	0,545	0,103	0,304	0,516	0,320	0,489	0,407	0,762	0,351	0,764	0,593	0,523	0,234	0,057	0,671
Luxembourg	0,000	0,455	0,278	0,082	0,586	0,068	0,465	0,111	0,000	0,273	0,276	0,333	0,953	0,360	0,311	0,741	0,000	0,057	0,327	0,222	0,304	0,015	0,107	0,321
Mexico	0,114	0,545	0,833	0,909	0,986	0,124	0,581	0,003	0,926	0,818	1,000	0,819	1,000	0,520	0,711	0,000	0,667	0,336	0,400	0,333	0,810	0,646	0,872	0,960
Netherlands	0,000	0,455	0,333	0,460	0,495	0,024	0,256	0,150	0,192	0,364	0,310	0,152	0,391	0,440	0,133	0,815	0,214	0,087	0,218	0,037	0,126	0,015	0,009	0,122
New Zealand	0,008	1,000	0,056	0,593	0,710	0,136	0,233	0,041	0,455	0,136	0,310	0,167	0,531	0,080	0,200	0,370	0,333	0,083	0,000	0,074	0,444	0,040	0,442	0,395
Norway	0,000	0,182	0,222	0,250	0,896	0,048	0,279	0,033	0,176	0,182	0,224	0,181	0,484	0,080	0,067	0,593	0,310	0,057	0,182	0,000	0,000	0,015	0,090	0,212
Poland	0,073	0,727	0,778	0,758	0,927	0,112	0,488	0,125	0,719	0,409	0,069	0,181	0,547	0,760	0,422	0,333	0,857	0,238	0,545	0,556	0,415	0,022	0,194	0,515
Portugal	0,027	0,545	0,444	0,709	0,830	0,200	0,488	0,361	0,746	0,500	0,828	0,232	0,641	0,280	0,267	0,852	0,833	0,102	0,764	0,852	0,302	0,029	0,239	0,390
Slovak Republic	0,038	0,818	0,778	0,717	0,951	0,208	0,488	0,321	0,766	0,318	0,052	0,478	0,828	0,720	0,378	0,222	0,738	0,272	0,400	0,519	0,535	0,022	0,145	0,358
Slovenia	0,008	0,273	0,556	0,710	0,898	0,100	0,465	0,250	0,542	0,318	0,138	0,145	0,484	0,520	0,222	0,259	0,929	0,113	0,418	0,630	0,058	0,015	0,128	0,427
Spain	0,003	0,636	0,333	0,631	0,809	0,632	0,605	0,559	0,495	0,136	0,638	0,275	0,516	0,320	0,578	0,704	0,500	0,034	0,291	0,407	0,089	0,015	0,131	0,114
Sweden	0,000	0,455	0,389	0,407	0,491	0,168	0,233	0,067	0,388	0,273	0,207	0,239	0,313	0,120	0,089	0,556	0,119	0,060	0,145	0,074	0,229	0,029	0,028	0,313
Switzerland	0,000	0,545	0,333	0,231	0,274	0,012	0,140	0,113	0,049	0,182	0,138	0,167	0,578	0,480	0,067	0,333	1,000	0,034	0,145	0,000	0,072	0,011	0,201	0,355
Turkey	0,176	0,455	0,833	0,813	0,988	0,460	0,814	0,131	0,779	0,545	0,966	0,754	0,516	0,680	0,800	0,519	0,143	0,223	0,400	0,741	0,525	0,055	1,000	1,000
United Kingdom	0,011	0,818	0,278	0,471	0,533	0,044	0,279	0,076	0,388	0,227	0,241	0,210	0,688	0,320	0,311	0,222	0,524	0,109	0,327	0,296	0,200	0,000	0,373	0,382
United States	0,003	0,273	0,056	0,000	0,000	0,092	0,395	0,037	0,049	0,364	0,086	0,297	0,641	0,280	0,333	0,111	0,548	0,192	0,000	0,222	0,264	0,172	0,336	0,509
Brazil	0,181	0,455	0,944	0,959	0,972	0,136	0,512	0,197	0,952	0,364	0,793	0,971	0,828	0,280	0,600	0,481	0,286	0,347	0,327	0,333	0,977	1,000	0,208	0,507
Russia	0,373	0,364	0,833	0,826	1,000	0,084	0,372	0,095	0,794	0,364	0,000	0,268	0,797	0,480	1,000	1,000	0,619	0,475	0,818	0,556	0,688	0,405	0,000	0,387
South Africa	1,000	0,273	1,000	1,000	0,915	1,000	1,000	0,918	1,000	0,455	0,897	1,000	0,922	0,760	0,667	0,704	0,429	1,000	0,382	1,000	1,000	0,358	0,551	0,432

APPENDIX 4: Grey relational coefficient matrix

	min	min	max	max	max	min	max	min	max	max	max	max	max	min	max	max	max	max	max	max	max	min	min	max
Countries	HOU1	HOU2	HOU3	I1	I2	J1	J2	J3	J4	COM	EDU1	EDU2	EDU3	ENV1	ENV2	CE1	CE2	HEA1	HEA2	LS	S1	S2	WLB1	WLB2
Australia	0,944	0,524	0,818	0,609	0,423	0,817	0,606	0,864	0,707	0,733	0,659	0,719	1,000	0,862	0,763	0,628	1,000	0,904	0,902	0,871	0,517	0,945	0,563	0,484
Austria	0,949	0,478	0,500	0,590	0,427	0,912	0,606	0,816	0,640	0,647	0,744	0,651	0,438	0,490	0,789	0,380	0,568	0,836	0,604	0,730	0,787	0,986	0,717	0,510
Belgium	0,889	0,478	0,750	0,541	0,547	0,791	0,473	0,682	0,662	0,647	0,592	0,726	0,516	0,510	0,600	0,509	0,913	0,826	0,679	0,692	0,603	0,945	0,802	0,762
Canada	0,989	0,440	1,000	0,539	0,490	0,839	0,623	0,916	0,642	0,688	0,879	0,920	0,416	0,758	0,738	0,730	0,477	0,847	1,000	0,871	0,791	0,919	0,825	0,492
Chile	0,663	0,647	0,600	0,377	0,360	0,654	0,473	0,810	0,428	0,440	0,492	0,445	0,451	0,490	0,429	0,403	0,333	0,734	0,470	0,628	0,413	0,761	0,629	0,564
Czech Republic	0,969	0,379	0,450	0,420	0,364	0,977	0,606	0,834	0,396	0,550	0,935	0,645	0,451	0,424	0,652	0,600	0,396	0,718	0,505	0,600	0,571	0,958	0,750	0,592
Denmark	0,969	0,379	0,600	0,524	0,459	0,940	0,662	0,865	0,718	0,786	0,674	0,734	0,681	0,676	0,818	0,491	0,808	0,810	0,632	1,000	0,846	0,965	0,892	0,794
Estonia	0,728	0,647	0,500	0,395	0,353	0,833	0,606	0,801	0,396	0,579	0,829	0,932	0,372	0,714	0,570	0,659	0,438	0,681	0,426	0,415	0,557	0,825	0,869	0,564
Finland	0,974	0,407	0,600	0,531	0,370	0,912	0,558	0,786	0,555	0,786	0,806	0,920	0,696	0,806	0,818	0,529	0,488	0,852	0,604	1,000	0,843	0,919	0,818	0,613
France	0,974	0,478	0,563	0,562	0,427	0,781	0,506	0,663	0,565	0,524	0,630	0,676	0,405	0,556	0,570	0,491	0,568	0,898	0,579	0,551	0,588	0,972	0,689	1,000
Germany	0,995	0,524	0,563	0,615	0,423	0,962	0,662	0,837	0,611	0,647	0,763	0,767	0,525	0,532	0,789	0,491	0,525	0,805	0,545	0,730	0,686	0,986	0,791	0,699
Greece	0,974	0,379	0,409	0,380	0,355	0,440	0,387	0,333	0,405	0,407	0,558	0,493	0,427	0,455	0,429	0,458	0,438	0,826	0,663	0,370	0,499	0,945	0,702	0,527
Hungary	0,811	0,647	0,409	0,379	0,363	0,791	0,531	0,780	0,384	0,440	0,707	0,556	0,410	0,439	0,495	0,370	0,420	0,618	0,462	0,380	0,411	0,932	0,853	0,592
Iceland	1,000	0,379	0,500	0,550	0,438	0,919	1,000	0,974	0,793	1,000	0,630	0,590	0,627	1,000	1,000	0,415	0,636	0,904	0,696	1,000	0,974	0,951	0,530	0,460
Ireland	0,995	0,478	0,692	0,471	0,396	0,954	0,506	0,643	0,700	0,846	0,659	0,775	0,561	0,758	0,570	0,333	0,447	0,847	0,821	0,730	0,679	0,972	0,789	0,636
Israel	0,808	0,524	0,409	0,453	0,432	0,919	0,558	0,952	0,472	0,500	0,784	0,548	0,372	0,410	0,413	0,342	0,525	0,880	0,873	0,818	0,596	0,901	0,530	0,437
Italy	0,969	0,407	0,450	0,480	0,437	0,654	0,426	0,555	0,484	0,611	0,453	0,611	0,400	0,455	0,446	0,403	0,568	0,911	0,556	0,458	0,467	0,958	0,818	0,562
Japan	0,743	0,440	0,600	0,518	0,525	1,000	0,642	0,875	0,521	0,579	0,967	1,000	0,400	0,532	0,634	0,380	0,356	1,000	0,342	0,458	0,601	0,993	0,437	0,555
Korea	0,815	1,000	0,450	0,426	0,379	0,933	0,518	1,000	0,458	0,333	0,784	0,873	0,457	0,333	0,517	0,551	0,600	0,880	0,333	0,458	0,520	0,938	0,448	0,532
Latvia	0,589	0,407	0,409	0,366	0,353	0,702	0,558	0,696	0,388	0,478	0,829	0,622	0,492	0,610	0,506	0,551	0,396	0,588	0,396	0,458	0,489	0,682	0,897	0,427
Luxembourg	1,000	0,524	0,643	0,859	0,460	0,880	0,518	0,819	1,000	0,647	0,644	0,600	0,344	0,581	0,616	0,403	1,000	0,898	0,604	0,692	0,622	0,972	0,824	0,609
Mexico	0,815	0,478	0,375	0,355	0,337	0,801	0,462	0,994	0,351	0,379	0,333	0,379	0,333	0,490	0,413	1,000	0,429	0,598	0,556	0,600	0,382	0,436	0,364	0,342
Netherlands	1,000	0,524	0,600	0,521	0,502	0,954	0,662	0,770	0,723	0,579	0,617	0,767	0,561	0,532	0,789	0,380	0,700	0,852	0,696	0,931	0,799	0,972	0,983	0,804
New Zealand	0,984	0,333	0,900	0,457	0,413	0,786	0,683	0,925	0,524	0,786	0,617	0,750	0,485	0,862	0,714	0,574	0,600	0,858	1,000	0,871	0,530	0,926	0,531	0,559
Norway	1,000	0,733	0,692	0,666	0,358	0,912	0,642	0,938	0,740	0,733	0,690	0,734	0,508	0,862	0,882	0,458	0,618	0,898	0,733	1,000	1,000	0,972	0,848	0,702
Poland	0,873	0,407	0,391	0,398	0,350	0,817	0,506	0,800	0,410	0,550	0,879	0,734	0,478	0,397	0,542	0,600	0,368	0,678	0,478	0,474	0,547	0,958	0,720	0,493
Portugal	0,949	0,478	0,529	0,413	0,376	0,714	0,506	0,581	0,401	0,500	0,377	0,683	0,438	0,641	0,652	0,370	0,375	0,831	0,396	0,370	0,623	0,945	0,676	0,562
Slovak Republic	0,930	0,379	0,391	0,411	0,345	0,706	0,506	0,609	0,395	0,611	0,906	0,511	0,376	0,410	0,570	0,692	0,404	0,648	0,556	0,491	0,483	0,958	0,775	0,583
Slovenia	0,984	0,647	0,474	0,413	0,358	0,833	0,518	0,667	0,480	0,611	0,784	0,775	0,508	0,490	0,692	0,659	0,350	0,815	0,545	0,443	0,896	0,972	0,796	0,539
Spain	0,995	0,440	0,600	0,442	0,382	0,442	0,453	0,472	0,502	0,786	0,439	0,645	0,492	0,610	0,464	0,415	0,500	0,936	0,632	0,551	0,849	0,972	0,793	0,814
Sweden	1,000	0,524	0,563	0,551	0,504	0,749	0,683	0,881	0,563	0,647	0,707	0,676	0,615	0,806	0,849	0,474	0,808	0,892	0,775	0,871	0,686	0,945	0,946	0,615
Switzerland	1,000	0,478	0,600	0,684	0,646	0,977	0,782	0,816	0,910	0,733	0,784	0,750	0,464	0,510	0,882	0,600	0,333	0,936	0,775	1,000	0,875	0,979	0,713	0,584
Turkey	0,740	0,524	0,375	0,381	0,336	0,521	0,381	0,793	0,391	0,478	0,341	0,399	0,492	0,424	0,385	0,491	0,778	0,692	0,556	0,403	0,488	0,901	0,333	0,333
United Kingdom	0,979	0,379	0,643	0,515	0,484	0,919	0,642	0,868	0,563	0,688	0,674	0,704	0,421	0,610	0,616	0,692	0,488	0,820	0,604	0,628	0,715	1,000	0,573	0,567
United States	0,995	0,647	0,900	1,000	1,000	0,845	0,558	0,932	0,911	0,579	0,853	0,627	0,438	0,641	0,600	0,818	0,477	0,722	1,000	0,692	0,655	0,745	0,598	0,495
Brazil	0,734	0,524	0,346	0,343	0,340	0,786	0,494	0,717	0,344	0,579	0,387	0,340	0,376	0,641	0,455	0,509	0,636	0,590	0,604	0,600	0,339	0,333	0,706	0,497
Russia	0,573	0,579	0,375	0,377	0,333	0,856	0,573	0,840	0,387	0,579	1,000	0,651	0,386	0,510	0,333	0,333	0,447	0,513	0,379	0,474	0,421	0,552	1,000	0,564
South Africa	0,333	0,647	0,333	0,333	0,353	0,333	0,333	0,353	0,333	0,524	0,358	0,333	0,352	0,397	0,429	0,415	0,538	0,333	0,567	0,333	0,333	0,583	0,476	0,536

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2. Yazarlar tarafından herhangi bir çıkar çatışması beyan edilmemiştir (No potential conflict of interest was reported by the authors).
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