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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

IS THERE A RELATIONSHIP BETWEEN ENVIRONMENTAL-SOCIAL PERFORMANCE AND GDP PER CAPITA? EVIDENCE FROM THE G-20 COUNTRIES

ÇEVRESEL-SOSYAL PERFORMANS İLE KİŞİ BAŞINA GSYİH ARASINDA BİR İLİŞKİ VAR MIDIR? G-20 ÜLKELERİ ÜZERİNE BİR UYGULAMA

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Abstract

The fact that several environmental and social risks are on increase and have become a more complex structure with globalization, they impose greater jeopardy to countries than economic risks. Hence, it is necessary to investigate the relationship between the performances related to these risks. For this purpose, environmental and social performance indicators based on the G-20 countries' data have been weighted firstly with the Entropy method. Then, performance measurement has been done with the Gray Relational Analysis method. In the final stage, the relationship between these performance scores and the Gross Domestic Product (GDP) per capita, which is one of the economic performance indicators, has been investigated by calculating the Spearman rank correlation coefficient. Findings reveal that there is a strong positive relationship between environmental-social performance and GDP per capita.

Keywords: Sustainability, Environmental-Social Performance, GDP per Capita, G-20, Entropy, Gray Relational Analysis, Spearman Rank Correlation Coefficient.

JEL Codes: Q56, M14, I10

Öz

Küreselleşmeyle birlikte gittikçe artan ve daha karmaşık bir yapıya bürünen birçok çevresel ve sosyal riskin ekonomik risklerden daha önemli hale gelmesi, söz konusu riskleri barındıran performanslar arasındaki ilişkinin araştırılmasını gerekli kılmaktadır. Çalışmada bu amaçla, ilk olarak çevresel ve sosyal performans göstergeleri

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Entropi yöntemiyle G-20 ülkeleri temel alınarak ağırlıklandırmıştır. Ardından, Gri İlişkisel Analiz yöntemi ile performans ölçümü gerçekleştirilmiştir. Son aşama ise elde edilen bu performans puanları ile ekonomik performans göstergelerinden biri olan kişi başına düşen Gayri Safi Yurtiçi Hasıla (GSYİH) arasındaki ilişki Spearman sıra korelasyon katsayısı hesaplanarak araştırılmıştır. Analiz bulguları, çevresel-sosyal performans ile kişi başına düşen GSYİH arasında pozitif yönde güçlü bir ilişki olduğunu ortaya koymaktadır.

Anahtar Kelimeler: Sürdürülebilirlik, Çevresel-Sosyal Performans, Kişi Başına Düşen GSYİH, G-20, Entropi, Gri İlişkisel Analiz, Spearman Sıra Korelasyon Katsayısı.

JEL Kodları: Q56, M14, I10

1. Introduction

The concept of sustainability has been recognized globally with the Brundtland report, which is also called *"Our Common Future"*. Sustainable development is stated in this report as *"Meeting the needs of today without compromising the ability of future generations to meet their own needs*" (WCED, 1987, p.43). The United Nations Conference on Environment and Development also made this statement, which has been accepted by non-governmental organizations, politicians, and business leaders. The conference revealed that the existence of the right of every person to live in a healthy and harmonious nature is brought to the agenda (UN, 1992).

The concept of sustainability, which has many definitions, advocates a fair distribution of resources between present and future generations, by considering the ecological balance rather than the efficient allocation of resources over time (Gray & Milne, 2002). In other words, sustainability is about creating a society where an appropriate balance is created between economic, social, and ecological purposes (Szekely & Knirsch, 2005). The economic, environmental, and social performance dimensions of sustainability were first used in conjunction with John Elkington's (1997) suggestion of the triple performance approach (Triple Bottom Line-TBL). Among these dimensions, it is observed that environmental and social performances are gaining more importance day by day. As a matter of fact, our world faces many environmental and social challenges, which become more important with increasingly complex dynamics, such as climate change, biological threats, dwindling natural resources, pandemics, population growth, migration, and economic inequality.

According to the 2019 Global Risks Report prepared by the World Economic Forum (WEF), businesses compose 50% of environmental risks and 20% of social risks which are most perceived by the world. The share of economic risks among the aforementioned risks is only 10%. Moreover, it is noteworthy that economic risks have been replaced by environmental and social risks over the years (WEF, 2019). This situation raises questions about how to manage the risks mentioned, and how to balance these risks among themselves. For this reason, it becomes necessary to investigate whether there is a relationship between environmental-social performance and economic performance. Twenty (G-20) countries stand out for the application fields of the research, in terms of bringing emerging and developed economies together on a common platform and representing most of the world economy.

Studies measuring environmental, social, and economic performance at the country level are commonly seen in the literature (Hosseini & Kaneko, 2011; Štreimikienė & Baležentis 2013; Nilashi et al., 2018; Tajbakhsh & Shamsi, 2019). However, studies investigating the relationships between these performance dimensions of sustainability at the macro level are limited. The aim of this study is to fill this gap in the literature by examining the relationship between environmental-social performance and GDP per capita, one of the economic performance indicators, based on the 2018 data of G-20 countries. In the second part of the study, the relevant literature is addressed. In the third section, information is given about the data set, scope, analysis process, and method of the study, respectively. In the fourth section, findings are presented and in the final section, these findings are evaluated and suggestions are made. Then, by specifying the limitations of the study, areas for further research are given.

2. Literature Review

The increasing importance of environmental and social performance within the scope of sustainability along with globalization has increased the number of studies on this subject (Ranganathan, 1998; Gauthier, 2005; Orlitzky, 2005; Aras & Crowther, 2009; Liu et al. 2013; Aras, 2015). In the literature, it is seen that the studies conducted in this field, focus especially on corporate sustainability performance. Also, the measurement of the sustainability performance of cities and countries are commonly studied (Zhang et al., 2016; Tanguay et al., 2010; Distaso, 2007).

Keeble, Topiol & Berkeley (2003) emphasize that it is not an easy process to develop the indicators, used in sustainability performance evaluation, by harmonizing them with management needs. The paper points out that sustainability indicators are based on value judgments rather than fixed data, which makes this structure even more complex considering different projects and workflows of many institutions. From this point of view, it has been investigated with case studies on how proper use of indicators can be a powerful tool to evaluate the sustainability of businesses.

It is observed that the evaluation of sustainability performance is frequently used in supplier selection. For example, Baskaran, Nachiappan and Rahman (2012) carry out the sustainability evaluation of Indian textile suppliers using the Gray approach. On the other hand, Govindan, Khodaverdi and Jafarian (2013) and Dos Santos, Godoy & Campos (2019) apply the fuzzy TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method in evaluation. Moreover, Giannakis et al. (2020) have used the Analytic Network Process (ANP) in sustainability performance evaluation.

Addressing the sustainability issue at the urban level, Rosales (2011) examines the indicators needed to build sustainable cities. The paper tests the model of this indicator set in Mexico City with a case study. Tang et al. (2019) propose a model with 39 indicators under the category of economic, social, and ecological development for sustainability evaluation. To verify the effectiveness of this model, it has been applied to 16 cities in Anhui province, China, using the TOPSIS method.

Cracolici, Cuffaro and Nijkamp (2010) present a structural synchronous equation model to investigate the direction of the causal relationship between economic and non-economic aspects of countries' sustainability performance (economic, environmental and social). According to the results of the analysis conducted on 64 countries for 1980-1999, it has been observed that the high GDP level allows the population to reach a longer life expectancy and a higher education level. While this relationship between GDP and life expectancy is bidirectional, it is one-way with education level. This is an indicator showing that the population of most countries has not been able to transform the higher education skills it possesses into greater economic performance over time. However, it has been observed that the increase in the GDP level also increases the pollution levels of the countries. In this context, it has been emphasized that attention should be paid to control and monitor the negative effects of economic growth on the environment, especially for manufacturers in developing countries.

Hosseini and Kaneko (2011) carry out the sustainability assessment of countries at the macro level for 131 countries, between 2000 and 2007. In the study, in which the Principal Component Analysis (PCA) has been applied, the sustainabilities of the countries are addressed in four dimensions: institutional, environmental, social, and economic. Findings show that there is progress in economic, social, and institutional dimensions, whereas environmental conditions are getting worse. Similarly, Shmelev and Rodríguez-Labajos (2009), who evaluate sustainability on a macro scale, discuss the development of sustainability dimensions over time in the case of Austria by using Multi-Criteria Decision Aid (MCDA) methods.

Shmelev (2011) proposes a model to assess sustainability performance. The economic, social, and environmental development between 1985 and 2008 has been examined in the Russian example using the Analysis and Synthesis of Parameters under Information Deficiency (ASPID) method. Floridi et al. (2011) create an index to assess the sustainability of Italian Regions. Štreimikienė and Baležentis (2013), who similarly generate an index, aim to evaluate sustainable development goals and progress towards the implementation of sustainability in Lithuania. For this purpose, the country's sustainability performance has been measured for 2000-2011 using the Additive Ratio Assessment (ARAS) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods. Both methods' analysis shows that Lithuania has observed positive trends over the years.

Antanasijević et al. (2017) apply The Differential Multi-Criteria Analysis (DMCA) method to assess the sustainability performance of European countries between 2004-2014. The results of the analysis reveal that most of the countries in this group, except for Greece and Ireland, have made progress in terms of sustainability. Moreover, Tan et al. (2017) and Nilashi et al. (2018) adopt the Adaptive Neuro-Fuzzy Inference System (ANFIS) approach to measure sustainability performance at the country level.

Küpeli and Alp (2018) evaluate the renewable energy performance of G-20 countries with Data Envelopment Analysis (DEA) and balanced performance weights within the framework of sustainable development. According to the results of the analysis, the countries that stand out in terms of performance are listed. In this ranking, Australia, America, France, Germany, and Canada are the top 5 performing countries. On the other hand, India, Indonesia, China, South Africa, and Mexico are at the bottom. Türe (2019) uses both equal-weight and Entropy-weighted Gray Relational Analysis methods in its study where OECD countries' welfare levels are measured. The results reveal that Iceland, Australia, and Norway are in the top three in the performance appraisal, which is calculated considering the weights determined by Entropy. According to this analysis, Turkey, Greece, and Mexico are in the last row.

Sueyoshi and Wang (2020) conduct a sustainable development evaluation of 121 countries between 1990-2014 with Data Envelopment Analysis (DEA) and the convergence analysis. Similarly, Sun et al. (2020) use MCDA and DEA methods to measure the environmental sustainability performance of South Asia between 2001-2015. Findings show that Bhutan and Nepal have the highest performance. On the other hand, India, Sri Lanka, and Pakistan take places at the bottom. Moreover, Chen et al. (2020) examine the Chinese provinces between 2000 and 2012 with the relational network DEA approach. As a result of the analysis, high eco-efficiency levels for the western regions, and high production efficiency levels for the eastern regions have been determined. Furthermore, Liu et al. (2020) carry out the sustainability performance evaluation of 30 provinces in China and examine its development over the years. In this study covering 2005-2015, DEA, and Tobit regression methods have been used.

Wang et al. (2020) reveal that the improvement of economic, social, and governance (ESG) subjects at the country level has a positive effect on economic growth. In this study, conducted in 109 countries, it is observed that the effect is more pronounced in countries with stronger laws and incentives to improve ESG performance. Besides, Adedoyin et al. (2020) conclude that research and development (R&D) expenditures significantly affect the level of environmental sustainability in the study of EU countries based on 1997-2014 data.

3. Methodology

3.1. Data, Sample and Analysis Process

The study aims to investigate the relationship between environmental-social performance and GDP per capita. Environmental and social performance indicators of G-20 countries for 2018, which are determined by analyzing ESG data announced and shared by the World Bank, have been used in the study. These indicators are given in Appendix 1 and GDP per capita indicator data are included in Appendix 2.

In the first phase of this study, the indicators have been weighted with the Entropy method. Then, based on these indicator weights obtained, the social and environmental performance has been measured using the Gray Relational Analysis method. Similarly, Wang, Wu and Sun (2015) determine the relative importance of the indicators with the Entropy method to evaluate the corporate social responsibility performances of Chinese airline companies. Then, based on the results of Entropy, the paper measures the performance with the Gray Relational Analysis method. Similarly, Türe (2019) also uses Entropy and Gray Relational Analysis methods in another study, which investigate the welfare level of OECD countries.

At the final stage, the relationship between environmental-social performance and GDP per capita has been investigated. Since indicator data are not normally distributed, Spearman correlation coefficient has been calculated in this study.

3.2. Entropy

The concept of Entropy, which takes place in many sciences and engineering fields, was first described by Rudolph Clausius as a measure of thermodynamics in 1865. According to this definition, Entropy is a measure of disorder and the higher entropy is, the greater the disorder is (Zhang et al., 2011). Following the definition of Entropy in the field of thermodynamics, Shannon (1948) developed the concept of Information Entropy and expressed it as a *"measure of uncertainty in information"*.

Entropy is used to measure the effectiveness of information. The greater the differentiation within the data evaluated for a given indicator, the smaller the Entropy value is and accordingly the Entropy weight becomes so big. Bigger Entropy weight indicates that information is effective (Liu & Cui, 2008). Steps of the Entropy method are as follows:

Step 1: Creating the decision matrix

Criteria take place in the lines of the decision matrix ($C = \{C_j \mid j = 1,2, \dots, n\}$); alternatives are ($A = \{A_i \mid i = 1,2, \dots, m\}$) in the columns. "$x_{ij}$" is the value of the i alternative according to j criterion. Accordingly, the decision matrix is formed as follows (Equation 1).

$$D = \begin{array}{c} \begin{matrix} C_1 & C_2 & \cdots & C_j & \cdots & C_n \end{matrix} \\ \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1j} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2j} & \cdots & x_{2n} \\ \vdots & \vdots & \cdots & \vdots & \cdots & \vdots \\ x_{i1} & x_{i2} & \cdots & x_{ij} & \cdots & x_{in} \\ \vdots & \vdots & \ddots & \vdots & \cdots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mj} & \cdots & x_{mn} \end{bmatrix} \end{array} \begin{matrix} A_1 \\ A_2 \\ \vdots \\ A_j \\ \vdots \\ A_m \end{matrix} \quad (1)$$

Step 2: Normalization of the decision matrix

Each criterion value in the decision matrix is normalized by equation (2).

$$r_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}}; (i = 1,2, \dots, m \text{ ve } j = 1,2, \dots, n) \quad (2)$$

Step 3: Calculation of Entropy values

In this calculation (Equation 3), k represents a constant ($k = \frac{1}{\ln(m)}$) and is guaranteed to be $0 \leq E_j \leq 1$.

$$E_j = -k \sum_{i=1}^{n} r_{ij} \ln(r_{ij}); (i = 1,2, \dots, m \text{ ve } j = 1,2, \dots, n) \quad (3)$$

Because it is $lim_{r_{ij \to 0}} r_{ij} ln r_{ij} = 0, r_{ij} = 0$ is $r_{ij} ln r_{ij} = 0$ (Wang & Luo, 2010).

Step 4: Calculating Entropy weights

Entropy weights are calculated by using of equation (4) and equation (5).

$$d_j = 1 - E_j \quad (4)$$

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j}, \forall j \quad (5)$$

The sum of Entropy weights obtained is equal to 1.

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

3.3. Gray Relational Analysis

The Gray Relational Analysis (GRA) method was developed by Deng (1982) based on the gray system theory. The gray concept in this theory expresses the lack of information and uncertainty in a system (Liu & Lin, 2006). At this point, the GRA method measures the relationship between uncertain information and partial information by digitizing the uncertainty in the system. The steps of the GRA method are similar to Wu (2002) as follows:

Step 1: Creating the decision matrix

A decision matrix is created that shows the values ($x_i = (x_i(j), \dots . x_i(n))$) of m alternatives and n criteria and the value of the alternative according to the criterion (Equation 6).

$$X_i = \begin{bmatrix} x_1(1) & x_1(2) & \cdots & x_1(n) \\ x_2(1) & x_2(2) & \cdots & x_2(n) \\ \vdots & \vdots & \ddots & \vdots \\ x_m(1) & x_m(2) & \cdots & x_m(n) \end{bmatrix}; (i = 1, 2, \dots, m \text{ ve } j = 1,2, \dots, n) \quad (6)$$

Step 2: Creating the reference series and comparison matrix

The reference series are created using the most ideal values of the alternatives for each criterion (Equation 7).

$$x_0 = \left(x_0(j)\right) \quad j = 1, 2, \dots, n \tag{7}$$

A comparison matrix is obtained by adding the created reference series to the decision matrix as the first line. Here, it is aimed to reach the series that is closest to the reference series among the alternatives.

Step 3: Normalization process and creating the normalization matrix

In this step, three different equations are used according to the quality of the purpose function of the series.

Equation (8) is used for the *"larger is better"* situation.

$$x_i^*(j) = \frac{x_i(j) - \min_j x_i(j)}{\max_j x_i(j) - \min_j x_i(j)} \tag{8}$$

The following equation (9) is used for the *"smaller is better"* situation.

$$x_i^*(j) = \frac{\max_j x_i(j) - x_i(j)}{\max_j x_i(j) - \min_j x_i(j)} \tag{9}$$

For the *"nominal is better"* situation, equation (10) is used. Here $x_{0b}(j)$ the optimal value is determined and is within the $\max_j x_i(j) \geq x_{0b}(j) \geq \min_j x_i(j)$ range.

$$x_i^*(j) = \frac{|x_i(j) - x_{0b}(j)|}{\max_j x_i(j) - x_{0b}(j)} \tag{10}$$

After the normalization processes, the decision matrix is converted into a normalization matrix (Equation 11).

$$X_i^* = \begin{bmatrix} x_1^*(1) & x_1^*(2) & \cdots & x_1^*(n) \\ x_2^*(1) & x_2^*(2) & \cdots & x_2^*(n) \\ \vdots & \vdots & \ddots & \vdots \\ x_n^*(1) & x_n^*(2) & \cdots & x_n^*(n) \end{bmatrix} \tag{11}$$

Step 4: Creating the absolute value table

By taking the absolute value of the difference between $x_0^*(j)$ and $x_i^*(j)$ (Equation 12), an absolute value table is created (Equation 13).

$$\Delta_{0i} = |x_0^*(j) - x_i^*(j)| \,;\, i = 1, 2, \ldots, m \text{ and } j = 1, 2, \ldots, n \tag{12}$$

$$\Delta_{0i} = \begin{bmatrix} \Delta_{01}(1) & \Delta_{01}(2) & \cdots & \Delta_{01}(n) \\ \Delta_{02}(1) & \Delta_{02}(2) & \cdots & \Delta_{02}(n) \\ \vdots & \vdots & \ddots & \vdots \\ \Delta_{0m}(1) & \Delta_{0m}(2) & \cdots & \Delta_{0m(n)} \end{bmatrix} \tag{13}$$

Step 5: Creating the gray relational coefficient matrix

The elements of the gray relational coefficient matrix are calculated by equation (14). ζ is the separator coefficient in this equation and is in the $[0,1]$ range.

$$\gamma_{0i}(j) = \frac{\Delta_{min} + \zeta\Delta_{max}}{\Delta_{0i}(j) + \zeta\Delta_{max}} \tag{14}$$

$$\Delta_{max} = \max_i \max_j \Delta_{0i}(j) \text{ and } \Delta_{min} = \min_i \min_j \Delta_{0i}(j)$$

Step 6: Calculating gray relational grades

In the *"Gray relational degree"* measure, which is the measure of the geometric similarity between x_i^* series and x_0^* reference series in a gray system, equation (15) is used when the criteria are of equal importance. Equation (16) is used to show different degrees of importance.

$$\Gamma_{0i} = \frac{1}{n}\sum_{j=1}^{n}\gamma_{0i}(j); \quad i = 1, 2, \ldots, m \tag{15}$$

$$\Gamma_{0i} = \sum_{j=1}^{n}[w_i(j).\gamma_{0i}(j)] \,; \quad i = 1, 2, \ldots, m \tag{16}$$

The magnitude of the calculated value indicates how the similarity between x_i^* series and x_0^* reference series is strong. When this value is 1, it is possible to say that the compared series are the same.

3.4. Spearman Rank Correlation Coefficient

Spearman rank correlation coefficient is used as a measure of the relationship between two variables. If the relationship between variables is not linear or the variables are not normally distributed, this nonparametric method is preferred. In the method implementation, firstly, each X and Y in the series $(X_1, Y_1), (X_2, Y_2), \ldots, (X_n, Y_n)$ are listed to obtain $R(X_i)$ and $R(Y_i)$ values. Then, the Spearman rank correlation coefficient (r_s) is calculated using the equations below (Spearman, 1904a; Spearman, 1904b; Hauke & Kossowski, 2011).

$$\sum d_i^2 = \sum_{i=1}^{n}[R(X_i) - R(Y_i)]^2 \tag{17}$$

$$r_s = 1 - \frac{6\sum d_i^2}{n(n^2-1)} \tag{18}$$

The coefficient lies in the range $[-1, +1]$ and, 1 and – 1 indicate that there is a complete relationship between X and Y. The value of 0 indicates that there is no relationship between these two pairs.

4. Empirical Results

The weights of environmental and social performance indicators obtained from Entropy Analysis are given in Table 1. Here, it is observed that the *"Population density"* indicator is in the first place with 0.2360. The second rank is *"Mammal species, threatened"* with 0.1899 and the third is *"Mortality rate, under-5"* with 0.1574.

The results of the environmental and social performance measurement performed with the Gray Relational Analysis method are given in Table 2. Table 2 shows that the highest performance score belongs to Australia with 0.8032. This is followed by Germany with 0.7837 and Canada with 0.7799. On the other hand, South Africa, Indonesia, and India are in the last three rows.

Table 1. Relative Importance of Indicators

Indicators	**Weights**
Population density (people per sq. km of land area)	0.2360
Mammal species, threatened	0.1899
Mortality rate, under-5 (per 1,000 live births)	0.1574
Terrestrial and marine protected areas (% of the total territorial area)	0.1322
Unemployment, total (% of the total labor force)	0.1049
Strength of legal rights index (0=weak to 12=strong)	0.0634
Population ages 65 and above (% of the total population)	0.0556
The proportion of seats held by women in national parliaments (%)	0.0421
The ratio of female to male labor force participation rate (%)	0.0158
Labor force participation rate, total (% of total population ages 15-64)	0.0027
Total	**1.0000**

Table 2. Environmental and Social Performance of G-20 Countries

Ranking	Country	Performance Score
1	Australia	0.8032
2	Germany	0.7837
3	Canada	0.7799
4	United States	0.7722
5	Saudi Arabia	0.7571
6	France	0.7541
7	Russian Federation	0.7416
8	United Kingdom	0.7287
9	Mexico	0.6947
10	Argentina	0.6873
11	Italy	0.6719
12	Brazil	0.6467
13	Turkey	0.6450
14	Japan	0.6431
15	Republic of Korea	0.6338
16	China	0.6214
17	South Africa	0.6171
18	Indonesia	0.5277
19	India	0.4986

The relationship between the environmental and social performance scores is depicted in Table 2 and the GDP per capita values have been found by calculating the Spearman rank correlation coefficient. As can be seen in Table 3, it is determined that there is a positive and significant relationship at the level of 81%.

Table 3. Correlation Analysis Results

Number of obs.	19
Spearman's rho	0.8070*
Prob > | t |	0.0000

*$p<0.001$

5. Conclusion

Today, social and environmental risks have taken priority over economic risks due to global problems such as climate change, decreasing natural resources, biological threats, epidemics, population growth, and migration. These facts constitute solid proof of the need for investigation of the relationship between environmental-social performance and economic performance, which are the main dimensions of sustainability.

In this study, it is aimed to investigate the relationship between environmental-social performance and GDP per capita for G-20 countries, which is one of the economic performance indicators. In the first stage, environmental and social performance indicators have been weighted by using the Entropy method. Findings show that *"Population density"*, *"Mammal species, threatened"* and *"Mortality rate, under-5"* are the three most important indicators.

In the second stage, the Gray Relational Analysis method has been used, based on the indicator weights determined by the Entropy method, to measure environmental and social performance. According to the results obtained, Australia, Germany, Canada, the United States, and Saudi Arabia come out on top. Whereas, Republic of Korea, China, South Africa, Indonesia, and India are at the bottom. Supporting this finding, Australia, the United States, Germany, and Canada are among the top five countries in the study of Küpeli and Alp (2018), which evaluates the renewable energy performance of G-20 countries with balanced performance weights method. On the other hand, South Africa, China, Indonesia, and India are among the five countries with the lowest performance. Moreover, in the study of Türe (2019) measuring the welfare levels of OECD countries, Australia is one of the countries with the highest performance.

In the final stage of the analysis, the relationship between environmental-social performance scores and the economic performance indicator GDP per capita values has been investigated with the Spearman correlation coefficient and it is determined that there is a strong positive relationship. The Spearman correlation coefficient used in the study does not give information about the causality of the variables, but only shows the direction and strength of the relationship between them. Therefore, this finding indicates that variables move in the same direction.

It would not be feasible to transfer resources for environmental and social performance without having sufficient economic capacity. Similarly, Cracolici (2010) emphasizes that a good level of economic dimension is the basic condition for achieving effective social-environmental performance. Adedoyin et al. (2020) reveal that R&D expenditures significantly affect environmental sustainability performance in their study based on EU countries between 1997-2014. Furthermore, Wang et al. (2020) conclude that ESG improvement positively affects economic growth. This positive effect is found to be more noticeable for countries with stronger incentives and laws to improve ESG performance.

The United Nations (UN) has adopted the Sustainable Development Goals by 2030 to increase environmental and social performance and ensure the common well-being of humanity (UN, [06.04.2020]). However, no information has been shared on where the resources, needed to achieve these goals, will come from. On the other hand, developing countries need significant financial support to reach the level of developed countries. In this framework, international institutions, especially the World Bank, United Nations Development Program (UNDP), should take economic initiatives to support the environmental and social performances of developing countries in particular.

This study has been carried out through common indicators representing the environmental and social performances of G-20 countries. It is anticipated that the scope of application will expand with the spread of data sharing on these indicators soon. In this context, it is expected that more variables will be used in practice and their results will be observed in different country groups.

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Appendix I: The List of Indicators

Indicator Name	Indicator Description
Terrestrial and marine protected areas (% of the total territorial area)	Terrestrial protected areas are totally or partially protected areas of at least 1,000 hectares that are designated by national authorities as scientific reserves with limited public access, national parks, natural monuments, nature reserves or wildlife sanctuaries, protected landscapes, and areas managed mainly for sustainable use. Marine protected areas are areas of intertidal or subtidal terrain—and overlying water and associated flora and fauna and historical and cultural features—that have been reserved by law or other effective means to protect part or all of the enclosed environment. Sites protected under local or provincial law are excluded.
Mammal species, threatened	Mammal species are mammals excluding whales and porpoises. Threatened species are the number of species classified by the IUCN as endangered, vulnerable, rare, indeterminate, out of danger, or insufficiently known.
Labor force participation rate, total (% of total population ages 15-64)	Labor force participation rate is the proportion of the population ages 15-64 that is economically active: all people who supply labor for the production of goods and services during a specified period (modeled ILO estimate).
Unemployment, total (% of the total labor force)	Unemployment refers to the share of the labor force that is without work but available for and seeking employment (modeled ILO estimate).
The ratio of female to male labor force participation rate (%)	Labor force participation rate is the proportion of the population ages 15 and older that is economically active: all people who supply labor for the production of goods and services during a specified period. The ratio of female to male labor force participation rate is calculated by dividing the female labor force participation rate by male labor force participation rate and multiplying by 100 (modeled ILO estimate).
Mortality rate, under-5 (per 1,000 live births)	The under-five mortality rate is the probability per 1,000 that a newborn baby will die before reaching age five, if subject to age-specific mortality rates of the specified year.
Population density (people per sq. km of land area)	Population density is midyear population divided by land area in square kilometers.
The proportion of seats held by women in national parliaments (%)	Women in parliaments are the percentage of parliamentary seats in a single or lower chamber held by women.
Strength of legal rights index (0=weak to 12=strong)	Strength of legal rights index measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending. The index ranges from 0 to 12, with higher scores indicating that these laws are better designed to expand access to credit.
Population ages 65 and above (% of the total population)	Population ages 65 and above as a percentage of the total population. The population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship.

Source: World Bank. DataBank. https://databank.worldbank.org/home [01.03.2020].

Appendix II: GDP per Capita Data of G-20 Countries

Ranking	Country	GDP per capita (current US$)
1	United States	62,794.59
2	Australia	57,373.69
3	Germany	47,603.03
4	Canada	46,232.99
5	United Kingdom	42,943.90
6	France	41,463.64
7	Japan	39,289.96
8	Italy	34,483.20
9	Republic of Korea	31,362.75
10	Saudi Arabia	23,338.96
11	Argentina	11,683.95
12	Russian Federation	11,288.87
13	China	9,770.85
14	Mexico	9,673.44
15	Turkey	9,370.18
16	Brazil	8,920.76
17	South Africa	6,374.03
18	Indonesia	3,893.60
19	India	2,009.98

Source: World Bank. DataBank. https://databank.worldbank.org/home [01.03.2020].