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RESEARCH ARTICLE

Green Economy in Sustainable Development: An Analysis for OECD Countries

Sürdürülebilir Kalkınmada Yeşil Ekonomi: OECD Ülkeleri İçin Bir Analiz

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ABSTRACT

The understanding of the green economy, which is seen as the main strategy of sustainable development, is considered a remedy to eliminate the concerns between environmental concerns and economic goals. Therefore, measuring and considering the performance of countries in the context of the green economy is important in terms of policies to be implemented. The aim of the study is to measure and evaluate the green economy performance of the 20 founding OECD countries. In this context, a green economy index covering the years 2014-2018 was calculated based on the numerical data of 23 variables, which are thought to represent three different dimensions of the green economy. The contributions of these criteria to the green economy were weighted with the SWARA Method, one of the multi-criteria decision techniques. Using the obtained criteria weights, the green economy performance scores of the countries were determined through the TOPSIS Method. According to the scores obtained, it can be stated that the green economy performances of the 20 founding OECD countries increased in the examined period. In this performance increase, positive developments in economic and social indicators have a large share.

Keywords: Sustainable development, Green economy, SWARA, TOPSIS, Green economy index
JEL Classification: Q01, Q56, C44

ÖZ

Sürdürülebilir kalkınmanın temel stratejisi olarak görülen yeşil ekonomi anlayışı, çevresel kaygılar ile ekonomik hedefler arasındaki endişeleri yok edecek bir çare olarak değerlendirilmektedir. O halde, ülkelerin, yeşil ekonomi bağlamında performanslarının ölçülmesi ve dikkate alınması uygulanacak politikalar açısından oldukça önemlidir. Çalışmanın amacı, 20 kurucu OECD ülkesinin yeşil ekonomi performansını ölçmek ve değerlendirmektir. Bu bağlamda, yeşil ekonominin üç farklı boyutunu temsil ettiği düşünülen 23 değişkene ilişkin sayısal verilerden hareketle 2014-2018 yılları arasını kapsayan bir yeşil ekonomi endeksi hesaplanmıştır. Bu kriterlerin yeşil ekonomiye katkısının

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ağırlıklandırılması, çok kriterli karar tekniklerinden SWARA Metodu kullanılarak yapılmıştır. Elde edilen kriter ağırlıklarından faydalanılarak TOPSIS Metodu aracılığıyla ülkelerin yeşil ekonomi performans skorları belirlenmiştir. Elde edilen skorlara göre, 20 kurucu OECD ülkesinde ele alınan dönemdeki yeşil ekonomi performansının arttığı ifade edilebilir. Bu performans artışında, ekonomik ve sosyal göstergelerdeki olumlu gelişmelerin payı büyüktür.

Anahtar kelimeler: Sürdürülebilir kalkınma, Yeşil ekonomi, SWARA, TOPSIS, Yeşil ekonomi endeksi
JEL Sınıflaması: Q01, Q56, C44

1. Introduction

When the destructive effects of economic growth-based policies on the environment and society were felt seriously, especially after the 1970s, classical growth and related policies began to be questioned. In the following period, the concept of sustainable development was defined with the Bruntland Report published by the World Commission on Environment and Development in 1987. This concept is defined as "development that meets today's needs without compromising the ability to meet the needs of future generations" (World Commission on Environment and Development, 1987). Sustainable development refers to a development that is viewed from a very wide perspective at the country level rather than a perspective that is stuck at the organizational level or at the business level (Urdan and Luoma, 2020).

The concept of sustainability, defined by the Bruntland Report, was discussed extensively at the United Nations Conference on Environment and Development. Therefore, it has been decided that indicators such as gross national product, resources owned, or pollution level, which are currently widely used as sustainability indicators, are insufficient. In order to obtain more accurate and objective results on sustainability, it was emphasized that more comprehensive sustainable development indicators should be developed that take into account the interaction between different sectoral, environmental, demographic, social, and developmental parameters (United Nations, 1992).

Sustainable development refers to a long-term approach that aims at a balance between these three dimensions: economic, social, and environmental dimensions. Sustainable development and its current extension, the green economy model are two basic concepts that have been put forward as a solution to overcome the economic, social, and ecological crisis that the world economy has fallen into and to maintain a safer life in the future. The concepts of sustainable development and green economy are not actually competing concepts that can be substituted for each other. The green economy is the complement of a sustainable life and growth-development processes in political, economic, social, and ecological terms.

The second section presents the theoretical framework including the concepts of sustainability, sustainable development, and green economy. Under this heading, the relevant concepts are explained in detail. In the third section, the sustainable development triangle, which states that each of the dimensions of sustainable development has its own driving forces and goals and that the inside and the sides of the triangle are as important as the corners, is discussed. In the fourth section, the concept of corporate sustainability, which emerged with the use of the concept of sustainable development at the level of companies, is mentioned. In the fifth section, titled measuring sustainable development, sustainable development indicators and green growth indicators are mentioned. In the sixth section, where the analytical study is presented, the green economy performance of 20 founding OECD countries is evaluated. In this context, a green economy index covering the years between 2014 and 2018 is calculated based on the numerical data related to 23 variables considered to represent three different dimensions of the green economy. The contribution of these criteria to the green economy was weighted by using the Step-Wise Weight Assessment Ratio Analysis (SWARA) Method, one of the Multi-Criteria Decision Methods (MCDM). By using the criteria weights obtained, the green economy performance scores of the countries were determined through the TOPSIS Method. The article ends with the conclusion section. It is thought that the study will contribute to the literature.

Looking at our literature review, it is possible to conclude that the number of studies evaluating the sustainability performance of countries with all dimensions is quite insufficient. In addition, most of these studies include examples of developing or developed countries. This study, which focuses on OECD countries and covers all dimensions of sustainable development performance, aims to fill this gap in the literature. Unlike other studies, the Multi-Criteria Decision-Making Method was used in this study. In our study, the SWARA Method, which is a subjective decision-making analysis based on expert opinion, was used. When we look at similar studies in the literature, we see that studies mostly focus on the economic dimension of sustainability performance (Sevgin and Kundakçı, 2017; Eyuboğlu, 2017; Ela, Doğan and Uçar, 2018; Koca and Tunca, 2019; Özbek and

Demirkol, 2019; Orhan, 2020). In these studies, sample countries are evaluated according to their economic performance using different analysis methods. Other sustainability dimensions such as environmental, social, governance, and financial are relatively less studied in the current literature.

2. Conceptual Framework

Concepts such as global warming, environmental pollution, and social poverty are the most important issues for the future of our world today. In the context of the rapid increase in population in the world, the danger of extinction of the natural environment has led to the discussion of these issues on international platforms. Especially since the second half of the 20th century, one of the concepts on the agenda of countries and companies is sustainability and sustainable development (Engin and Akgöz, 2013).

2.1. Sustainability and sustainable development

The concept of sustainability, which is one of the most frequently used concepts of the 21st century, is a participatory process that ensures the prudent use of the social, cultural, scientific, and natural resources of society and requires it to be respected (Gladwin, Kennelly and Krause, 1995).

The concept of sustainable development has been defined in different ways since its emergence. This situation caused the concept to become ambiguous. Economists stated that living standards should be maintained at a certain level, ecologists emphasized the concepts of biodiversity and ecological resilience, and sociologists stated that sociological ties and mutual relations within communities should be preserved. The concept of sustainable development, which emerged in the late 1980s, is a concept that will contribute to the development of countries in economic, social, and environmental issues. As a result of the production-oriented study of world countries and international large companies, the increase in poverty and injustice in income distribution in developing countries have led to the emergence of the concept of sustainable development. Even if the concept

of sustainable development is vague, it is still a very common term used by politicians and other people all over the world (Soubbotina and Sheram, 2000; Cole, 2006).

The concept of sustainability started to be used widely after it was stated in the report "Our Common Future", also called the Brundlant Report, published by the UN Environment and Development Commission in 1987. This report is important as it is the starting point for sustainable development to come to the fore both scientifically and politically. In this report, sustainability is defined as meeting the needs of the current generation without eliminating the ability of future generations to meet their own needs (IULA-emme, 1997; Al, 2019).

The sustainable development view in the Brundtland Report can be considered as a call for policies that take into account the need for economic growth and aim at maximum growth. In addition, two other important features of the concept are that the situation of the poor and disadvantaged is not endangered and that natural resources are preserved for the use of future generations. This concept brought a different perspective to economic development and revealed that quality is as important as quantity (Soussan, 1992). In this context, the concept of sustainable development has begun to be supported by governments, business circles, and economists. One of the most important reasons for this current to find broad support is the ozone hole over Antarctica, which was first identified in 1984. From the Japanese Antarctic Meteorological Research Institute, Dr. Shigeru Chubachi measured low ozone levels over Antarctica and discovered depletion in the ozone layer (Ohring, Boykov, Bolle, Hudson and Volkert, 2009). In addition to Chubachi, again in 1984, scientists from the British Antarctic Research determined that the examination in question was repeated every spring and explained that this negative situation was due to human activity (Farman, Gardiner and Shannklin, 1985).

Sustainable development was introduced on a global scale at the Rio Conference held in 1992. One year after this conference, the UN Commission for Sustainable Development was established. Therefore, ever since it has become an indispensable

part of the agenda of the countries. Following the adoption of sustainable development as the common goal of humanity for the 21st century, an action plan was created at the UN 1992 Rio Environment and Development Conference, also known as the Earth Summit, which sets out the principles and areas for environmental and development problems to achieve this goal (Barlas, 2013).

After the Rio Conference, the Johannesburg World Sustainable Development Summit was held in 2002. The aim of this summit was to implement the decisions taken in Rio and to solve the difficulties encountered in achieving the determined goals. In this context, two important decisions emerged from this summit. The first is the commitments made by governments and the issues that will be put into practice by governments as an action plan. The other is that the responsibilities do not belong only to governments, but that these responsibilities should be assumed by all stakeholders. Aiming to achieve concrete actions and results, the Johannesburg Summit recommends that commercial organizations improve the dialogue between businesses and the communities in which they operate and other stakeholders in order to make efforts to increase their environmental and social responsibilities. At the Leaders Summit in Johannesburg in 2002, after evaluating the developments and goals on Agenda 21, it was agreed at the Rio+20 Summit in Brazil in 2012 that despite global economic problems, adherence to Agenda 21 principles should be maintained and the responsibilities of the countries should be emphasized more strongly. In addition to the deterioration in ecosystems, this action plan, which draws attention to increasing poverty, hunger, and ignorance, aimed to prepare our world against the threats of the new century while drawing attention to the importance of global cooperation for the improvement of quality of life and the protection of ecosystems (Yalcin, 2016).

Despite all these developments, global trends towards sustainable development have slowed down considerably since the beginning of the 21st century. Sustainable development was considered only one of the obligations of states. In this context, a new way was needed because the measures implemented by governments in the field of environment and development became insufficient. The concept that meets this need is the green economy.

2.2. Green economy

Although there is no universal consensus in the definitions, there is a consensus on what the concepts of green economy and green growth mean. These concepts are often used synonymously with the concept of sustainable development or perceived as a cross-section of it (Bowen, 2012).

Green growth is the protection of natural assets to ensure the continuation of resources and environmental services that increase people's well-being, and in this context, the promotion of economic growth and development (OECD, 2011). Green growth, which is defined as the effectiveness of the use of natural resources, will both minimize pollution and its environmental effects and create a flexible environment against environmental disasters by revealing the role of natural capital and environmental management in the prevention of physical disasters (World Bank, 2012).

The concept of green economy is mainly based on the concept of sustainable development. Green growth refers to a growth process that can be applied according to the changing geographical and environmental conditions of the countries, that minimizes ecological risks, considers future generations without harming the environment, and includes a new economic growth paradigm for existing systems (Diniz and Bermann, 2012; Yılmaz, 2018). The concept of green growth, which emerged thanks to the 5th Environment and Development Ministerial Conference convened in 2005 has become a phenomenon known all over the world with the 2008 Global Crisis, which included social, ecological, and economic conflicts. At this conference, it was agreed to go beyond the sustainable development discourse and follow the green growth path (Kararach et al., 2018). In the 2011 report of the UN Environment Program, it is emphasized that the green economy has three main goals in the global sense. These are to contribute to the revival of the world economy, to increase employment and to protect the vulnerable in society, to shape the economy according to the sustainable growth model, to contribute to the elimination of poverty, to reduce the carbon dependency of economies and to slow down the deterioration in ecosystems

(UNEP, 2011). At the United Nations Conference on Sustainable Development Rio+20 held in 2012, it was confirmed that green growth is a strategy for achieving sustainable development (UNESCAP, 2012). In this context, it was agreed that the exit from the 2008 Global Crisis could be achieved with a new green arrangement (Allen and Clouth, 2012).

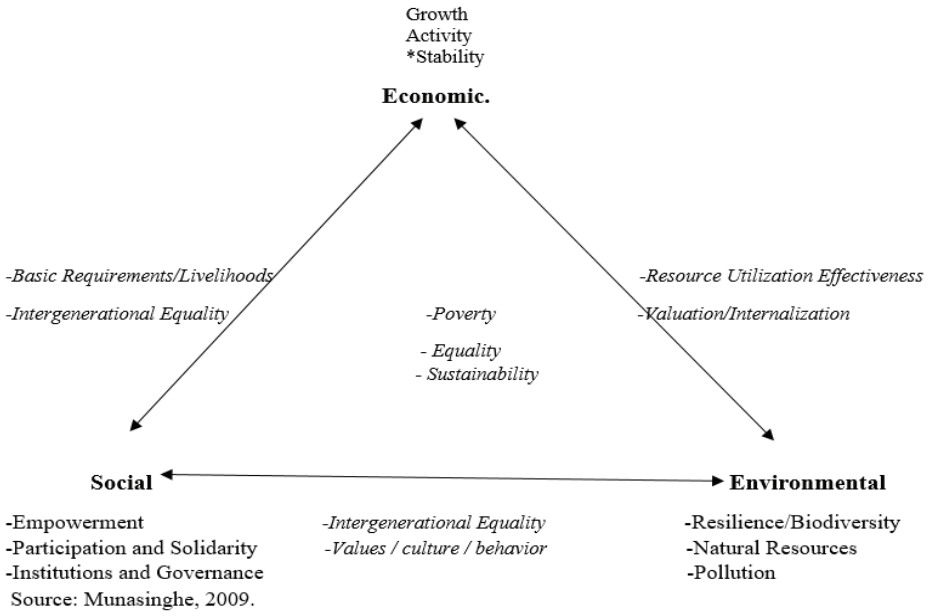
The green economy, which is defined as the sustainable innovation process that ensures sustainable socioeconomic development, is an institutional factor against socioeconomic and environmental challenges in the globalizing economy. The main purpose of the green economy, which establishes a very important link between the concepts of economic growth and environmental sustainability is to achieve increases in environmental quality and social inclusion with increases in investments and the economic growth process. The idea of a green economy is to correct the relations between negative externalities caused by uncontrolled economic growth and environmental problems, which are its natural consequences.

3. Sustainable Development Triangle

Munasinghe (2001) talked about a new framework called "Sustainomics", which was created with a transdisciplinary approach to achieve sustainable development. While the Sustainomics framework emphasizes focusing attention on sustainable development objectively and openly, avoiding the hegemony of any one discipline, this idea has been heavily resisted because of interdisciplinary rivalries. According to the basic idea of Sustainomics, it is essential that the economic, social, and environmental dimensions of sustainable development be addressed in a balanced and consistent manner. Also, the relative emphasis on traditional development versus sustainability needs to be balanced. In this context, while the South's priorities are concepts such as development, consumption, growth, combating poverty and justice, the concepts that the North focuses on are pollution, growth, and the unsustainability of population growth (Markandya, Harou, Bellu and Cistulli, 2002; Munasinghe, 1993, 2009; Yeni, 2014).

Figure 1 shows the basic elements of sustainable development and the connections between these elements according to the approach proposed by Munasinghe.

Figure 1. Sustainable Development Triangle



Source: Munasinghe, 2009.

Each area at the edges of the triangle has its own characteristics and goals. The economic dimension takes into account the enhancement of human well-being through increased consumption of goods and services; the environmental dimension focuses on maintaining the integrity and resilience of ecosystems; the social dimension emphasizes ensuring that people achieve their goals as individuals and groups, apart from enriching and strengthening human relations (Munasinghe, 2009).

4. Measuring Sustainable Development

Since the late1990s, many international organizations such as the EU (European Union), the European Statistical Office (Eurostat), the Organisation for Economic

Development and Cooperation (OECD), the United Nations Economic Commission for Europe (UNECE), and the World Bank have initiated various projects to detect sustainable development. Therefore, some countries that have conducted studies on sustainable development indicators have contributed to measuring sustainable development (UN, 2014).

The measurement of sustainable development may change as a result of each country and international organization using its own existing data specific to its structure. The OECD has taken into account the environmental, economic, and social framework as to how sustainable development can be measured.

4.1. Sustainable development indicators

Sustainable development indicators are variables that try to measure how much progress has been made in terms of sustainability and to what extent the goals have been achieved. Indicators are important tools that contribute significantly to environmental, economic, institutional, and socially sustainable development and in the decision-making process. Sustainable development indicators are carried out as indicator determination studies in various countries and international organizations. The focus of these studies is based on the indicator frameworks determined and developed by various international organizations such as the United Nations, OECD, World Bank (WB), and the European Union. The reason for the creation of sustainable development indicators is the demand to determine the sustainability of development. Sustainable development indicators are variables with a wide field of study, as they provide effectiveness between the necessary information and the decisions taken for planning, realization, success, and support (Karacan, 2013).

Sustainable development, which has economic, social, and environmental dimensions, is a concept that is difficult to evaluate objectively due to its multidimensionality. In this context, sustainable development should be carefully measured by methods appropriate to economic, social, and environmental variables. Discussions about objective measurement, monitoring, and evaluation

of sustainable development still continue today. Sustainable development indicators in the EU are ranked according to some important issues. These topics are: it consists of concepts such as socio-economic development, sustainable production and consumption, demographic changes, public health, climate change, energy, sustainable trade, natural resources, global partnership, and good governance (Eurostat, 2022). Table 1 shows the Eurostat Sustainable Development Indicator (SDG) set for the EU.

Table 1: EU SDG Indicator Set 2022

Goal	Indicator name
End poverty in all its forms everywhere.	People at risk of poverty or social exclusion; People at risk of income poverty after social transfers; Severe material and social deprivation rate (SMSD); People living in households with very low work intensity; In work at-risk-of-poverty rate; Housing cost overburden rate.
End hunger, achieve food security and improved nutrition and promote sustainable agriculture.	Obesity rate; Agricultural factor income per annual work unit (AWU); Government support to agricultural research and development; Area under organic farming; Use of more hazardous pesticides; Ammonia emissions from agriculture.
Ensure healthy lives and promote well-being for all at all ages.	Healthy life years at birth; Share of people with good or very good perceived health; Smoking prevalence; Standardised death rate due to tuberculosis, HIV, and hepatitis; Standardised avoidable mortality; Self-reported unmet need for medical care.
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.	Low achievement in reading, maths, and science; Participation in early childhood education by sex; Early leavers from education and training; Tertiary educational attainment Y25-34; Adult participation in learning; Share of adults having at least basic digital skills.
Achieve gender equality and empower all women and girls.	Physical and sexual violence to women; Gender pay gap in unadjusted form; Gender employment gap; Inactive population due to caring responsibilities; Seats held by women in national parliaments and governments; Positions held by women in senior management.
Ensure availability and sustainable management of water and sanitation for all.	Population having neither a bath, nor a shower, nor indoor flushing toilet in their household; Population connected to at least secondary wastewater treatment; Biochemical oxygen demand in rivers; Nitrate in groundwater; Phosphate in rivers; Water exploitation index, plus (WEI+).
Ensure access to affordable, reliable, sustainable, and modern energy for all.	Primary and final energy consumption; Final energy consumption in households per capita; Energy productivity; Share of renewable energy in gross final energy consumption; Energy import dependency; Population unable to keep home adequately warm.

Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.	Real GDP per capita; Investment share of GDP; Young people neither in employment nor in education and training; Employment rate; Long-term unemployment rate; Fatal accidents at work per 100 000 workers.
Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.	Gross domestic expenditure on R&D; R&D personnel; Patent applications to the European Patent Office (EPO); Air emission intensity from the industry; New name: Share of buses and trains in inland passenger transport - previously called 'Share of buses and trains in total passenger transport'; New name: Share of rail and inland waterways in inland freight transport - previously called 'Share of rail and inland waterways in total freight transport'.
Reduce inequality within and among countries.	Relative median at-risk-of-poverty gap; Income distribution - income quintile share ratio; Income share of the bottom 40 % of the population; Purchasing power adjusted GDP per capita; Gross disposable income of households per capita; Asylum applications.
Make cities and human settlements inclusive, safe, resilient, and sustainable.	Severe housing deprivation rate; Population living in households considering that they suffer from noise; Years of life lost due to PM2.5 exposure; Road traffic deaths; Settlement area per capita; Recycling rate of municipal waste.
Ensure sustainable consumption and production patterns.	Consumption of hazardous and non-hazardous chemicals; Material footprint; Average CO2 emissions per km from new passenger cars; Gross value added in environmental goods and services sector; Circular material use rate; Generation of waste excluding major mineral wastes.
Take urgent action to combat climate change and its impacts.	New name: Net greenhouse gas emissions - indicator previously called 'Greenhouse gas emissions'; Net greenhouse gas emission of the Land use, Land use change, and Forestry (LULUCF) sector; Climate-related economic losses; Contribution to the international 100bn USD commitment on climate-related expending; Population covered by the Covenant of Mayors for Climate and Energy signatories.
Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.	Marine protected areas; Estimated trends in fish stock biomass; Estimated trends in fishing pressure; Bathing sites with excellent water quality; Global mean surface seawater acidity; Marine waters affected by eutrophication.
Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.	Share of forest area; Soil sealing index; Estimated soil erosion by water - area affected by severe erosion rate; Terrestrial protected areas; Common bird index; Grassland butterfly index.

Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels.	Population reporting occurrence of crime, violence, or vandalism in their area; General government total expenditure on law courts; Perceived independence of the justice system; Corruption Perceptions Index; Population with confidence in EU institutions.
Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.	Official development assistance as a share of gross national income; EU financing to developing countries; EU imports from developing countries; General government gross debt; Shares of environmental taxes in total tax revenues; Share of households with high-speed internet connection.

Source: Eurostat, 2022.

Table 1 consists of 101 indicators structured according to the 17 SDGs. Except for SDG 13, each target has 6 indicators primarily attributed to it. Of the 101 indicators, 31 are used for multi-purpose, i.e., to monitor multiple SDGs. All indicators are grouped into sub-themes to underline mutual connections and highlight different aspects of each SDG.

4.2. Green growth indicators

Green growth indicators were stated in the interim report of the green growth strategy by the OECD in 2010. The fact that green growth indicators are expressed in the OECD report is important for realizing better green growth (OECD, 2010). Table 2 shows the green growth indicators in the Green Policy Platform.

Table 2: Green Growth Indicator Set

Socio-Economic Context	GDP per capita; Population; Population density; Unemployment; Gini index; Human Development Index.
Natural Asset Base	Average annual deforestation; Annual freshwater withdrawals per capita; Agricultural land; Terrestrial and marine protected areas.
Environmental and Resource Productivity	CO2 emissions per capita; Carbon productivity.
Environmental Quality of Life	Population exposure to air pollution (PM2.5); Access to improved sanitation; Access to improved water sources; Access to electricity.
Policies and economic opportunities	Fossil fuel consumption subsidies; Environmentally related tax revenue; Renewable electricity.
Wealth Changes	Changes in wealth per capita.

Source: Green Policy Platform, 2022

In Table 2, green growth indicators of the world countries gathered under six headings are presented. The OECD's study of green growth indicator sets covers data in the above-mentioned areas between the years 1990 and 2015.

5. Method and Data Set

Policy makers/decision-makers can make the best decisions with valid and reliable information. This requirement reveals the importance of determining the variables and their weights in the decision problem. Due to the nature of the decision problem, it is necessary to produce an index/performance value for the whole problem by making use of many variables and to make a decision as a result of this value.

A green economy can be understood as an economy where environmental, economic, and social policies and innovations enable society to use resources efficiently and increase human well-being in an inclusive way (EEA, 2012). This study aims to measure the green economy performance of the 20 founding OECD countries (Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States) by using annual data from 2014-2018. Based on the study of Nahman, Mahumani and De Lange (2016), 23 variables were determined within the framework of 3 main headings: economy, social, and environment. The variables and sources used in the study are given in Table 3.

Table 3: Variables Used in the Study

	Variable	Symbol	Source
Economic Indicators	GDP (constant 2015 US$)	EC1	World Development Indicators (WDI)
	GDP per capita (constant 2015 US$)	EC2	WDI
	Gross fixed capital formation (% of GDP)	EC3	WDI
	Agriculture, forestry, and fishing, value added (% of GDP)	EC4	WDI
	Consumer price index (2010 = 100)	EC5	WDI

Social Indicators	Life expectancy at birth, total (years)	SO1	WDI
	Mortality rate, infant (per 1,000 live births)	SO2	WDI
	School enrolment, primary (% gross)	SO3	WDI
	Gini index	SO4	OECD Data
	Access to electricity (% of population)	SO5	WDI
	People using at least basic drinking water services (% of population)	SO6	WDI
	Overall Global Gender Gap Index	SO7	WDI
	Human Development Index	SO8	United Nations Development Programme
	Final energy consumption in households per capita (Kilogram of oil equivalent (KGOE))	SO9	Eurostat
Environmental Indicators	Renewable energy (Total, % of primary energy supply)	EN1	OECD Data
	Fossil fuel energy consumption (% of total)	EN2	WDI
	Adjusted savings: natural resources depletion (% of GNI)	EN3	WDI
	Energy intensity level of primary energy (MJ/$2017 PPP GDP)	EN4	WDI
	Total greenhouse gas emissions (kt of CO2 equivalent)	EN5	WDI
	Forest area (% of land area)	EN6	WDI
	Arable land (% of land area)	EN7	WDI
	CO2 emissions (metric tons per capita)	EN8	WDI
	Renewable internal freshwater resources, total (billion cubic meters)	EN9	WDI

In the MCDM problem, the process of weighting the criteria has a great influence on the outcome of the problem. Weighting methods are of three types: subjective, objective, and a combination of the two. Subjective weighting methods such as AHP and SWARA analyse by using expert experience and thoughts. In contrast, objective weighting methods such as Entropy and Critic use the structure of the data. Then it uses mathematical methods and weights the criteria. This method does not take into account the opinions of experts. The advantages and disadvantages of these methods are left for another study. They are combination models that use both models together. In this study, the SWARA and Entropy methods from both methods were tried together. The methods gave similar results. SWARA was chosen because it is a method that takes expert

opinion into account. The objective weighting method was left to the literature because it took up too much space in the study.

After the variables were determined in the study, the SWARA method was used to weight these variables. For the production of a single index, the Technique for Order Preference by Similarity to Ideal Solutions / TOPSIS method was used.

Today, the development of many MCDM methodologies requires a significant amount of calculation to be taken into account (Figuera, Greco and Ehrgott, 2005). What needs to be done to make better decisions is to formulate and make thinking transparent in all its aspects. The decision-making process includes many criteria and sub-criteria used to rank the alternatives to a decision. These criteria may not be physical, but they may also not have the measures to serve as a guide for ranking alternatives. To make the best ranking among the alternatives, it is necessary to add all the criteria to the problem and to establish priorities within the criteria themselves. This is a very difficult task. For these purposes, the SWARA and TOPSIS methods used in the research are briefly explained in the following sections.

5.1. SWARA method

To evaluate dispute resolution methods in terms of economic, social, etc. aspects, it is necessary to apply evaluation methods that can reveal solutions according to multiple qualities/criteria. The use of multi-criteria methods will be meaningful if the weight of one criterion is higher or lower than the other criterion. Therefore, criterion weights should be evaluated. SWARA ensures that the opinions of experts or disputed parties are included in the solution while calculating the importance of the criteria in the rational decision-making process. This method can be preferred especially in the practical applications of alternative dispute resolution (Keršulienė and Turskis, 2011). In this study, the SWARA method was preferred because it is easy to apply and provides convenience in terms of first making a criterion ranking**.** SWARA has four main sets of regulations and procedures. In the first step, experts are asked to rank the criteria from the most important to the least important. In this study, ten expert opinions were consulted and the criteria were listed in Table 4.

Table 4: Ranking of Expert Criteria by SWARA Method

No	Criteria	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	GEOMEAN	Avr.	Ranking
1	Economy	1	1	3	1	1	3	3	2	1	1	1.49	1.70	1
2	Social	2	3	2	3	2	2	2	3	2	2	2.26	2.30	3
3	Environment	3	2	1	2	3	1	1	1	3	3	1.78	2.00	2
1.E:10.E = Expert criterion ranking Avr. = Arithmetic Average GEOMEAN = Geometric mean														

Expert opinions were used in the calculation of Table 4. This table shows the ranking of the importance of the three main criteria of a sustainable economy. In the next stage, the experts were asked to express their relative significance levels as a percentage for each criterion, starting from the second criterion. For this, the j. criterion is compared with the j-1 th criterion. This value is called the sj value, the percentage of importance of comparisons between criteria. Table 5 shows the sj values.

Table 5: Results of the 1st Expert SWARA Method

No	Criteria	Order of Importance	sj	kj	qj	SWARAwj
1	Economy	1	-	1	1	0.41
2	Social	2	0.3	1.3	0.77	0.31
3	Environment	3	0.1	1.1	0.7	0.28

The coefficient kj as the factor that affects the determination of the result from the sj value, which is the percentage of importance between the criteria, is created as in Equation (1).

The coefficient kj as the factor that affects the determination of the result from the sj value, which is the percentage of importance between the criteria, is created as in Equation (1).

$$k_j = \begin{cases} 1 & j = 1 \\ s_j + 1 & j > 1 \end{cases} \quad (1)$$

Here, qj recalculated weighting using kj coefficient was performed in the way shown by Equation (2).

$$q_j = \begin{cases} 1 & j = 1 \\ \frac{q_{j-1}}{k_j} & j > 1 \end{cases} \quad (2)$$

$$w_j = \frac{q_j}{\sum_1^n q_j} \quad (3)$$

Finally, the relative weights of the criteria are calculated as in Table 6 (the results are rounded to two digits). Table 7 shows the weights together with the sub-criteria. In the calculation of the green economy index, the Real GDP criterion is seen as more remarkable than the other criteria. As the main criterion, the environmental criterion weight (0.358) affects the green economy more.

Example: If the expert opinion in Table 5 is s_2=0.3, then k_2=1+0.3=1.03. $q_2 = \frac{q_{2-1}}{k_2} = 1/1.3 = 0.77$ and $w_2 = \frac{q_2}{\sum_1^n q_j} = 0{,}31$. These values are shown in Table 5.

Table 6: the SWARA Method Weighting Results of Experts

No	Criteria	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	GEOMEAN	Avr.
1	Economy	0.41	0.37	0.25	0.39	0.28	0.27	0.30	0.32	0.35	0.37	0.33	0.33
2	Social	0.31	0.33	0.28	0.28	0.34	0.32	0.33	0.27	0.33	0.33	0.31	0.31
3	Environment	0.28	0.30	0.47	0.34	0.38	0.41	0.37	0.41	0.32	0.30	0.35	0.36
1.E:10.E = Expert criterion ranking Avr. =Arithmetic Average GEOMEAN= geometric mean													

These criteria were used to create the index. According to Table 6, the most important criterion for calculating the sustainable economy index is the environmental criterion with 36%. In second place is the economy with an importance level of 33%. The social criterion took third place with an importance level of 31% (the figures are rounded).

Table 7: Weighting Results of All Criteria

Main criteria	Main Criterion Weight	No	Sub-Criteria	Avr.	Sub-Criteria Weight
ECONOMY	0.329	1	Real GDP per capita	0.234	0.077
		2	Real GDP	0.215	0.071
		3	Gross Fixed Capital Formation	0.199	0.066
		4	Inflation	0.166	0.055
		5	Value Added of Agriculture	0.185	0.061
SOCIAL	0.312	1	Life expectancy at birth	0.121	0.038
		2	Infant Mortality	0.109	0.034
		3	Net Schooling Rate	0.111	0.035
		4	Gini coefficient	0.119	0.037
		5	Electrical Access	0.095	0.030
		6	Utilization of Drinking Water Services	0.135	0.042
		7	Gender inequality index	0.097	0.030
		8	Human development index	0.129	0.040
		9	Final energy consumption in households per capita	0.083	0.026
ENVIRONMENT	0.358	1	Total Greenhouse Gas Release	0.131	0.047
		2	CO_2 Emissions	0.122	0.044
		3	Renewable Energy	0.136	0.049
		4	Fossil Fuel Energy Consumption	0.123	0.044
		5	power density	0.083	0.030
		6	Depletion of natural resources	0.112	0.040
		7	Renewable water sources	0.122	0.044
		8	Forest land	0.095	0.034
		9	Arable land	0.077	0.027

Note: Rounded in figures

In Table 7, the sub-criteria used to produce the sustainable economy index were weighted according to the SWARA method. Then the main criterion weights were also processed. The weight of the sub-criterion together with the main criterion was calculated. According to these calculations, the most important criterion for producing the index is the Real GDP Per Capita sub-criterion of the main criterion of the economy with 0.077. Only when the ranking is made between the sub-criteria, does the Real GDP Per Capita sub-criterion come in first place again.

5.2. TOPSIS method

When making or deciding on a selection/ranking/index of available options, a decision maker often must consider different aspects of available solutions, both in terms of potential benefits and costs. To support decision-makers, MCDM techniques are used to select the best solution in many respects. There are many MCDM methods such as AHP, ELECTRE, PROMETHEE, VIKOR, or TOPSIS. The TOPSIS method was used in this study. The TOPSIS method is based on the logic that the alternatives in the problem should have the smallest geometric distance from the positive ideal solution point and the non-ideal solution should have the largest distance by being at the bottom point. The ideal solution consists of all the best criterion values available, and the non-ideal solution consists of the worst of all achievable criterion values.

As in every MCDM method, the TOPSIS method starts with the decision matrix (Table 8) created between alternatives and criteria and continues with normalization (Table 9).

Table 8: TOPSIS Method Decision Matrix

	K1	K2	...	Kn
A	f11	f12	..	f1n
B	f21	f22	..	f2n
...	...	...	...	...
Z	fm1	fm2	..	$F_{(mn)}$ =

The normalization of the decision matrix and the creation of the normalized decision matrix specified in Table 9 are performed with the form in Equation (3).

$$r_{ij} = \frac{f_{ij}}{\sqrt{\sum_i^m f_{ij}^2}} \tag{3}$$

Table 9: TOPSIS Method Normalized Decision Matrix

	K1	K2	...	Kn
A	r11	r12	..	r1n
B	r21	r22	..	r2n
...	...	...	...	...
Z	rm1	rm2	..	rmn

In the next step, a weighted decision matrix is created based on expert opinion or using criteria weights determined by another MCDM method such as AHP or other methods.

$$v_{ij} = w_j r_{ij} \tag{4}$$

In Table 10, the weighted decision matrix is given.

Table 10: TOPSIS Method Weighted Decision Matrix

	K1	K2	...	Kn
A	v11	v12	..	v1n
B	v21	v22	..	v2n
...	...	...	...	...
Z	vm1	vm2	..	vmn

Using the weighted decision matrix, the positive ideal solution is $V^* = \{V_1^*, V_2^*, V_3^*, \dots, V_N^*\}$ and the negative ideal solution is $V^- = \{V_1^-, V_2^-, V_3^-, \dots, V_N^-\}$ values are obtained. Here:

$$V^* = \left\{\left(\underset{i}{maksV_{ij}}, j \in I'\right), \left(\underset{i}{minV_{ij}}, j \in I''\right)\right\}$$
$$V^- = \left\{\left(\underset{i}{minV_{ij}}, j \in I'\right), \left(\underset{i}{maksV_{ij}}, j \in I''\right)\right\} \tag{5}$$

I'= When showing that the problem is utility oriented
I''= Indicates that the problem is cost-oriented.

By calculating the n-dimensional Euclidean distance, the separation measurement values are calculated in the form in equation (6).

$$S_i^* = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^*)^2}$$

$$S_i^- = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^-)^2} \quad (6)$$

The ratio of the negative ideal solution deviation to the total deviation is called the measure of proximity to the ideal solution C_i^*. The relative proximity of an A_i alternative to the ideal solution of A* is defined in equation (7).

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^*}$$

$$0 \leq C_i^* \leq 1 \; ve \; i = \{1,2,3, \dots, m\} \quad (7)$$

If Ai=A*, then Ai=A-. If the proximity measure is close to 1, it will be determined that alternative Ai is close to the ideal solution, and if it is close to zero, it is close to the negative ideal solution.

6. Results

In this study, the green economy performances of the 20 founding OECD countries between 2014-2018 were evaluated. In Table 11, a green economy index consisting of a total of 23 variables belonging to five economic, nine social, and nine environmental dimensions, which are the sub-dimensions of a sustainable economy, was created. According to the index scores obtained, it can be said that the green economy performance of six countries including the USA (1), Luxembourg (6), Denmark (7), Sweden (8), Germany (9), and Switzerland (10) has not changed. Table 12 shows the five-year green economy index ranking of OECD states. 2015 was the year when the rankings changed the most. Considering Turkey in Table 11, although the country score ranks second among OECD countries according to the economy and social criteria, it ranked twelfth in the environmental criteria. While its total score was in second place in 2014, it was in third place in 2015 as a result of the poor environmental criteria.

Table 11: TOPSIS Scores of the Green Economy Index of States

Countries	2014	2015	2016	2017	2018
Austria	0.227757	0.19206	0.197311	0.198984	0.2006
Belgium	0.21108	0.177911	0.181071	0.181446	0.188848
Ecuador	0.354427	0.391909	0.395626	0.404425	0.407627
Denmark	0.261567	0.22116	0.227898	0.232253	0.232923
Italia	0.225151	0.186486	0.189087	0.195632	0.205744
Germany	0.246874	0.206321	0.210892	0.215262	0.217647
Greece	0.214164	0.191204	0.192371	0.202659	0.2031
Iceland	0.332209	0.327831	0.328964	0.318499	0.34289
Ireland	0.198081	0.168228	0.185589	0.18334	0.184118
Italy	0.211683	0.17255	0.172346	0.177063	0.182304
Luxembourg	0.266122	0.240321	0.242745	0.244656	0.243557
Netherlands	0.170733	0.184255	0.18636	0.191302	0.195304
Norway	0.345176	0.297056	0.307466	0.306538	0.307308
Portugal	0.194005	0.14394	0.148343	0.151197	0.158331
Spain	0.212011	0.168147	0.173066	0.17617	0.18559
Sweden	0.250563	0.21337	0.215742	0.220064	0.220534
Switzerland	0.241655	0.201462	0.204415	0.204998	0.21252
Turkey	0.358852	0.355983	0.352489	0.349847	0.349903
United Kingdom	0.231057	0.183929	0.188659	0.192877	0.19804
United States	0.516594	0.504243	0.506617	0.512983	0.528211

In Table 11, the Green Economy Indexes of the OECD Countries were calculated by the TOPSIS method for the years 2014-2018. The United States has become the first country with a green economy for 5 consecutive years. However, in Table 13, in terms of the social criteria used in the index calculations, the United States is seen in third place. This shows that the United States is lagging behind Canada and Turkey in terms of social indicators.

Table 12: TOPSIS Ranking of the Green Economy of OECD Countries

Countries	2014	2015	2016	2017	2018
Austria	12	11	11	12	13
Belgium	17	16	17	17	16
Ecuador	3	2	2	2	2
Denmark	7	7	7	7	7
Italia	13	13	13	13	11
Germany	9	9	9	9	9
Greece	14	12	12	11	12
Iceland	5	4	4	4	4

Ireland	18	18	16	16	18
Italy	16	17	19	18	19
Luxembourg	6	6	6	6	6
Netherlands	20	14	15	15	15
Norway	4	5	5	5	5
Portugal	19	20	20	20	20
Spain	15	19	18	19	17
Sweden	8	8	8	8	8
Switzerland	10	10	10	10	10
Turkey	2	3	3	3	3
United Kingdom	11	15	14	14	14
United States	1	1	1	1	1

Table 12 shows the performance rankings of the countries according to the green economy index for 5 years. for five consecutive years, the USA, Denmark, Sweden, and Switzerland have always been calculated in the same order. other countries, on the other hand, have shown bumpy performance.

Table 13: Scores of OECD Countries in 2015 and Green Economy Index

Countries	Economy		Social		Environment		The year 2015	
	Score	ROW	Score	ROW	Score	ROW	index	ROW
Austria	0.160002	18	0.212161	9	0.204018	9	0.19206	11
Belgium	0.145055	19	0.21197	10	0.176709	15	0.177911	16
Ecuador	0.203178	8	0.606785	1	0.365763	3	0.391909	2
Denmark	0.164175	17	0.23592	5	0.263384	5	0.22116	7
Italia	0.192026	12	0.180358	15	0.187074	11	0.186486	13
Germany	0.195227	11	0.204106	12	0.219631	7	0.206321	9
Greece	0.233771	7	0.176299	17	0.163543	18	0.191204	12
Iceland	0.334042	3	0.309756	4	0.339695	4	0.327831	4
Ireland	0.196388	10	0.18367	14	0.124625	20	0.168228	18
Italy	0.17586	16	0.161002	18	0.180788	14	0.17255	17
Luxembourg	0.267738	4	0.233835	6	0.21939	8	0.240321	6
Netherlands	0.182742	15	0.177276	16	0.192747	10	0.184255	14
Norway	0.236818	6	0.223173	7	0.431177	2	0.297056	5
Portugal	0.139257	20	0.123831	19	0.168732	16	0.14394	20
Spain	0.197221	9	0.122916	20	0.184303	13	0.168147	19
Sweden	0.188208	13	0.207147	11	0.244754	6	0.21337	8
Switzerland	0.247768	5	0.220598	8	0.13602	19	0.201462	10
Turkey	0.390046	2	0.491576	2	0.186325	12	0.355983	3

United Kingdom	0.183421	14	0.203836	13	0.164528	17	0.183929	15
United States	0.630022	1	0.389522	3	0.493183	1	0.504243	1

The USA is first in the Green Economy Index. This first place is the weighted sum of the economic, social, and environmental indices. However, in this first place, the USA is in third place among OECD countries when it is examined alone in the social field. He needs to improve himself in this area. Turkey is in third place in total. However, it ranks quite twelfth in environmental criteria. This is far behind. It shows the existence of environmental problems in Turkey.

7. Conclusion

The concepts of sustainability, sustainable development, and green economy constitute the main research area of the study. The concept of sustainable development was first brought to the agenda at the 1972 Stockholm Conference and today it has become one of the most important issues of both the business world and the policies of the country. Sustainable development refers to the use of scarce resources by considering future generations. As a result of the meaning added by this concept, today's businesses are not seen as institutions that make a profit by producing and selling goods and services. They are also considered as beings sensitive to the problems of society and producing solutions. The concept of corporate sustainability emerged in the period when the role of institutions in sustainable development came to the fore. Institutional sustainability states that institutions should consider not only economic issues, but also environmental and social issues. According to the basic idea of sustainomics, the economic, social, and environmental dimensions of sustainable development must be handled in a balanced and consistent manner. Also, the relative emphasis on traditional development versus sustainability needs to be balanced. Therefore, some countries that have conducted studies on sustainable development indicators have contributed to measuring sustainable development. The measurement of sustainable development may change as a result of the use of its own data specific to the structure in which each country and international organization is located.

The OECD has taken into account the environmental, economic, and social framework as to how sustainable development can be measured.

The green economy performance was measured by using the data of the 20 founding OECD countries between the years 2014-2018. In this measurement, 23 variables were used within the framework of 3 main headings: economy, social and environment. After the variables were determined in the study, the SWARA method was used to weight these variables. In order to support decision-makers, the TOPSIS method, one of the MCDM techniques, was used to present the best solution in many respects. It has been shown that the TOPSIS scores obtained as a result of the calculations can be used to produce green economy indices. It has been shown that the TOPSIS scores obtained as a result of the calculations can be used to produce green economy indices.

While the performance rankings of six countries remained constant within a five-year period, the performances of other countries varied. According to the green economy performance ranking, while Greece was 14th among OECD countries in 2014, it rose to 12th in 2018. In the same period, Spain has experienced both declines and rises over the years. Spain's performance score, which was in fifth place, decreased until 2017 and regressed to 19th place, then improved again in 2018 and rose to 17th place.

A green economy should be given importance for sustainable growth. Therefore, it is imperative that developed and developing countries take steps by thinking about future generations. Countries can increase the green economy index score by making improvements in environmental criteria as well as the development of economic and social criteria. Improvements to be made especially on energy will increase the index score. Improvements to be made in the energy criteria not only increase the environmental score but also can affect the economic and social scores indirectly or directly.

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