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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

EXAMINING GREEN GROWTH CONDITIONS AND ACHIEVEMENTS OF THE OECD COUNTRIES: A DESCRIPTIVE ANALYTICAL APPROACH

OECD ÜLKELERİNİN YEŞİL BÜYÜME DURUMLARININ VE İLERLEMELERİNİN İNCELENMESİ: TANIMLAYICI ANALİTİK BİR YAKLAŞIM

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Abstract

The Organisation for Economic Co-operation and Development (OECD) is the leading actor for green growth. The OECD has been taking important actions to promote, monitor, and support green growth. The main objective of this study is to analyze the green growth conditions and achievements of the OECD countries. The Green Growth Index 2022, proposed by the Global Green Growth Institute, is used for the analysis. 34 OECD countries are included in the analysis. The OECD countries are examined using the Green Growth Index, the dimensions and indicators of the Green Growth Index. This study uses a descriptive analytical approach to analyze green growth conditions and the achievement of OECD countries. The results show that OECD countries generally have high achievement levels in green growth. On the other hand, OECD countries show statistically significantly different achievement levels in the green growth dimensions. The main strength of OECD countries in achieving green growth is social inclusion and their main weakness is green economic opportunities. The selected OECD countries can be divided into 5 clusters. These clusters have different weaknesses and strengths in terms of green growth.
Keywords: Green Growth, OECD, Green Growth Index
JEL Classification: O43, O44, Q01, Q56

Öz

Ekonomik İşbirliği ve Kalkınma Teşkilatı (OECD) yeşil büyüme konusunda önde gelen aktördür. OECD yeşil büyümeyi teşvik etmek, izlemek ve desteklemek için önemli adımlar atmaktadır. Bu çalışmanın temel amacı, OECD ülkelerinin yeşil büyüme durumlarını ve ilerlemelerini analiz etmektir. Analiz için Küresel Yeşil Büyüme Enstitüsü tarafından önerilen Yeşil Büyüme Endeksi 2022 kullanılmıştır. Analize 34 OECD ülkesi dahil edilmiştir. OECD ülkeleri Yeşil Büyüme Endeksi, Yeşil Büyüme Endeksi'nin boyutları

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ve göstergeleri kullanılarak incelenmiştir. Bu çalışma, OECD ülkelerinin yeşil büyüme koşullarını ve başarılarını analiz etmek için tanımlayıcı analitik bir yaklaşım kullanmaktadır. Sonuçlar, OECD ülkelerinin yeşil büyüme konusunda genel olarak yüksek başarı seviyelerine sahip olduğunu göstermektedir. Öte yandan, OECD ülkeleri yeşil büyüme boyutlarında istatistiksel olarak önemli ölçüde farklı başarı düzeyleri göstermektedir. OECD ülkelerinin yeşil büyümeyi gerçekleştirmedeki temel gücü sosyal içerme, temel zayıflığı ise yeşil ekonomik fırsatlardır. Seçilen OECD ülkeleri 5 kümeye ayrılabilir. Bu kümeler yeşil büyüme açısından farklı zayıf ve güçlü yönlere sahiptir.
Anahtar Kelimeler: Yeşil Büyüme, OECD, Yeşil Büyüme Endeksi
JEL Sınıflandırması: O43, O44, Q01, Q56

1. Introduction

Ensuring a sustainable life on earth is one of the most important issues of our time. Individuals, companies, organizations, international agencies, policymakers, researchers, and countries must work together to ensure sustainability while striving for high prosperity. Thus, sustainable development has become one of the common focuses and goals of policy makers (Li et al., 2022). In promoting economic development, policymakers should take the necessary measures and guide economic actors to ensure the sustainability of natural resources (Munier, 2006). In this sense, many actors consider sustainable development a priority. Some companies are trying to adopt environmentally friendly practices and apply green techniques, such as reducing energy consumption, using renewable energy sources, and introducing green products or technologies (Albertini, 2013; Khan et al., 2020). In addition, some international organizations and agencies such as the United Nations (2015), the European Union (European Commission, 2010), the OECD (2011), the World Bank Group (2017) and the International Monetary Fund (IMF, 2020) are taking actions to promote, monitor and support the sustainable development of nations.

The main concerns of sustainable development are economic growth, social protection, and environmental quality protection (Bak et al., 2019). However, it is not easy to strike a balance between these components of sustainable development. For example, the acceleration of economic growth and industrialization promotes the extensive use of natural resources and traditional energy sources, which leads to waste and pollution (Dwivedi et al. 2022). High economic development and growth may result in overconsumption and neglect of resource efficiency (Coscieme et al., 2020; Eisenmenger et al., 2020). Therefore, there is a need to promote environmental practices for high-income countries (EEA, 2016; Pineiro-Villaverde & García-Álvarez, 2020). This led to the proposal for a new agenda: Green Growth. The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP, 2011) defines green growth as the process of greening the conventional economic system and a strategy to move towards a green economy. The OECD (2011a) defines green growth as "*fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies.*". While sustainable development seeks to incorporate environmental sustainability into economic strategies, green growth focuses on transforming the economic system into a green one (UNESCAP, 2011). Green growth provides new economic opportunities (Kasztelan, 2017a) and contributes to sustainable development by combining social and environmental protection with consideration of economic

development (Gavurova et al., 2021). Green growth is a more attractive approach for policymakers than traditional environmental protection approaches, as traditional approaches are often associated with an economic slowdown (Capasso, 2019). This aspect of traditional environmental protection approaches could be an obstacle to development. Green growth effectively reduces pressure on the environment (Capasso, 2019; Kasztelan, 2017a; Reilly, 2012) and is critical to achieving sustainable development (World Bank, 2012).

Over the last decades, the OECD countries have been among the fastest growing economies (Wang et al., 2020). However, fast economic growth may result in high damage to the environment. Thus, green growth must be the focus of countries. which prioritizes sustainable economic growth while minimizing resource use and carbon emissions (Arzova & Şahin, 2024). There are some studies focusing on measuring and analyzing green growth achievements of the OECD countries. Kim et al. (2014) used a total of 12 indicators to measure overall achievement of green growth of the OECD countries. Kasztelan (2017b) analyzed the level of green growth in some selected OECD countries using Hellwig's method based on 33 indicators. Bak et al. (2019) analyzed the green growth development of the OECD countries using the multi-dimensional correspondence analysis based on a total of 7 indicators. Koçak (2020) measured the dynamics of the green growth in the OECD countries using grey relational analysis based on a total of 22 indicators. Wang et al. (2020) compared the development trends of green growth in some selected OECD from 2004 to 2010 using green productivity approach. Ates and Derinkuyu (2021) evaluated the green growth performance of the OECD countries using the I-distance method based on a total of 11 indicators. Gavurova et al. (2021) analyzed the condition and development of the OECD countries using a total of 15 indicators. These studies mainly focused on measuring green growth performance of the OECD countries. Gavurova et al. (2021) used univariate and multivariate statistical approaches in evaluation green growth achievements of the OECD countries. Besides, Veysikarani and Akdağ (2024) analyzed the relationship between green future and prosperity in the OECD using The Green Future Index and the Legatum Prosperity Index. Tufail et al. (2024) analyzed the relationship between green finance and green growth for some selected OECD countries. There is a need for more efforts in understanding the level of achievements, challenges, needs, strengths, and weaknesses of OECD countries in relation to green growth. For this purpose, this study tries to enhance current knowledge using a descriptive analytical approach.

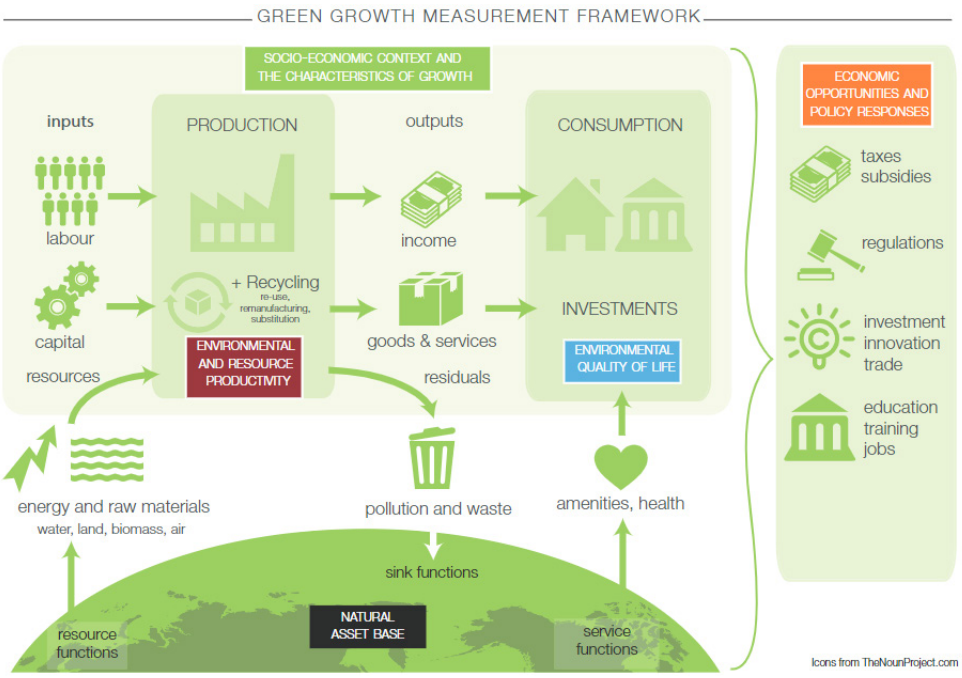
This study aims to analyze the green growth conditions and achievements of OECD countries. For this purpose, the Green Growth Index 2022 (Acosta et al., 2022) is used. First, the green growth achievements of some selected OECD countries were analyzed using a descriptive approach. Then, a cluster analysis is applied to the countries based on green growth indicators. The paper is structured into four main sections. The next section briefly introduces green growth efforts in the OECD. Then the methodological approach of the paper, including the sample, data, indicators, and methods, is explained. The results of the analysis are then presented in detail. The final section presents the conclusions and recommendations.

2. OECD Green Growth Strategy

In 2009, the OECD countries adopted the Declaration on Green Growth in which they stated that they intend to step up their efforts to pursue green growth strategies (OECD, 2009). The OECD argues that "green" and "growth" can go hand – in – hand in this declaration (OECD, 2009). Later, the OECD (2011a) launched the Green Growth Strategy, which contains concrete recommendations, guidelines, and measurement approaches to support countries' green growth efforts. The OECD (2011b, 2014, 2015, 2017) proposed some measurement tools and indicators to measure and monitor countries' green growth efforts and progress. The OECD created a framework for measuring green growth and proposed a set of indicators. These studies have since been updated. The OECD, which publishes studies on measuring and monitoring green growth, is the leading agency in the field of green growth (Hu et al., 2024; Kasztelan, 2017a; Kim et al., 2014; Šneiderienė et al., 2020). The OECD publishes its work on green growth as OECD Green Growth Studies. In its most recent report, the OECD identified 26 indicators to measure green growth and monitor progress in the following 4 main areas (OECD, 2017).

The Green Growth Measurement Framework is given in Figure 1 (OECD, 2017).

Figure 1: Green Growth Measurement Framework



Source: OECD (2017). *Green Growth Indicators 2017*. OECD Publishing, Paris. https://doi.org/10.1787/978.926.4268586-en

The production and consumption of the economy are at the heart of the OECD's approach to monitoring green growth. The OECD framework reflects a "network" concept (Kim et al., 2014), which describes the interactions between the economy, the natural asset base and policy action (OECD, 2017).

3. Methodology

3.1. Sample and Data

The main objective of the study is to analyze the green growth conditions and achievements of OECD countries. There are various proposals for measuring green growth. The most well-known proposals for measuring and monitoring green growth are the Green Growth Measurement Framework proposed by the OECD (2011b, 2014, 2015, 2017), the Measuring Progress Towards an Inclusive Green Economy proposed by the United Nations Environment Programme (UNEP, 2012) and the Green Growth Index proposed by the Global Green Growth Institute (Acosta et al., 2019). The latest Green Growth Index 2022 (Acosta et al., 2022) is used in this study. The framework of the Green Growth Index is shown in Table 1.

Table 1: Indicator Framework for the Green Growth Index (2022)

Index	Dimensions (n=4)	Indicator Categories (n=16)	# of Indicators (n=40)
Green Growth Index	Efficient and Sustainable Resource Use	EE – Efficient and Sustainable Energy	3
		EW – Efficient and Sustainable Water Use	3
		ME – Material Use Efficiency	3
		SL – Sustainable Land Use	3
	Natural Capital Protection	BE – Biodiversity and Ecosystem Protection	3
		CV – Cultural and Social Value	3
		EQ – Environmental Quality	3
		GE – Greenhouse gas Emissions Reduction	3
	Green Economic Opportunities	GJ – Green Employment	1
		GN – Green Innovation	1
		GT – Green Trade	1
		GV – Green Investment	1
	Social Inclusion	AB – Access to Basic Services and Resources	3
		GB – Gender Balance	3
		SE – Social Equity	3
		SP – Social Protection	3

Source: Acosta, L.A., Nzimenyera I., Sabado Jr., R., Munezero, R.M., Nantulya, A., Shula, K., Quiñones, S.G.L., Luchtenbelt, H.G.H., Czvetkó, T., Lee, S. & Adams, G.P. (2022). *Green Growth Index (2022) – Measuring performance in achieving SDG targets*. GGGI Technical Report No. 27, Green Growth Performance Measurement Program, Global Green Growth Institute (GGGI), Seoul, South Korea. https://greengrowthindex.gggi.org/wp-content/uploads/2023/02/2022-Green-Growth-Index-1.pdf

The Global Green Growth Institute (GGGI) uses 4 dimensions to calculate an aggregated Green Growth Index (GGI) for countries. These dimensions are efficient and sustainable resource use, natural capital protection, green economic opportunities, and social inclusion. These dimensions are calculated using 16 indicator categories, and a total of 40 indicators are calculated. (Table 1). The GGI, dimensions and indicator categories are scored on a scale of 1 to 100, with a high score indicating high performance (Acosta et al., 2022). The GGI uses a very high number of indicators for all countries. This makes it possible to compare countries and country groups with the whole world. It also has a reliable methodological background. For these reasons, the GGI is used to examine OECD countries in terms of green growth achievements and conditions. A total of 39 OECD countries are included in the GGI data. However, 5 of these countries (Czechia, South Korea, Slovak Republic, Türkiye, and United States of America) were excluded from the analysis due to missing data. In conclusion, 34 OECD countries are included in the analysis.

3.2. Method

This study uses a descriptive analytical approach to analyze green growth conditions and achievements of OECD countries. Descriptive analytics helps decision makers to understand the past and current conditions of the units (Bayrak, 2015; Delen & Demirkan, 2013; Kunc & O'Brien, 2019). Therefore, this study uses the descriptive analytics approach to identify the current conditions and analyze the achievement level of OECD countries in terms of green growth. Descriptive analytics mainly involves summarizing and visualizing data. In this sense, some summary measures, charts, and graphs are used to analyze the Green Growth Index and its components for the selected OECD countries. In addition, cluster analysis is used to identify differences and similarities between the countries by classifying the OECD countries based on green growth achievement level. The K-Means algorithm is used to classify the OECD countries.

4. Results

Green growth conditions and achievements of OECD countries are analyzed in two main steps. In the first step, the green growth index and the sub-indices of the green growth index are examined. The average scores of these indices were compared using a descriptive statistical approach. Index-based and country-based comparisons were made in order to show the current conditions and achievements of the countries. In the second step, the selected OECD countries were clustered based on the Green Growth indicators using the k-means clustering method. The main purpose of applying cluster analysis is to identify similarities and differences in green growth achievement of the countries.

4.1. Green Growth Achievements of the OECD Countries

In the first step, the achievements of OECD countries in terms of green growth are examined. The average index scores of the OECD countries and the world average are shown in Table 2 on the basis of the GGI and the dimensions of green growth.

Table 2: OECD and World Comparison in terms of Green Growth (2022)

Measure	OECD Average	World Average
GGI – Green Growth Index	64.83	55.02
ESRU – Efficient and Sustainable Resource Use	63.58	56.65
NCP – Natural Capital Protection	72.01	63.03
GEO – Green Economic Opportunities	45.04	40.78
SI – Social Inclusion	87.20	65.45

While the global GGI average is 55.02, the OECD average is 64.22 in 2022. The OECD averages are higher than the global averages for all dimensions of the GGI. OECD countries appear to have different achievement levels in the green growth dimension. To test whether the achievement levels of the countries in the green growth dimensions are significantly different, the Friedman test was applied. The results of the Friedman test are shown in Table 3.

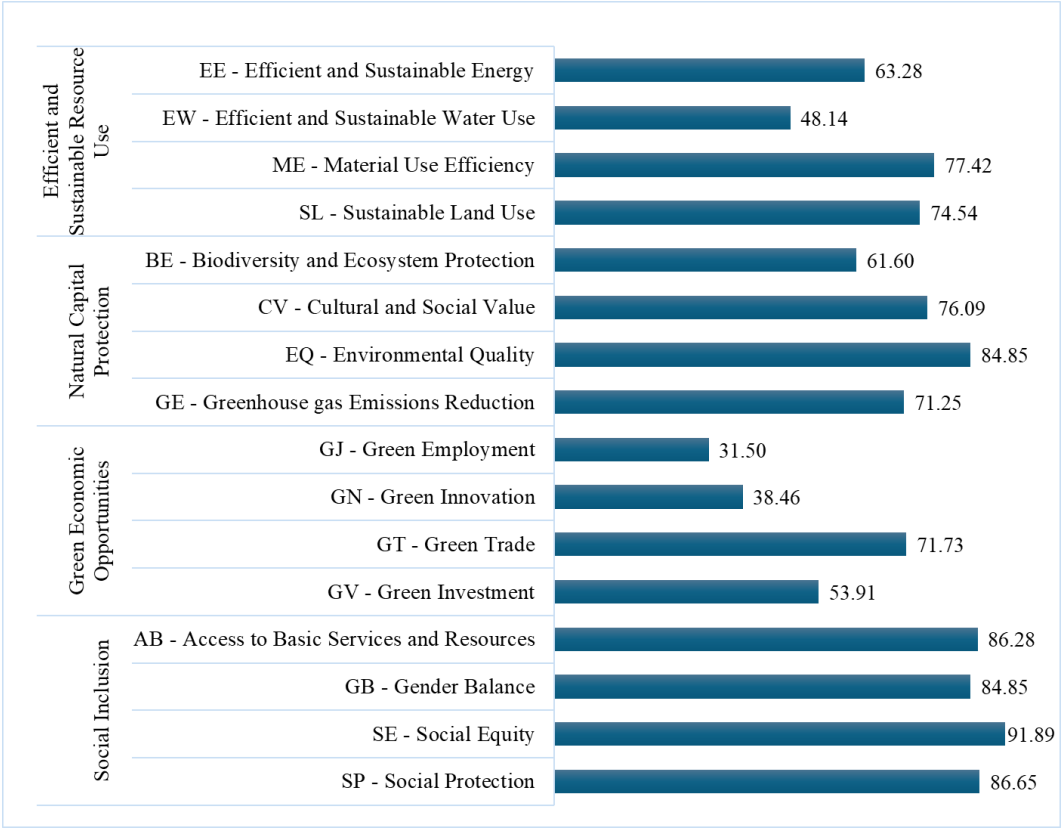
Table 3: Comparison of Green Growth Dimension Achievements in the OECD

Friedman Test Results			Pairwise Comparisons (Durbin-Conover)		
χ^2	df	p-value	Compared Variables	Test Statistic	p-value
91.7	3	< 0.001	ESRU – NCP	7.62	< 0.001
			ESRU – GEO	13.51	< 0.001
			ESRU – SI	20.44	< 0.001
			NCP – GEO	21.13	< 0.001
			NCP – SI	12.82	< 0.001
			GEO – SI	33.95	< 0.001

The results of the Friedman test and the pairwise comparison (Table 3) show that the OECD countries have significantly different achievement levels in the dimensions of green growth. The OECD has the highest achievement in the social inclusion dimension ($\bar{x}_{SI}$ = 87.2). The second highest achievement level belongs to natural capital protection ($\bar{x}_{NCP}$ = 72.01), and the third highest achievement level belongs to efficient and sustainable resource use ($\bar{x}_{ESRU}$ = 63.58). On the other hand, the OECD has the lowest achievement in green economic opportunities ($\bar{x}_{GEO}$ = 45.04). The green economic opportunities dimension is also the least achieved green growth dimension in the world ($\bar{x}$ = 40.78). Therefore, the OECD countries need to prioritize green economic opportunities and efficient and sustainable resource use for green growth.

Average green growth indicator category scores are given in Figure 2.

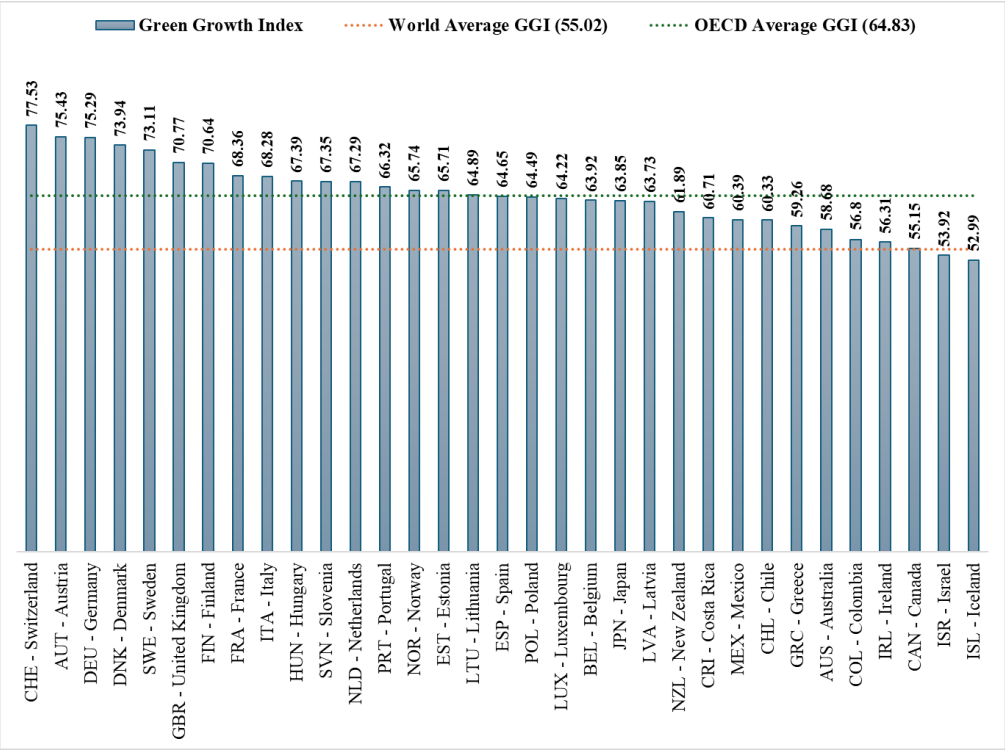
Figure 2: Green Growth Indicator Achievement of the OECD Countries



OECD countries have achieved very high levels of social inclusion indicators. Among the social inclusion indicators and the overall indicators, the highest score belongs to social equity ($\bar{x}$ = 91.89) indicator. In addition to the social inclusion indicators, OECD countries have a very high achievement in the environmental quality ($\bar{x}$ = 91.89), an indicator of the natural capital protection. OECD countries have the lowest scores for green employment ($\bar{x}$ = 31.5), green innovation ($\bar{x}$ = 38.46), efficient and sustainable water use ($\bar{x}$ = 48.14), and green investment ($\bar{x}$ = 53.91) respectively. Green employment, green innovation, and green investment are green economic opportunity indicators. Therefore, we can say that the most important obstacle in achieving green growth is green economic opportunity for OECD countries. In achieving green growth, the main strength of OECD countries is social inclusion, and their main weakness is green economic opportunities.

Each of the OECD countries' green growth indexes are given in Figure 3.

Figure 3: Green Growth Index Score of the OECD Countries



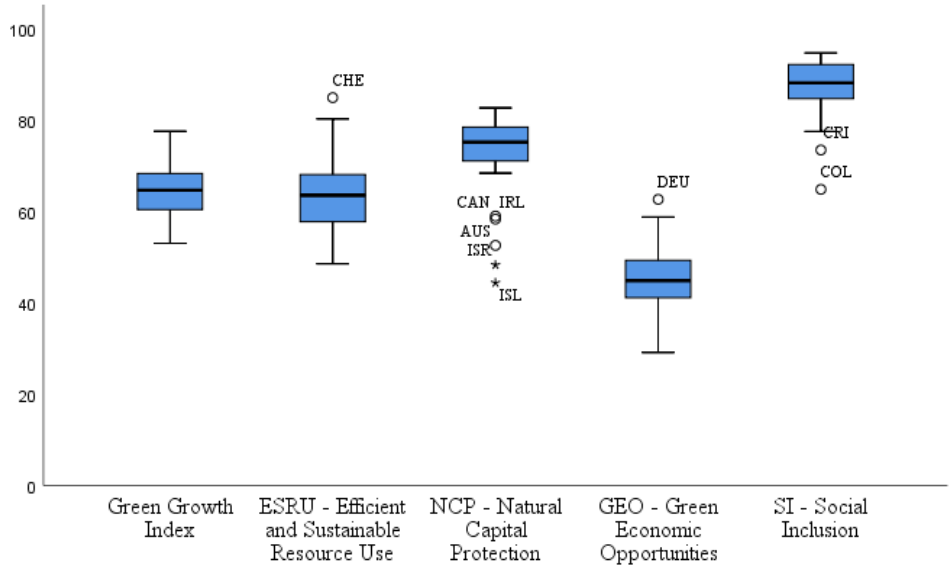
Among the OECD countries, Switzerland (score = 77.53), Austria (score = 75.43), Germany (score = 75.29), Denmark (score = 73.94) and Sweden (score = 73.11) have the highest green growth index scores. Besides, these countries are also the top 5 countries based on the green growth index. On the other hand, Iceland (score = 52.99), Israel (score = 53.92), and Canada (score = 55.15) have the lowest green growth index scores. Iceland and Israel have lower green growth index scores than the world average ($\bar{x}$ = 55.02). The remaining 32 countries have higher green growth index scores than the world average.

Among the OECD countries, Switzerland (score = 77.53), Austria (score = 75.43), Germany (score = 75.29), Denmark (score = 73.94) and Sweden (score = 73.11) have the highest scores on the green growth index. These countries are also in the top 5 of the green growth index. On the other hand, Iceland (score = 52.99), Israel (score = 53.92) and Canada (score = 55.15) have the lowest green growth index scores. Iceland and Israel have a lower green growth index score than the world average ($\bar{x}$ = 55.02). The remaining 32 countries have higher green growth index scores than the world average.

4.2. Clustering the OECD Countries based on Green Growth Indicators

Each of the OECD countries may have different conditions and achievement levels in terms of green growth. To identify these differences, countries need to be examined based on each green growth dimension and indicator. The distribution of the green growth index and the dimensions are shown in Figure 4.

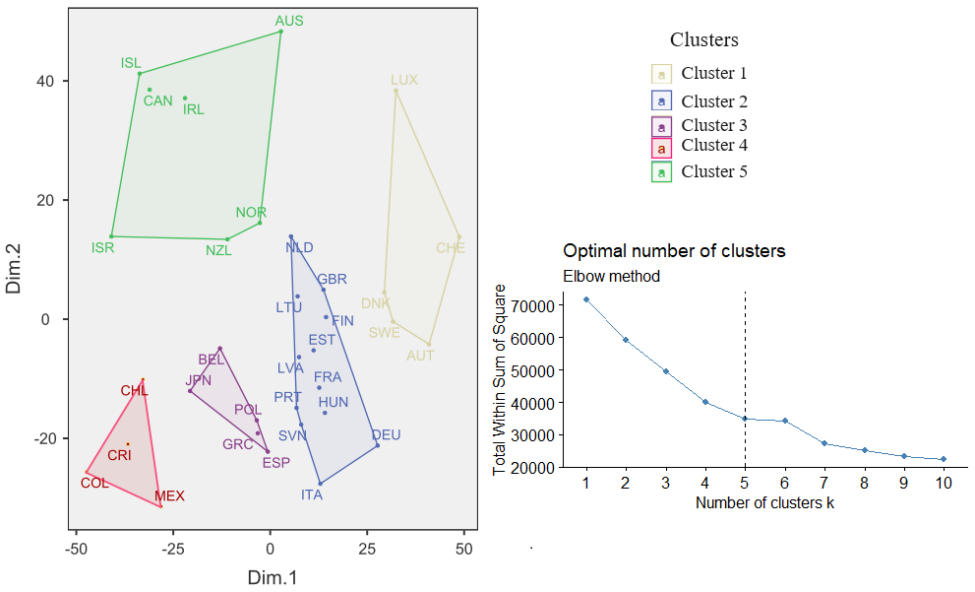
Figure 4: Distribution of Green Growth Achievement of the OECD Countries



The OECD countries appear to be similar in terms of the green growth index. However, these countries perform differently in the dimensions of green growth. Switzerland (CHE) shows a much better achievement in efficient and sustainable resource use compared to the other OECD countries. Iceland (ISL), Israel (ISR), Australia (AUS), Canada (CAN) and Ireland (IRL) have lower achievements in natural capital protection compared to the other OECD countries. Germany (DEU) has achieved much better in terms of green economic opportunities compared to the other OECD countries. Colombia (COL) and Costa Rica (CRI) have lower social inclusion achievements compared to the other OECD countries.

There are different achievement levels in green growth among the OECD countries. In order to identify these differences, a cluster analysis was applied for the OECD countries. In applying the cluster analysis, 16 green growth indicator category (Table 1) scores were used. Cluster plot of the OECD countries are shown in Figure 5.

Figure 5: Cluster Analysis Results



K-Means algorithm is used for clustering countries. K-Means is a non-hierarchical clustering method. In order to apply the K-Means method, the optimal number of clusters must be determined first. The Elbow method is used to determine the optimal number of clusters. The distortion/inertia decreases up to k=5 on the elbow line. Even though there is a small break at k=7 on the elbow line, the inertia starts to decrease linearly after k=5. For this reason, the optimal number of clusters is selected as 5. To summarize, OECD countries can be divided into 5 clusters based on the green growth indicator scores which are shown on the cluster plot (Figure 5). The countries in each cluster and the average green growth index scores of each cluster are listed in Table 4.

Table 4: OECD and World Comparison in terms of Green Growth (2022)

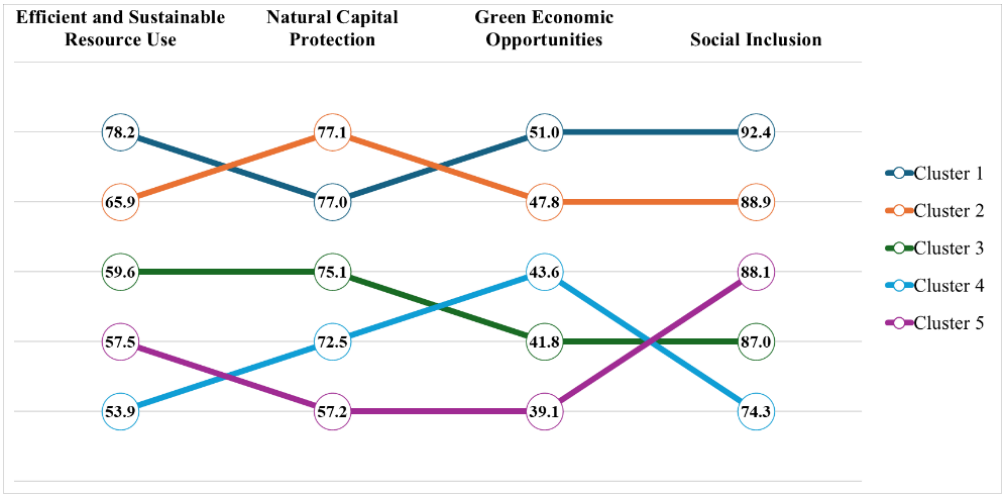
Cluster	Country	Average Green Growth Index
Cluster 1	Austria – Denmark – Luxembourg – Sweden – Switzerland	72.8
Cluster 2	Estonia – Finland – France – Germany – Hungary – Italy – Latvia – Lithuania – Netherlands – Portugal – Slovenia – United Kingdom	68.0
Cluster 3	Belgium – Greece – Japan – Poland – Spain	63.2
Cluster 4	Chile – Colombia – Costa Rica – Mexico	59.6
Cluster 5	Australia – Canada – Iceland – Ireland – Israel – New Zealand – Norway	57.8

The clusters were numbered on the basis of the average scores of the Green Growth Index, i.e., Cluster 1 has the highest average GGI score, and Cluster 5 has the lowest average GGI score. The

countries in cluster 1 have high achievements in the green growth index. These countries can serve as a benchmark for the other OECD countries. On the other hand, the countries in cluster 5 have low achievement in green growth index in average compared to other OECD countries.

Each cluster has its own strengths and weaknesses. To find out these characteristics of the cluster, we need to examine them using the dimensions of green growth and the indicators of green growth. The average score of the clusters for the dimensions of green growth and their ranking are shown in Figure 6.

Figure 6: Average GGI Dimension Scores of the Clusters



Cluster 1 and Cluster 2 are high achiever clusters in terms of green growth dimensions. Cluster 1 has the highest average scores on efficient and sustainable resource use ($\bar{x}$ = 78.2), green economic opportunities ($\bar{x}$ = 51), and social inclusion ($\bar{x}$ = 92.4) and the second highest average score on natural capital protection ($\bar{x}$ = 77). Cluster 2 has the highest average score on natural capital protection ($\bar{x}$ = 77.1) and the second highest average score for efficient and sustainable resource use ($\bar{x}$ = 65.9), green economic opportunities ($\bar{x}$ = 47.8) and social inclusion ($\bar{x}$ = 88.9). The countries in these clusters can be seen as the high achievers.

Cluster 3 ranks third in the efficient and sustainable resource use ($\bar{x}$ = 59.6) and in natural capital protection ($\bar{x}$ = 75.1), but fourth in green economic opportunities ($\bar{x}$ = 41.8) and social inclusion ($\bar{x}$ = 87).

Cluster 4 has the lowest average scores for efficient and sustainable resource use ($\bar{x}$ = 53.9) and social inclusion ($\bar{x}$ = 74.3). Cluster 4 ranks fourth in the natural capital protection ($\bar{x}$ = 72.5) and third in green economic opportunities ($\bar{x}$ = 43.6). The countries in this cluster need to focus on sustainable resource use and social inclusion to make progress on green growth.

Cluster 5 has the lowest average scores for natural capital protection ($\bar{x}$ = 57.2) and for green economic opportunities ($\bar{x}$ = 39.1). Cluster 5 ranks 4th for efficient and sustainable resource use ($\bar{x}$ = 57.5) and 3rd for social inclusion ($\bar{x}$ = 88.1). Countries in this cluster are moderately strong on social inclusion but weak on other dimensions of green growth. The countries in this cluster need to focus on natural capital protection and green economic opportunities to make progress on green growth.

These clusters can also be examined in terms of 16 green growth indicators. The average scores of the clusters for the green growth indicators can be found in Table 5.

Table 5: Average Green Growth Indicator Scores of the Clusters

	Efficient and Sustainable Resource Use				Natural Capital Protection			
Cluster	**Efficient and Sustainable Energy**	**Efficient and Sustainable Water Use**	**Material Use Efficiency**	**Sustainable Land Use**	**Biodiversity and Ecosystem Protection**	**Cultural and Social Value**	**Environmental Quality**	**Greenhouse gas Emissions Reduction**
Cluster 1	74.8^{H}	78.5^{H}	77.3	85.6^{H}	63.6	87.3^{H}	82.7	77.4
Cluster 2	64.0	45.9	80.3	82.8	66.8	82.9	86.2^{H}	74.7
Cluster 3	58.9	35.6	85.7^{H}	72.6	67.2^{H}	73.1	85.9	76.6
Cluster 4	57.7^{L}	32.3^{L}	82.3	57.1^{L}	61.5	64.3^{L}	86.0	82.4^{H}
Cluster 5	60.1	48.2	64.0^{L}	63.8	47.4^{L}	65.2	82.6^{L}	50.7^{L}
OECD Average	**63.3**	**48.1**	**77.4**	**74.5**	**61.6**	**76.1**	**84.8**	**71.3**
	Green Economic Opportunities				**Social Inclusion**			
Cluster	**Green Employment**	**Green Innovation**	**Green Trade**	**Green Investment**	**Access to Basic Services and Resources**	**Gender Balance**	**Social Equity**	**Social Protection**
Cluster 1	32.7	48.1^{H}	75.6^{H}	64.4^{H}	92.3^{H}	93.2^{H}	94.6^{H}	89.8^{H}
Cluster 2	32.0	37.5	75.1	61.5	89.2	86.3	93.3	87.2
Cluster 3	28.8	30.8	75.3	49.4	89.8	80.6	93.9	86.2
Cluster 4	48.0^{H}	30.1^{L}	70.1	36.8^{L}	66.0^{L}	75.0^{L}	79.7^{L}	77.6^{L}
Cluster 5	22.3^{L}	43.5	61.5^{L}	46.5	86.0	85.1	93.1	88.9
OECD Average	**31.5**	**38.5**	**71.7**	**53.9**	**86.3**	**84.8**	**91.9**	**86.7**

Note: H: Highest value among the clusters, L: Lowest value among the clusters

Cluster 1 has the highest average achievement in 11 of the green growth indicators. The main strength of this cluster is the efficient and sustainable water use. The countries in this cluster are high achievers in terms of green growth. On the other hand, these countries need to make more efforts to protect biodiversity and ecosystems, improve environmental quality, reduce greenhouse gas emissions, and promote green employment. Cluster 2 is above the OECD average for all green growth indicators except for efficient and sustainable water use and green innovation. This cluster has the highest average achievement in environmental quality. Cluster 3 has the highest average achievement in material use efficiency and biodiversity and ecosystem protection. This cluster is

strong on these indicators but performs moderately on other indicators. Cluster 4 has the highest average achievement in greenhouse gas emissions reduction and green employment. However, cluster 4 has the lowest average scores on 10 of the green growth indicators. The biggest weakness of the countries in this cluster are the social inclusion indicators. Countries in this cluster need to make more efforts in the area of social inclusion to increase their green growth achievement. Cluster 5 has the lowest average achievement on 6 of the green growth indicators. The biggest weakness of the countries in this cluster is the natural capital protection. In addition to the natural capital protection indicators, countries in cluster 5 also need to make more efforts in the areas of green employment and green trade.

5. Conclusion

This study analyzes the conditions and achievements of green growth in OECD countries using a descriptive analytical approach. This study attempts to examine the achievements, challenges, needs, strengths, and weaknesses of OECD countries in relation to green growth. For this purpose, the Green Growth Index 2022 proposed by the Global Green Growth Institute (Acosta et al., 2022) was used. The OECD countries were examined using the aggregated green growth index, the dimensions and indicators of the green growth index.

The results show that OECD countries have high achievements in green growth in general. However, some countries are lagging behind. OECD countries have significantly different achievement levels in the green growth dimensions. The average achievement levels in green growth dimensions are social inclusion ($\bar{x} = 87.2$), natural capital protection ($\bar{x} = 72.01$), efficient and sustainable resource use ($\bar{x} = 63.58$) and green economic opportunities ($\bar{x} = 45.04$) respectively. Compared to the other dimensions, the OECD countries have the highest achievement level in the social inclusion dimension of green growth in general but also have the lowest achievement level in the green economic opportunities dimension of green growth. The main barrier to achieving green growth for OECD countries is green economic opportunities. Therefore, efforts on green economic opportunities need to be strengthened, especially in the areas of green employment, green innovation and green investment. OECD countries need to prioritize green economic opportunities to boost their green growth. They must also do more to promote efficient and sustainable resource use.

OECD countries show varying degrees of success in green growth indicators. In order to identify similarities and differences between OECD countries in terms of green growth, the countries were grouped into clusters. The cluster analysis results show that OECD countries can be grouped into 5 homogeneous clusters based on green growth indicators. These clusters have different strengths and weaknesses. It can be understood that OECD countries have different conditions, strengths and weaknesses in terms of green growth achievement level. The OECD is making great efforts to guide and support countries in green growth. However, OECD countries have different conditions, resulting in different levels of achievements on the various green growth indicators. To achieve a high level of green growth, identifying these differences is an important reference for guidance. By defining countries' conditions and achievement levels, policy makers and relevant stakeholders

can design more effective plans and develop more effective and useful green growth strategies. The results of this study can provide important clues for identifying country – and cluster-based current green growth conditions, achievements, needs, challenges, and strengths and weaknesses related to green growth.

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