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Does Inclusive Green Growth in Türkiye Have an Impact on Global Warming?

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Türkiye'de Kapsayıcı Yeşil Büyüme Küresel Isınma Üzerinde Etkili Mi?

Öz

Bu çalışmada Türkiye için kapsayıcı yeşil büyüme ve küresel ısınma arasındaki ilişki 1991-2020 dönemi veri seti yardımıyla analiz etmek amaçlanmıştır. Bu çerçevede çalışmada ilk olarak kapsayıcı yeşil büyümeyi temsil etmesi için kapsayıcı yeşil büyümeyi meydana getiren bileşenler kullanılarak 'Temel Bileşenler Analizi' yardımıyla kapsayıcı yeşil büyüme endeksi oluşturulmuştur. Ardından, kapsayıcı yeşil büyüme endeksi, toplam işgücü ve teknolojik gelişmenin küresel ısınma üzerindeki etkisi Johansen eş bütünleşme testi, FMOLS, DOLS ve CRR tahmincileri kullanılarak analiz edilmiştir. Sonuçlar her üç modelde de Türkiye'de kapsayıcı yeşil büyümenin küresel ısınmayı azaltmadaki rolünün etkili olmadığına dair kanıtlar içermektedir. Bu sonuçların yanı sıra, teknolojik gelişmenin küresel ısınma üzerindeki etkisinin her üç modelde de negatif ve istatistiki olarak anlamlı olduğu saptanmıştır. Bununla beraber, toplam işgücünün küresel ısınma üzerindeki etkisinin yine her üç modelde de negatif olduğu fakat katsayının sadece DOLS tahmincisinde istatistiki olarak anlamlı olduğu bulunmuştur. Türkiye'de kapsayıcı yeşil büyümenin gerçekleştirilmesinde, finansal kapsayıcılığında sağlanması, nitelikli işgücünün artırılması ve kamu kaynaklarının daha verimli alanlara yönlendirilmesi büyük önem arz etmektedir.

Anahtar Kelimeler: Kapsayıcı yeşil büyüme, Küresel ısınma, FMOLS, DOLS, CRR

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Abstract

This study aims to analyze the relationship between inclusive green growth and global warming for Türkiye with the help of the 1991-2020 period data set. In this context, in the study, the inclusive green growth index was first created with the help of 'Principal Components Analysis by using the components that make up inclusive green growth to represent inclusive green growth. Then, the impact of the inclusive green growth index, total labor force, and technological development on global warming was analyzed using the Johansen cointegration test, FMOLS, DOLS, and CRR estimators. The results contain evidence in all three models that the role of inclusive green growth in Türkiye is ineffective in reducing global warming. In addition to these results, the effect of technological development on global warming was found to be negative and statistically significant in all three models. However, it was found that the impact of the total labor force on global warming was negative in all three models. Still, the coefficient was statistically significant only in the DOLS estimator. It is of great importance to ensure inclusive green growth in Türkiye, ensuring financial inclusion, increasing the qualified workforce and directing public resources to more productive areas.

Keywords: Inclusive green growth, Global warming, FMOLS, DOLS, CRR

Makale Türü: Araştırma Makalesi

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1. Introduction

Since the Industrial Revolution, the economy has tested rapid growth at the expense of reducing human and environmental welfare. This situation puts tremendous pressure on the sustainability of development (Tang and Qin, 2022). Otherwise, while the economic growth figures of countries are increasing, poverty and inequalities between countries/regions are also growing. The World Inequality Report, published in 2022, reveals that the wealthiest 10 percent of the global population currently earns 52 percent of global income, while the poorest half earns 8.5 percent. Thus, it becomes a necessity for the economy to move towards a greener and more inclusive transformation for more sustainable growth and development (Li et al., 2023).

At this point, one of the issues frequently discussed in recent years is that economic growth is not enough to increase poverty and inequality in income distribution and employment. The fact that the opportunities created by growth are not spread equally throughout society has turned attention from pure economic growth to inclusive economic growth (Avcı and Tonus, 2020a). The growth model that creates prosperity and income increase for the entire population constitutes a society built by individuals and distributes all material and spiritual welfare components equally, defined as inclusive growth (Keyifli et al., 2022: 41). Problems such as global monetary crises, unfair income distribution, unemployment, and poverty cause countries to re-plan their economic growth strategies and policies by spreading them equally across the society. For economic growth in a country to be inclusive and sustainable, the income of every segment of society must be increased, as well as their opportunities in education, health, and social fields. Inclusive growth ensures the balance between sustainable development and economic growth. While providing this balance, unlike traditional growth models, it does not focus only on the amount of output but on the equal distribution of the amount of output. When evaluated from this perspective, inclusive growth is at the center of the economic policies discussed in recent years, as it allows both economic and social goals to be evaluated in one pot (Özgün, 2021: 274).

The multidimensional structure of inclusive growth makes it closely related to fields such as industry, agriculture, services, and labor force. A better understanding of inclusive growth and the principles of inclusive growth in general are listed below (Green et al., 2017: 3-4):

- Economic growth should be seen as a tool for sharing inclusion, not an outcome
- Poor segments should be given the same quality services as urban segments.
- Investments in human capital should be increased
- Social safety networks should be developed. In this way, individuals should be supported during critical periods of their lives.
- Innovations and opportunities for shared leadership should be provided
- The level of participation of the general public should be increased as a way of knowledge production
- Small changes and details should be focused on as much as significant changes.

After the sustainable development goals (SDGs) were made public, almost all countries implementation started new and different improvement strategies and policies focusing on inclusive green growth, which refers to combining both green and inclusive growth. Thus, today, we can summarize inclusive green growth as economic growth that facilitates reach to more sustainable socio-economic deals for more people, regions, and countries. In addition, it protects the more vulnerable, all in a more equitable environment. (Desalegn and Tangl, 2022). Inclusive green growth is critical

because it promotes the environmental, economic, and social dimensions of sustainable development. Table 1 below expresses the potential benefits of green growth policies implemented in this context for sustainable development.

Table 1: Potential benefits of green growth policies on sustainable development

Benefit type	Impact on well-being	Channels through which policy affects welfare
Environment	Directly increases well-being	improving the environment
Economic	Rise well-being by increasing income	-Rise in production factors -Time-lapse innovation through correcting market failures in knowledge -Increased efficiency -Increased efficiency by fixing non-environmental market failures and effective behavior
Social	High welfare through distributional impact, enhanced volatility, and other social indicators	- Increasing endurance against natural disasters, commodity price fluctuations, and economic crises - Employment opportunities and poverty alleviation

Source: World Bank (2012). Inclusive Green Growth: The Pathway to Sustainable Development. (http://hdl.handle.net/10986/6058).

This framework created for green growth in Table 1 expresses the balance between the costs, expressed in possible alleviation in investment, income, and consumption, and the advantages, described in possible developments on social, environmental, and economic fronts. It forms the basis of inclusive green growth.

On the other hand, pure green growth cannot be considered inclusive because low-income communities use natural resources to survive without environmental concerns. This continues the deformation of nature and becomes a systemic risk for the whole economy.

According to the report published by the World Economic Forum in 2020, business, government, and civil society leaders ranked biodiversity loss and ecosystem collapse as one of humanity's five biggest threats in the next ten years. The same report states that approximately 1 million species are in danger of extinction due to human activities, and current production and consumption patterns, population dynamics, land use, urbanization, trade, industry, and management models form the basis of this loss. Thus, green growth should center on what needs to be done in the future to avoid taking stuck on unsustainable paths and to ensure local interest. For this reason, green growth policies should be carefully designed to minimize irreversible adverse effects. Carefully designed green policies affect growth through four channels (Fay, 2012).

- Input effect (due to enhancing factors of production)
- Efficiency effect (by bringing the production amount closer to the production limit)
- Incentive effect (through promote the economy in times of crisis)
- Innovation impact (by speed up development and adoption of technologies)

In this context, the aim of the policies implemented by countries towards green growth is to ensure sustainability and minimize environmental deformations. Thus, green growth and green economy approaches are seen as practical tools that enable countries to directly achieve sustainable development and reduce global warming. In recent years, countries have implemented various policies

to combat global warming. The basis of these policies is mostly related to the source of energy production. In many studies conducted in this field, choosing alternative energy sources helps reduce the effects of global warming because fossil fuels emit greenhouse gases. For example, in the USA, within the scope of the 'Clean Energy Plan' within the scope of the US Department of Energy, it is aimed to increase the use of renewable energy by 2030 and to significantly reduce carbon emissions, based on 2005.

On the other hand, EU countries are also carrying out various studies in this field. One of these, the 'Energy Roadmap 2050' study published by the European Commission, in which the policy targets for 2050 are expressed; It has been stated that the main goal is to reduce greenhouse gas emissions by 80-95% by saving energy and increasing renewable energy production. In addition, according to the same study, EU countries also have a high energy efficiency target. In this context, an approximately 40% reduction in energy demand is targeted by 2050 (European Commission, Energy Roadmap 2050).

E-7 countries also implement various policies regarding global warming. For example, after the ratification of the Paris climate agreement in India in 2017, serious steps began to be taken in the country to implement a sustainable energy policy and limit greenhouse gas emissions. In this context, it is aimed to expand renewable energy in order to limit greenhouse gas emissions created by fossil fuel use in the country. In China, various development plans are being implemented for alternative energy sources and various feed-in tariffs are provided in this field.

In this study, the relationship between inclusive green growth in Türkiye and global temperature increase has been tested empirically. First, national and international studies on the field in question were examined in this regard. Secondly, the inclusive green growth index, the study's primary control variable, was created. In the following third part of the study, the relationship between the inclusive green growth index and global temperature increase was empirically examined using the FMOLS and DOLS estimators' method. The findings were evaluated in the last part of the study, and policy recommendations were presented.

2. Literature Review

In the economic literature, global temperature increases are generally associated with global warming. Studies conducted within this framework mainly include economic growth, energy use, technological innovation, and trade openness, which are thought to impact global warming. This study contributes to the literature through two different channels. The first of these contributions is the inclusive green growth index, which represents the primary control variable of the study. This study constitutes one of Türkiye's first studies to calculate the inclusive green growth index.

On the other hand, the second contribution of the study is that it examines the relationship between global temperature increase and the inclusive green growth index for Türkiye. The number of studies directly examining the relationship between global temperature increase and inclusive green growth index is limited. In this context, the aim of this study is to fill this gap in the literature.

The literature of the study, which discussing the relation between global temperature increase and inclusive green growth index, occurs two parts: studies examining global warming and inclusive growth. Table 2 below provides a summary of the selected literature on global warming.

Table 2: Selected Literature to Examine the Impact of Global Warming and Temperature Changes on Various Macroeconomic Variables

Author(s)	Period	Country	Methodology	Results
Acaroğlu and Güllü (2022)	1980-2019	Türkiye	ARDL Bounds Test, Toda-Yamomoto Causality Analysis	The study examining the relationship between climate change and energy consumption concluded that increasing renewable energy will assistance decrease the temperature. In contrast, the increase in fossil fuel consumption will enhance the temperature.
Bölük and Mert (2015)	1961-2010	Türkiye	ARDL Bounds Test	At the end of the study, the authors obtained results showing that renewable electricity generation in Turkiye will provide support environmental development and, accordingly, will play an essential role in decreasing greenhouse gas emissions.
Jebli and Youssef (2015)	1980-2009	Tunisia	ARDL Bounds Test	In the study investigating the relation between carbon emissions, GDP, and non-renewable and renewable energy consumption for Tunisia, evidence was found that non-renewable energy positively affects CO2 emissions. In contrast, renewable energy has a weak and negative impact.
Arouri et al. (2012)	1981-2005	Middle East and North African Countries	Panel Cointegration	In the study examining the relationship between energy consumption, carbon emissions, and economic growth, it is stated that energy consumption has a positive and significant effect on CO2 emissions in the long term.
İslam et al. (2021)	1990-2019	Saudi Arabia	ARDL Bounds Test	In the study examining the impacts of carbon emissions, precipitation, inflation, temperature, population, and unemployment on economic growth in Saudi Arabia, it was found that carbon emissions had a negative effect on economic growth, while precipitation and temperate variables were to some cointegrated mainly with the country's economic growth in negatively and positively directions, respectively. It was found to be. As in most other countries, the short-term impact of inflation and population on economic growth vary, but their long-term effect is positive.
Cian et al. (2007)	1978-2000	31 Selected Countries	Dynamic Panel Data	The study examining the effect of temperature changes on energy demand found that summer temperatures in hot countries cause an increase in annual electricity demand. In contrast, the rise in temperature in cold countries reduces electricity demand.

When the studies stated in Table 2 are evaluated in general, it would not be wrong to state that although factors such as the sample group, the period covered, and the method used vary, there is a consensus that the effects of global warming and temperature changes are adverse on both the economy and the environment. Table 3 lists selected local and international studies on inclusive growth.

Table 3: Chosen national and international studies on inclusive growth

Author(s)	Period	Country	Methodology	Results
Mamman et al. (2023)	1996-2020	48 African Countries	System GMM	Findings in the study measuring the effect of fiscal policies on inclusive growth show that public debt service worsens both poverty and income inequality and increasing public debt pressures in the region negatively affect inclusive growth.
Yang et al. (2023)	2009-2017	72 selected countries	System GMM	In the study examining the role of economic freedom and inclusive growth in financial development, findings were obtained that inclusive growth positively contributes to overall financial development by increasing economic freedom.
Cui et al. (2022)	2010-2020	Selected 40 Countries	Spatial Autocorrelation Test	In the study where the impact of financial inclusion and renewable energy use on inclusive growth was measured, the authors found that financial inclusion and renewable energy make a contribution positively to inclusive growth.
Altunç and İşlek (2022)	1995-2019	MENA Countries	Emirmahmutoğlu and Köse (2011) and Panel Fourier TodaYamamoto test	In the study examining the impact of financial openness on inclusive growth, according to the Emirmahmutoğlu and Köse (2011) test results, a unidirectional causality was found from inclusive growth to financial openness, and according to the Panel Fourier Toda Yamamoto test results, a bidirectional causality was found between financial openness and inclusive growth.
Keyifli et al. (2022)	1985-2019	Argentina, China, Brazil, India, Mexico, Indonesia, Türkiye and S. Africa	Bootstrap Panel Rolling Window causality	The study examining the relationship between inclusive growth and public sector size found that inclusive growth caused public sector size in India, Mexico, Indonesia, and South Africa, and public sector size caused inclusive growth in Türkiye.
Kouton (2020)	1991-2015	44 African Countries	System GMM	The study investigating the possible impact of renewable energy consumption on inclusive growth found that renewable energy consumption has a significant positive effect on inclusive growth, especially in low-level African countries.
Aslam et al. (2020)	2010-2017	Selected 83 Countries	System GMM	The study examined the effect of Institutional quality, social inclusion and digital inclusion on inclusive growth in different countries characterized by diverse income groups; it was found that there was a straight connection between institutional quality and inclusive growth for a

	group of high-income countries. Still, there was no such connection in other income groups.

When the studies in Table 3 are evaluated in general, it can be seen that the results of the studies on inclusive growth, which express that sustainable economic growth enables an increase in welfare in the general society (especially in non-income education, health, and social areas), are similar. Unlike traditional growth models, which do not guarantee that all income groups that make up the population receive a homogeneous share of growth, inclusive growth aims to spread development to all segments of society by focusing on poverty and income justice (Keyifli et al., 2022: 41). On the other hand, some studies deal with inclusive growth theoretically. In this context, Ngepah's (2017) study is essential. Ngepah (2017) focused on two issues in his research on Africa. The first is whether there is a connection between inclusive growth and environmental sustainability. The study stated that the connection between the two variables was weak.

The second point that the study draws attention to is that there is no income and wealth distribution equality in Africa. In this context, the study states that creating inclusive growth in Africa is very difficult. Another crucial theoretical study examining inclusive growth is the work of Özütler (2018). Özütler (2018) investigated the parameters of inclusive growth in his study and revealed that inclusive finance practices, public finance, income distribution and labor market, institutional inclusion, integration movements, and degrees of convergence constitute the driving forces of inclusive growth. Avcı and Tonus (2020b) researched inclusive growth for Türkiye using various indices such as weighted average, trimmed average, equal weight, and indices created by taking their averages. As a result of the research, they found that Türkiye exhibited more inclusive growth in the 2006-2018 period.

3. Model, Dataset and Method

3.1. Variables

3.1.1. Dependent Variable: Global temperature increase

The independent variable used in the study examining the relationship between global warming and inclusive green growth is global temperature increase. Global temperature values and precipitation generally determine climate change and global warming. In this context, temperature data was taken from the General Directorate of State Meteorology, represents the annual average temperature (TEMP) and covers the years 1991-2020.

Temperature increases and climate change, to determine as an essential temporal change of the global climate system, constitute one of the biggest problems the world has faced in recent years. In this context, many factors, such as deforestation, ocean acidification, and soil erosion, which increase greenhouse gases, contribute to climate change (Yong et al., 2022).

Due to global warming, drought conditions currently affect Türkiye, which has a semi-arid climate. It is expected to make it vulnerable to droughts that will likely increase (Acaroğlu and Güllü, 2022). In this context, the annual average temperature increase was preferred as the independent variable in the study to represent global warming.

3.1.2. Main Independent Variable: Inclusive green growth index

In the study, to create the inclusive green growth index in Türkiye, variables were selected based on some studies based on green growth (Ofori et al., 2023; Acosta et al., 2019; OECD, 2017) and included the essential components of inclusive green growth (socioeconomic and environmental). A comprehensive framework has been created. In this framework, the variables selected to create the index are expressed as follows:

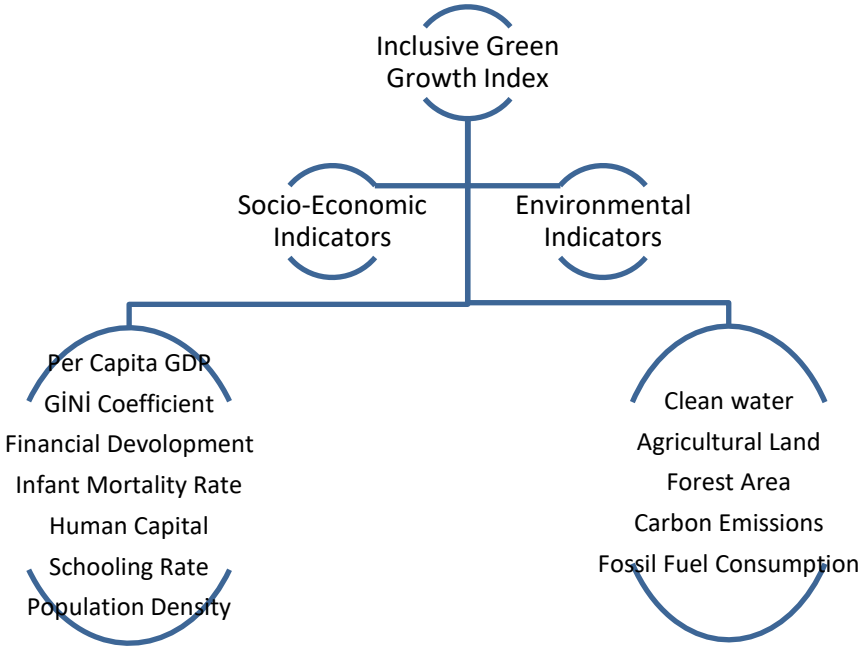

Figure 1: Variables Used to Create the Inclusive Green Growth Index

The Principal Component Analysis (PCA) method was implemented within the framework of the chosen indicators to create an inclusive green growth index in Türkiye, and the variables used cover the years 1991-2020 and were obtained from the World Bank database.

Principal component analysis, widely used in multivariate data analysis, is generally a variable reduction method. This method transforms each variable into a different variable with a mean of 0 and a standard deviation of 1 through standardization (Gökçe, 2014: 59).

In short, with principal component analysis, many variables such as x1, x2,…,xp can be analyzed without causing significant loss of information by reducing these variables to a small number of variables representing them, and various results can be achieved in line with the target of the study. (Alpaykut, 2017: 378; Özarslan Doğan and Afşar, 2022: 182). The KMO test is a method used to compare the magnitudes of partial correlation coefficients and observed correlation coefficients. KMO test values greater than 0.50 indicate that the data set is suitable for analysis. The Bartlett tests whether the data set is suitable for principal component analysis. The correlation matrix is equal to the identity matrix. The null hypothesis is tested against the alternative hypothesis that the correlation matrix is not equal to the identity matrix (Koçak and Uzay, 2018: 87).

Table 4: KMO and Barlett Chi-Square Test

KMO Test	0,81
Barlett Chi-Square Test	472,55 (0.0000)

According to Table 4, the KMO test is 0.81. Since 0.81>0.50, it can be said that the variables in Table 4 are suitable for principal component analysis. On the other hand, the Bartlett Chi-Square Test result appears to be statistically significant. In this case, it can be said that the selected variables are suitable for principal component analysis.

3.1.3. Control Variables: Technology and Total Labor Force

In the analyzed study the empirical relationship between global warming and inclusive green growth, patent applications and labor force variables were selected to represent technology as control variables. The variables in question cover 1991-2020 and were obtained from the World Bank database. The common belief in the economic literature is that technological progress positively impacts climate change, global warming, and the environment.

In many studies conducted in this context (Akyol and Mete, 2021; Lin and Zhu, 2019b, p. 1508; Zhang et al., 2017, p. 18), technology is crucial to environment and sustainability. Developing technology will enable the development of production methods and, thus, the creation of new ideas and patents. It ultimately will lead to the current production process becoming more environmentally friendly. The environmentally friendly production process will significantly contribute to reducing global warming.

On the other hand, the labor force is another control variable chosen in the study. As a result of uncontrolled population growth around the world, especially in developing countries, labor supply tends to increase to increase per capita income. In this context, the country's labor force requires growth in real output or labor productivity per unit. In addition, the total labor force in a country is also associated with the population and expresses the increase in total output.

4. Method: Johansen Cointegration Test, FMOLS, DOLS and CRR

This study aims to empirically examine the impact of inclusive green growth on global warming in Türkiye for the period 1991-2020. Accordingly, the model used to analyze the data was created as in Equation 1:

$$TEMP_t = \beta_0 + \beta_1 GREEN_t + \beta_2 LPATENT_t + \beta_3 LLABOR_t + \varepsilon_t \quad (1)$$

In the model, TEMP refers to the dependent variable, global warming; GREEN, the inclusive green growth index; LPATENT, the logarithm of the natural state of the number of patent applications; LLABOR, the logarithm of the natural state of the total labor force, and ε_t is the error term. In addition, the t index in the model indicates that the variables are time series, and β's indicate the parameter coefficients.

To examine the long-term causality relationship between inclusive green growth and global warming, the cointegration test developed by Johansen (1988) was applied. Then, the long-term relationship between the variables was examined with the help of FMOLS, DOLS, and CRR estimators.

4.1. Unit Root Tests

Unit root analysis of the variables was performed before analyzing cointegration analysis, FMOLS, DOLS, and CRR estimators. The variables must be stationary to find meaningful relationships between the variables used in econometric analyses; that is, they must not contain unit roots (Mucuk and Uysal, 2009:108). In this context, the existence of unit root was investigated with the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, and the test results obtained are expressed in Table 4.

Table 4: ADF and PP Unit Root Test Statistics Results

Variables	ADF	PP
TEMP	1.249 (0.997)	0.183 (0.732)
DTEMP	-5.988(0.000)***	-9.343(0.000)***
GREEN	-1.682 (0.733)	-2.385 (0.379)
DGREEN	-7.901 (0.000)***	-7.790 (0.000)***
LPATENT	-1.532 (0.795)	-1.772 (0.692)
DLPATENT	-4.422 (0.007)***	-4.553 (0.005)***
LLABOR	-1.532(0.795)	-1.629 (0.756)
DLLABOR	-4.403 (0.008)***	-4.441 (0.007)***

Note: The *** sign indicates that the H0 hypothesis was rejected at the 1% significance level for the ADF and PP Unit Root Tests.

According to the ADF and PP test statistics results expressed in Table 4, the H0 hypothesis cannot be rejected for all variables at the 5% significance level. That is, all variables are non-stationary at level and contain unit roots. After taking the first differences in the variables, ADF and PP tests were reapplied, and it was observed that the variables became stationary. As a result, all variables used in the study are stationary at the I(1) level.

4.2. Cointegration Analysis

In the study, since all variables that are not stationary at the level become stationary when their differences are taken, it can be interpreted that their degree of integration is the same. The fact that the series is stationary of the same order allows the frequently used Johansen cointegration test to be applied.

The existence of the cointegration relationship between inclusive green growth and global warming was examined with the cointegration test developed by Johansen (1988). The equation for this is as follows:

$$Y_t = \sum_{i=1}^{p} A_i Y_{t-1} + \beta X_t + u_t \quad (2)$$

There should be I(1) series that are not stationary at the X_t and Y_t Level values in Equation 2 become stationary when their first differences are taken. When the equation is first differentiated and renewed again, it takes the form of equation 2 below.

$$\Delta Y_t = \pi Y_{t-1} + \sum_{i=1}^{p-1} \tau_i Y_{t-1} + \beta X_t + v_t \quad (3)$$

In Equation 3, $\pi = \sum_{i=1}^{p} A_i - I$ and $\tau_i = -\sum_{j=i+t}^{p} A_j$ On the other hand, it is expressed as π=αβ. It refers to two matrices with α and β (kxr) dimensions and rank r (Göçer et al., 2013). On the other hand, α refers to the error correction term coefficient, that is, the adaptation speed, β refers to the long-term cointegration coefficients matrix, and finally, r refers to the rank of the matrix in question (Tarı, 2009: 427; Akpolat and Altıntaş, 2013:124).

If rank is equal to 1, it can be said that there is 1 cointegration relationship between the variables; if it is greater than 1, it can be said that there is a cointegration relationship between the variables equal to the rank value. On the other hand, interpretation is made by looking at the trace and statistics to see whether there is a cointegration relationship between the variables. Table 5 below shows the Johansen cointegration test results for the variables.

Table 5: Johansen Cointegration Results

Ho: There is no long-term relationship between variables
H1: There is a long-term relationship between variables

Hypothesis	Iz Statistic	Critical Value (0.05)	Probability Value
None*	53.72602	47.85613	0.0127*
Maximum1	23.05665	29.79707	0.2433
Maximum2	5.755801	15.49471	0.7242
Maximum3	0.014414	3.841466	0.9043

4.3. Long-Term Analysis: FMOLS, DOLS and CRR Estimators

Although a cointegration relationship was detected between the variables in the cointegration test developed by Johansen (1988), the cointegration coefficients could not be interpreted. For this reason, cointegration coefficients were obtained by Modified Ordinary Least Squares (FMOLS), Dynamic Ordinary Least Squares (DOLS), and Canonical Cointegrating Regression (CCR) methods. To apply the methods in question, the variables must be stationary at the I (1) level when their first differences are taken (Çatalbaş, 2022: 25; Erdoğan et al., 2018).

As Berke (2012) stated, in the case of cointegration relations between dependent and independent variables, if coefficient estimation is made using the standard least squares method, deviations will occur from the assumptions of LCM that are unbiased, consistent and efficient (Kırca and Topal, 2017: 10).

Stock and Watson (1993) suggested adding the lags and antecedents of the differences along with the level values of the explanatory variables to the model in order to eliminate the bias and endogeneity problem in the Ordinary Least Squares (OLS) estimator with the DOLS method. DOLS produces strong and consistent estimates in the presence of endogeneity problems and autocorrelation in the independent variables. FMOLS, on the other hand, tries to eliminate this problem by using kernel estimators of the parameter that causes the endogeneity problem. FMOLS uses the covariance matrix of error terms to eliminate problems arising from long-term correlations between cointegration equations and stochastic processes (Çatalbaş, 2022: 25; Erdoğan et al., 2018). In addition to FMOLS, CCR uses stationary transformations of the data to eliminate the long-term correlation between the cointegration equation and stochastic shocks (Aykırı and Bulut, 2019).

For this reason, in this study, FMOLS, DOLS and CCR estimators, which take into account long-term dynamic relationships in the estimation of cointegration parameters, were preferred to obtain consistent and effective results. Table 6 shows FMOLS, DOLS, and CRR estimation results.

Table 6: FMOLS, DOLS, and CRR Estimation Results

	FMOLS		DOLS		CRR	
Variables	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**
D(LPATENT)	-0.069668	0.0081***	-0.170512	0.0039***	-0.071721	0.0083***
D(GREEN)	0.147938	0.0048***	0.443305	0.0019***	0.154412	0.0065***
D(LLABOR)	-0.027893	0.8346	-0.894367	0.0220**	-0.047950	0.7447

Note: ***, and ** indicate 1%, and 5% significance levels, respectively.

According to the FMOLS, DOLS, and CRR results in Table 6, the LPATENT coefficient is statistically significant and has a negative effect on global warming. It also overlaps with Bindi (2019) and Akyol and Mete (2021). With technological development, the share allocated to R&D funds increases, thus increasing efficiency in both production and energy. With the increase in productivity, less resource

use occurs, positively minimizing environmental deformations and reducing global warming (Grossman and Krueger, 1991:7; Yılmaz, 2020: 1740).

On the other hand, the GREEN coefficient is statistically significant in all three models and appears to affect global warming positively. This means that an increase in inclusive green growth in Türkiye has an increasing effect on global warming. Economic growth must first be achieved for a country to achieve inclusive green growth and succeed in this field. At the heart of this is maximizing the welfare of every individual in society and spreading this equally.

After this stage is achieved, improving more environmentally friendly indicators such as the country's net savings, dependency ratio and GDP carbon intensity indicators is crucial. When evaluated in this context, employment should be increased in countries where inclusive green growth is targeted, but this should be done with a qualified labor force. On the other hand, countries that want to be successful in inclusive green growth must plan their spending and income policies to minimize income inequalities and poverty. This means fewer bribery and corruption incidents in society and less negative impact on low-income segments accessing public services (Avcı and Tonus, 2020: 39).

Another point in achieving inclusive green growth is how environmentally friendly the energy source is and how much of this resource is used to meet the increasing energy demand as a requirement of economic growth. When these results are considered for Türkiye, it can be seen that non-environmental energy resources are used intensively to realize economic growth, the first stage of inclusive green growth in Türkiye. This means more greenhouse gases for more growth. On the other hand, it is concluded that the country's per capita national income figures are not evenly distributed throughout the society, which means that individuals use natural resources without any environmental concerns to obtain more income.

Finally, the LLABOR coefficient negatively affects global warming in all three models. In addition, while the coefficient was found to be statistically significant only in the DOLS estimator, it was also insignificant in the other two models. When these results are considered for Türkiye, it can be seen that non-environmental energy resources are used intensively to realize economic growth, the first stage of inclusive green growth in Türkiye.

5.Conclusion and Recommendations

Today, the fact that economic growth alone is no longer sufficient to ensure justice in income distribution, reduce unemployment, and prevent poverty has led countries to seek a more comprehensive policy to solve these problems. As a result, the concept of inclusive growth, expressed as a growth model that increases welfare for the whole population that constitutes the society and distributes all material and non-material elements of prosperity homogeneously, has emerged. Following the Sustainable Development Goals (SDGs) announced by the United Nations, many countries have drawn the world's attention to inclusive green growth, combining both green and inclusive growth, and have begun implementing new development strategies in this context. Inclusive green growth, which is on the agenda for this purpose, is expressed as economic growth that provides broader access to sustainable socioeconomic opportunities for a more significant number of people, regions, or countries while protecting the vulnerable, and all of this is done in a fair environment.

This study seeks an answer to whether there is an empirical relationship between inclusive green growth and global warming in Türkiye between 1990 and 2021. In this context, the study first created a comprehensive green growth index for Türkiye within the framework of the selected indicators using the Principal Component Analysis method. Then, the impact of the created inclusive green growth index, total workforce, and technological progress on global warming was investigated using the Johansen cointegration test, FMOLS, DOLS, and CRR estimators. According to the Johansen

cointegration results, it was concluded that there is a long-term relationship between inclusive green growth, global warming, technological development, and the total labor force. According to the FMOLS, DOLS, and CRR estimation results, technological development is statistically significant. It has a negative effect on global warming in all three models, and inclusive green growth is also essential in all three models and has a positive impact on global warming. The total labor force negatively affected global warming in all models, but it was found to be statistically significant only in the DOLS estimator.

Different development levels of countries also make the importance they attach to economic growth and development different. It is known that while developing countries give more importance to economic growth, developed countries give more importance to economic development. When we look at the environmental indicator components of inclusive green growth, the abundance of clean water, agricultural land, and forest lands increases according to the development level of the countries. In other words, developed countries that attach importance to development want to have cleaner water, more agricultural land, and forest land. However, in developing countries, reasons such as more production, opening more industrial branches, building more houses, and not giving enough importance to public transportation cause increased carbon emissions and consumption of fossil fuels. Considering that Türkiye is also a developing country, it is predictable that the increase in inclusive green growth will increase global warming. The fact that developing countries such as Türkiye prefer economic growth rather than economic development causes carbon emissions and fossil fuel consumption to increase and, therefore, global warming to increase. At this point, this study offers various policy recommendations to policymakers, as stated below:

• First of all, it is necessary to see the increase in the labor force resulting from the population growth in the country as an advantage and to increase the quality of this labor force. This is only possible by ensuring equality of opportunity and providing access to quality education for all segments of society. The qualified labor force will be the driving force in reducing poverty and income inequality and removing obstacles to growth in the country.

• On the other hand, financial inclusion should be supported. Thus, low-income people who need subsidies, loans, and grants should be supported, and the segment should be encouraged to invest and produce. In this way, income increase will have the opportunity to spread throughout society.

• More public resources than the private sector is needed for inclusive green growth. However, public resources are transferred to very limited or inefficient projects in developing countries. At this point, a choice needs to be made about which projects should be targeted first in developing countries such as Türkiye.

• Promoting sustainable land use and transitioning to renewable energy and food production are vital to inclusive green growth. Especially developing countries need to produce and implement efficient policies in these areas.

• Finally, governance, representation, accountability and sustainable resource use must be at the highest level to ensure inclusiveness in every sense in a country. Only in this way can the country's resources be used efficiently and rationally. In this way, social income can be distributed equally to individuals.

Although this study is thought to make significant contributions to the current literature, it has some narrowness. In this context, the first narrowness of the study is the difficulty of accessing data and the period in creating the comprehensive green growth index. In future studies, an examination can be made using a more extensive data set and different methods to develop the inclusive green growth index. For instance, a comparative analysis of countries/country groups with varying levels of

improvement can be made, or future research on the subject can be made by creating more diverse time series or panel data models by adding additional variables to the studies.

Ethics approval and consent to participate

Not applicable.

Authors contribution statement

The contribution of the 1st author to the article is 100%.

Competing interest

The author declares no competing interests.

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