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To import or not to import: A global comparative study of energy and natural resource policies for sustainable development

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ABSTRACT

Nonattainment of Sustainable Development Goals (SDG) is a pressing policy concern. The energy-led growth pattern needs a policy-level reorientation to address this concern. This present study examines the impacts of energy imports and natural resource rents on sustainable development across 127 countries over 1990–2019. The empirical model also takes account of population growth, corruption, and globalization. Using the cross-sectional augmented autoregressive distributed lag (CS-ARDL) method, the results reveal that energy imports negatively influence sustainable development in both the short and long run. The utilization of domestic natural resource rents has a positive yet insignificant influence on sustainable development. The roles of population growth and globalization are found to be favorable, while corruption has a negative effect on sustainable development. The study outcomes are utilized to develop a benchmark policy design to attain sustainable development. The policy framework is designed by reorienting the energy import and natural resource rent, while calibrating the effects of population growth, corruption, and globalization.

1. Introduction

Energy consumption is one of the biggest triggers of the economy since it is required to sustain economic growth. With the increase in economic growth, there will be more demand for goods and services which require energy. However, energy-dependent developing countries might face significant balance of payments problems while promoting economic growth through energy imports (Adams et al., 2000). Many countries increase their energy imports through energy trade to boost the economy (Singh et al., 2019). However, while there is an income advantage for energy-exporting countries, they might face current account deficit problems. Therefore, energy imports might pressure the economy while promoting economic growth (Asif, 2009). Since fossil fuels make up a large portion of energy imports, they might also negatively affect the environment (Bilal et al., 2022). In addition, energy dependency might lead to various energy security issues in the case of shocks in the energy market, disputes between countries and economic crises. Green energy transition might lead to a cleaner ecosystem, infrastructure, and economy (Zhang et al., 2023). Energy is closely related to the targets of the Sustainable Development Goals, namely SDG 7 (Affordable and clean energy), SDG 12 (Responsible consumption and production), and SDG 13 (Climate action) (Hussain et al., 2023). Besides, as committed in the Paris Agreement, governments are trying to achieve net zero targets for 2050 and minimize the environmental impacts of human activity (Xiang et al., 2022; Chen et al., 2023). With more frequent occurrences of extreme weather, pursuing the target of global carbon mitigation is more pronounced than ever (Zhang et al.,

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List of nomenclatures

SDG	Sustainable Development Goals
AE	Advanced Economies group
EMDE	Emerging and Developed Economies group
GDP	Gross Domestic Product
CO2	Carbon Dioxide
USA	United States of America
IMF	International Monetary Fund
KOF	Konjunkturforschungsstelle
APEC	Asia-Pacific Economic Cooperation
QOG	Quality of Government
WDI	World Development Indicators
Methods	
GMM	Generalized Method of Moments
OLS	Ordinary Least Squares
FMOLS	Fully Ordinary Least Squares
DOLS	Dynamic Ordinary Least Squares
CSD	Cross-sectional Dependence
CIPS	Cross-sectional Im, Pesaran, and Shin
CADF	Cross-sectional Augmented Dickey-Fuller
CS-ARDL	Cross-sectional Augmented Autoregressive Distributed Lag
CCE-MG	Common Correlated Effect-based Mean Group
AMG	Augmented Mean Group
MG	Mean Group
ECT	Error Correction Term
Parameters (measurements)	
SDI_{it}	*Sustainable Development Index* (index range 0–1)
$ENIM_{it}$	*Total Energy used minus the Production* (in kilogram of oil equivalent per capita)
IG_{it}	*Globalization Index* (index range 1–100)
$POPGR_{it}$	*Population Growth* (in percentage)
BCI_{it}	*Bayesian Corruption Index* (index range 0–100)
RES_{it}	*Total Natural Resources Rent* (as percentage of GDP)

2023). For this reason, researchers focus on sustainable solutions for the energy-environment relationship as cross cutting research can be the key toward deep decarbonization (Zou et al., 2023).

Stiglitz (1974) argues that natural resources (non-renewable) with limited supply create a barrier to economic growth. The Dutch Disease theory supports this claim. The increase in the extraction and supply of natural resources leads to additional foreign exchange inflows and raises the real exchange rate. Accordingly, the government loses its competitiveness in foreign trade over time (Matsen and Torvik, 2005). Similarly, Nordhaus et al. (1992) argued that due to the increase in population and the non-renewable nature of natural resources, natural resources will stress economic growth and the level of world output will decrease. Another hypothesis is the natural resource curse which states that abundant natural resources may be a disadvantage for economic performance (Sachs and Warner, 1995). First, resource-rich countries might create all economic policies based on this sector and neglect other service and manufacturing sectors, weakening the natural resource stock and other sectors over time. Second, since there is no sector diversification, crises in the field of natural resources will affect the economy more negatively. Auty (2002) supported the natural resource curse hypothesis and argued that resource-rich countries might perform worse than countries with few resources. In addition, he emphasized that without sectoral diversity, sustainable development cannot be achieved. Meanwhile, resource-rich countries might increase natural resource rents (Safdar et al., 2022) if they improve institutional indicators such as education, democracy, freedom, human rights, accountability, and human capital. In this way, they can establish the infrastructure for sustainable development.

Corruption is one of the key factors undermining sustainable development because it negatively affects institutional quality parameters. It also impedes economic development by reducing national income (Reinikka and Smith, 2004). For this reason, many studies have concluded that there is an adverse effect of corruption on sustainable development (Murshed and Mredula, 2018; Hope, 2022). The other factor affecting sustainable development is the growth of the population. However, the direction of this effect varies according to development levels. Population growth in developed countries can positively affect sustainable development because they have better education, health, and human capital performance. It also encourages technological innovation (Boserup, 1981) and contributes to sustainability. Therefore, the increase in human capital will trigger a positive impact of the population on sustainable development. The concept of human capital refers to individuals' knowledge, skills, and educational attainments, as well as their health and physical strength (Appleton and Teal, 1998).

Since the world is looking forward to attaining the SDG objectives by 2030, the role of energy and natural resources needs to be redefined following a comprehensive policy framework. By far, the global energy-led economic growth pattern has been unsustainable, and therefore, a policy-driven growth reorientation is necessary. This growth reorientation needs to encompass reorienting a set of policy instruments, which are seemingly recognized as global growth drivers. Developing an SDG-oriented policy framework needs to consider the roles of energy and natural resources while calibrating the policy instruments for achieving policy convergence. By far, the policy and academic discourse has yet to envisage a benchmark policy design for attaining sustainable development, and this policy void builds the research objective of the present study. Addressing this policy void necessitates answering the following research question:

Research Question: *How does the role of energy and natural resources need to be redefined to attain Sustainable Development at the global scale?*

Addressing this research question entails developing a global policy benchmark for attaining sustainable development. In this pursuit, the impacts of energy imports and natural resource rents on the attainment of sustainable development at the global scale is analyzed. Inclusion of the global growth and development drivers, e.g., globalization, corruption, and population, growth has helped in making the policy framework more generalizable, as these drivers can help in calibrating the policy framework based on the contextual settings. Therefore, while offering a benchmark design, the policy framework also offers a sense of generalizability. Herein lies the policy-level contribution of the present study. Moreover, the study divides the global sample into two groups such as the advanced economies group (AE) and the emerging and developed economies group (EMDE) to understand the heterogeneity of the effects of energy imports and natural resources on sustainable development.

Developing a policy framework requires the application of suitable methods. The consideration of the global sample might lead to the possibilities of cross-sectional dependence, as the countries are possibly associated with each other via trade and other economic spillovers. Therefore, second-generation methodological tools are used in empirical pursuit. We employ second-generation unit root and cointegration tests for initial diagnostics, while long-run coefficients are estimated through a novel CS-ARDL approach. The robustness of the estimates is also validated against second-generation long-run coefficient estimation procedures. Thus, the methodological complementarity with the policy objective is maintained in the present study.

The remainder of the study consists of four parts. The second part introduces a review of literature, the third part describes the empirical model, the fourth part discusses empirical results, and the last part provides suitable policy recommendations.

2. Literature review

This section presents an empirical literature review on the relationship between energy imports, natural resources, and sustainable development.

Several empirical studies have examined the relationship between energy imports and environmental welfare. For example, in a study employing a multivariate causality approach, Adewuyi and Awodumi (2021) analyzed the nexus between the import of refined petroleum, growth and carbon emissions in South Africa and Nigeria. They considered the analysis at sectoral and aggregate levels taking data from 1981 to 2015. In addition to causality tests, they employed simultaneous equation and threshold model analysis. Their analysis demonstrated that Nigerian environmental quality increases with sectoral and aggregate outputs if it can keep per capita petroleum import above a threshold. About South Africa, their analysis presented the outcome that carbon emissions will increase if the country can keep import of petroleum beyond the threshold. However, it was also discovered that these emissions may present a small reverse effect on per capita output.

In the case of China, Huang and Zhao (2022) analyzed the effect of strategies related to sustainability such as green trade and green growth using data from 1980 to 2020. They employed an autoregressive distributed lag model as well as granger causality techniques to understand how these strategies affect natural resources of oil, gas, and coal in China. They discovered a favorable association between natural gas and oil consumption and green growth. In terms of green trade, they also discovered a favorable association between the consumption of these two fossil fuel sources and green trade. Their results gave an indication that along trade routes, usage of gas and oil can decrease the costs of the environment and carbon footprint. This will ultimately enhance the usage for the sustainability of green trade and growth in China. In another study of China, Li et al. (2022) investigated how green energy and green trade affect green growth using provincial data. They employed the system Generalized method of moments (GMM) analysis and covered the period from 2007 to 2016. The results showed that green growth is affected significantly and positively via green trade and green growth. They also showed that local green growth can be significantly affected by high and medium-technology green trade.

In the European countries of Spain, Germany, and France, Rezaei Sadr et al. (2022) investigated how net energy imports, consumption of oil, gas, and coal affect carbon dioxide emissions. They employed fully modified OLS and dynamic OLS techniques and covered the data period from 1995 to 2019. The results suggested that net energy imports along with other three fossil fuel sources increase carbon dioxide emissions significantly. Additionally, Naimoğlu (2022) used a panel dataset of 10 countries, which are emerging energy importing countries and utilize nuclear energy. They investigated how nuclear energy, the price of energy as well as imports of energy affect carbon dioxide emissions in these ten economies. They utilized various methods including pooled mean group, dynamic fixed effect as well as the mean group estimation technique. The relationship with GDP proved the validity of the environmental Kuznets curve hypothesis in these economies. In terms of nuclear and price of energy, it was revealed that both assist in reducing CO2 emissions. In terms of energy imports, it was revealed that the increase of energy imports is associated positively with environmental degradation.

Sarkodie and Strezov (2018) investigated the energy portfolio of Australia and how it affects the environmental quality. Specifically, they explored how renewable sources, fossil fuel sources, exports, and imports of energy as well as GDP affect CO2 emission and ecological footprint employing FMOLS, DOLS and Canonical Cointegrating regression techniques. They found that renewable increases CO2 emission, while energy imports, fossil fuel sources and GDP enhance CO2 emission. From the sensitivity analysis, it was discovered that above 5% energy imports will dampen the emission reduction goals of the country. In another time series study for the USA, Ben Youssef (2023) examined how CO2 emission is affected by net energy imports as well as clean energy consumption and gross domestic product. The author utilized vector error correction as well as autoregressive distributed lag model techniques. The study discovered that there is a short run causality which runs to renewable consumption from the imports of energy. Another finding indicated that renewable consumption reduced carbon emissions. Additionally, Bildirici and Kayıkçı (2022) tried to establish the relationship between imports of energy, growth and current account balance in South Korea, Israel, and China. They utilized both conventional granger causality and the Markov switching version of Bayesian granger causality tests. They have discovered that energy imports decreasing policies have favorable impacts on current account balance, but negatively affect the GDP.

In terms of the relationship between natural resources and ecological and developmental impacts, empirical studies have provided mixed results. According to Sachs and Warner (1995), natural resources can have a significant adverse impact on the economic performance of a nation, leading to the theory of the natural resource curse. This is because dependency on natural resources may produce the behavior of rent seeking, which negatively affects the growth of a country. In a meta-analysis, Havranek et al. (2016) explored the percentage of studies which have found either positive, negative, or insignificant impacts between natural resources and development. They reported that about 20% of studies have found a positive association, about 40% have found a negative association, and about 40% of studies were not able to find any relation between natural resources and development.

Gu et al. (2023) examined the roles of natural resources, economic and geopolitical risk on the economic performance of the USA by employing novel quantile regression approaches. The study showed that natural resources are one of the primary factors for the failure of an economy along with geopolitical risk. Thus, they were able to confirm the resource curse hypothesis for this country. Li et al. (2022), on the other hand, examined the role of natural resources for economic growth of seven countries. Utilizing the same technique as that of Gu et al. (2023), the study found that natural resources positively affect the economic performance across the quantiles. Globalization was also found to be positively affecting economic growth, while renewable energy consumption negatively affected growth.

Similarly, to examine how corruption and natural resources affect economic growth, analyzed panel time series data for the 43 OIC member countries from 1984 to 2016. The results showed that corruption impedes the growth of the economy. However, the impact of natural resources on economic development is both positive and significant. Likewise, Haseeb et al. (2021) used quantile-on-quantile regression to analyze time series data from 1970 to 2018 to assess how natural resources affect economic growth. The findings demonstrate that, except for India, natural resources have an important and favorable influence on the economic development of the top Asian nations.

In a study of 30 Asia-Pacific economies, Sinha and Sengupta (2019) employed Bootstrapped quantile regression to analyze the nexus between natural resources and human development in the presence of globalization. The study, utilizing data from 1996 to 2016, found that separate natural resource rents from coal, oil, mineral, and forest reserves have favorable impacts on human development, but rents from natural gas and overall natural resource rents have adverse impacts on human development. In another study, Nchofoung et al. (2021) examined how inclusive human development is affected by natural resources in 107 developing economies. They found mixed results. First, the impact of natural resources on inclusive human development was positive for the overall sample, oil exporting nations, Latin America and Caribbean, upper middle income, and less developed economies.

However, they found negative results for high income, lower middle income, lower income, Africa, and least developed nations. In addition, they discovered that both the trade and control of corruption have positive effects on the dependent variable.

2.1. Research gap

The review of previous literature suggests that when it comes to the examination of the impacts of energy imports or natural resources on sustainable development, they have used either ecological quality or economic growth as a measure of sustainable development and only focused on either economic performance or environmental degradation using them as separate measures. Some studies have used the human development index to see how it is affected by natural resources. There comes the unique contribution of this study. In contrast to the previous literature, this study adopts a sustainable development index of Hickel (2020), which encompasses three dimensions of sustainable development such as economic, social, and environmental dimensions. As a result, compared to the previous literature, the present study provides a more comprehensive understanding of energy imports and natural resources on sustainable development, which is a multidimensional index. Using a multidimensional index is critical because energy imports and natural resources might have conflicting impacts on ecological and development dimensions of sustainable development. Hence, it becomes important to understand how energy imports and natural resources affect developmental and ecological dimensions simultaneously rather than separately. Using a multidimensional index provides an opportunity to understand this simultaneous impact. Furthermore, using the second-generation econometric modeling approach by considering heterogeneity and cross-sectional dependence can provide novel and robust insights into the hypothesized association. Additionally, the present study provides a heterogenous analysis of energy imports and natural resources on sustainable development for advanced economies as well as emerging and developing economies.

3. Model, method, and data

3.1. Empirical model

The present study aims to evaluate the impact of globalization index, net energy imports, natural resources rent, population growth, and the Bayesian corruption index on sustainable development in 127 countries from the period 1990 to 2019. These 127 countries are further divided into Advanced Economies (AE) and Emerging and Developing Economies (EMDE), according to the International Monetary Fund (IMF) classification. Table A1 in the appendix provides the list of countries according to their respective groups and regions.

The following first equation reveals the connection between the independent variables and sustainable development, the second equation (2) presents the logarithmic econometric specification of Eq. (1) where α_o represents the fixed term; $\beta_1, \beta_2, \beta_3, \beta_4$ and β_5 symbolize the coefficients of independent variables, respectively, i denotes the cross sections, t represents the time series and lastly, ε is the error term.

$$SDI_{it} = f(ENIM_{it}, IG_{it}, POPGR_{it}, BCI_{it}, RES_{it}) \tag{1}$$

$$InSDI_{it} = \alpha_{it} + \beta_1 InENIM_{it} + \beta_2 InIG_{it} + \beta_3 InPOPGR_{it} + \beta_4 InBCI_{it} + \beta_5 RES_{it} + \varepsilon_{it} \tag{2}$$

SDI_{it} stands for sustainable development index, which is obtained from the index of education, income, and life expectancy. The development index divided by the ecological index, i.e. the rate to which material footprints and consumption-based carbon emission is greater than the planetary limits shares (Hickel, 2020), while the $ENIM_{it}$ is weighed as the total energy used minus the production, all assessed in oil equivalents where use of energy refer to the primary energy use before transformation, which equals indigenous production in addition to imports and changes in stocks, fewer exports, and fuel supplied for international transport i.e. ships and aircraft WDI (World Bank, 2020). Naimoğlu (2022) concluded that an upsurge in energy imports will cause an increase in emissions of carbon. IG_{it} is the globalization index and it is sourced from the KOF Swiss Economic Institute. The index of globalization is determined by summing up the political, economic, and social globalization apart from globalization of the environment. The expected sign of the index of globalization can be either positive or negative since several studies have captured both the positive and negative impacts of the index of globalization on environmental stability. For example, Khan et al. (2019) have found that the index of globalization, which entails social, economic, and political globalization, positively affects CO2 emissions in Pakistan. Shujah Ur et al. (2019) found that in central and eastern European countries, globalization reduces CO2 emissions, Zaidi et al. (2019) also attest to this fact that globalization has significant negative influence on CO2 emissions for the APEC countries.

Furthermore, $POPGR_{it}$ is the population growth, which is measured by the growth rate of people or residents living in a country and it is sourced from the WDI. The expected sign for population growth is negative. Asumadu-Sarkodie et al. (2016) argued that in Rwanda, population growth contributes to CO2 emissions and subsequently, negatively affects economic growth. Appiah et al. (2019) also noted that population growth leads to a rise in CO2 emissions. BCI_{it} is the Bayesian Corruption index and it is obtained from the Quality of Government (QOG) database. The Bayesian Corruption index is the sum of total of corruption levels, where corruption refers to as public power abuse for personal benefit, and the value of BCI is around 0 to 100. The expected sign of BCI can either be positive or negative. Lastly, RES_{it} is the total amount of rent from natural gas, oil, minerals, coal (both soft and hard), and forests. The data for this variable is collected from the WDI. The expected sign is negative. This was affirmed by Danish et al. (2019) where they concluded that resource rents are responsible for the upsurge in pollution. Similarly, Balsalobre-Lorente et al. (2018) stated the resource rents as a factor responsible for causing environmental pollution. The resource curse theory explains why countries with abundant resources fail economically. An increase in the export of natural resources and resource sector development may lead to low investment in the manufacturing sector (Zhang and Brouwer, 2019). Also, Bekun et al. (2019) found that pollution causing environmental instability in EU countries is due to resource rents.

3.2. Methodology

Before proceeding to the main estimation techniques, preliminary diagnostics are carried out to ensure the applicability of the methods. Fig. 1 presents the step-by-step implementation of these techniques.

3.2.1. Cross sectional dependence test

First, the study applies the weak cross sectional dependence test of Chudik and Pesaran (2015), which is used to determine whether there exists cross sectional dependence, or not. Before selecting the appropriate estimation method for the variables, the possibility of cross-sectional dependence is checked. The necessity for the cross-section dependency test arises from the fact that nations share comparable economic characteristics. As the world becomes more interconnected through international trade and financial markets, economies that are otherwise comparable will feel the effects of any global crisis. Hence, the cross-sectional dependence test proposed by Chudik and Pesaran (2015) is applied in the present study, and it is represented as the following equation:

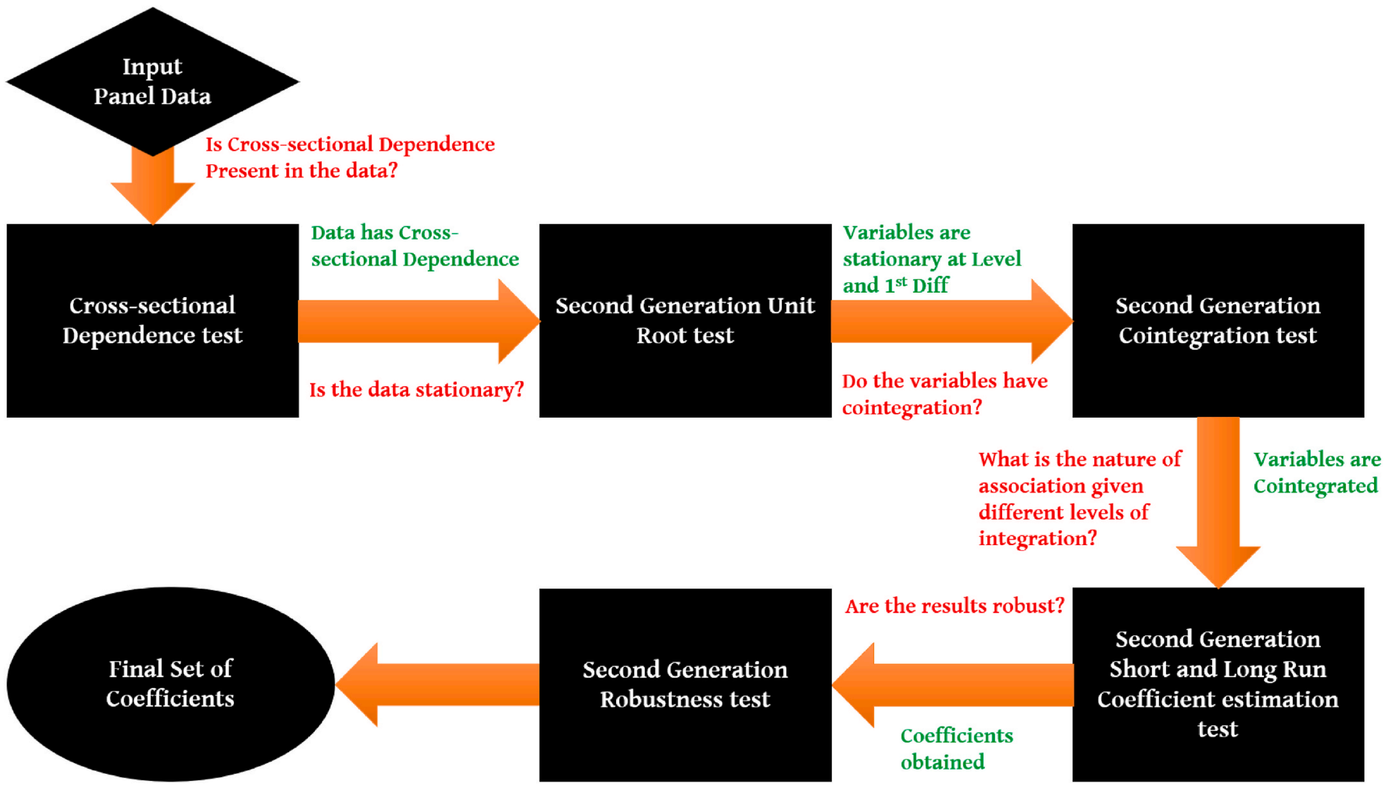

Fig. 1. Stepwise empirical schema.

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j}^{N} = i + 1\rho_{ij}\right), N(01) \quad (3)$$

Here, T refers to time series unit, N refers to cross sectional units and ρ_{ij} denotes the correlation coefficient between i and j units. The null hypothesis is that error terms are weakly cross sectionally dependent, and the rejection of the null hypothesis will imply strong cross-sectional dependence.

3.2.2. *Cross sectional unit root test*

After determining cross sectional dependence, estimation of the stationary of variables via 2 s generation unit root tests is carried out. The cross-sectional Im, Pesaran, and Shin (CIPS) by Pesaran (2007), and the cross-sectional augmented Dickey-Fuller (CADF) by Pesaran (2007) are used to examine the order of integration of the series. These second-generation unit root tests are specifically designed to account for cross-sectional dependence among the time series units in the panel. The mathematical expression of CADF is as follows:

$$\Delta Y_{it} = \alpha_i + \rho_i Y_{it-1} + \varphi_i \overline{Y}_{t-1} + \sum_{j=0}^{k} \beta_{j+1} \Delta \overline{Y}_{t-j} + \sum_{q=0}^{k} \delta_q \Delta Y_{it-q} + \varepsilon_{it} \quad (4)$$

In eq. (4), $\overline{Y}_{t-1}$ is the average of lagged levels at time t of all N samples of the model's individual series. The CIPS statistics are derived by averaging the t-statistics on the lagging value following the estimation of the CADF regression for every cross-section:

$$CIPS = N^{-1}\sum_{i=1}^{N} CADF_i \quad (5)$$

Where $CADF_i$ is the augmented Dickey-Fuller statistic at the cross-sectional level for the i^{th} cross sectional unit.

3.2.3. *Cross sectional cointegration test*

Following the second-generation unit root tests, Westerlund (2007) cointegration test is used to determine the connection and long-run elasticity that exists among variables. The rationale behind this is that this technique provides statistical values which ascertain whether the data series have a long run relationship or not. The equation for calculating the procedure is given below:

$$\Delta W_{i,t} = \alpha_i T_t + \gamma_i W_{i,t-1} + \rho_i V_{i,t-1} + \sum_{l=1}^{p_i} \gamma_{i,l} \Delta W_{i,t-1} + \sum_{l=-q_i}^{p_i} \beta_i V_{i,t-1} + \mu_{i,t} \quad (6)$$

The equation is expressed with constant trend if $T_t = (1)$ and no constant trend if equals (0). However, if it equals (1, t), it then expresses constant and trend.

3.2.4. *Cross-sectional augmented autoregressive distributed lag test*

The cross-sectional augmented autoregressive distributed lag (CS-ARDL) was developed by Chudik and Pesaran (2015). CS-ARDL model compliments the ARDL model with the linear addition of cross-sectional of both dependents and independent variables to capture the cross-sectional correlation in the error term (Chudik and Pesaran, 2015). Cross-sectional dependence and slope heterogeneity are accounted for with the application of dynamic common correlated effect predictors. CS-ARDL can handle the cross-sectional dependence, homogeneity slope issue, and feedback effects and deals with the mixture in the integration order of variables, handles small sample size and applicable in the presence of structural breaks and unbalanced panel data. The CS-ARDL has accurate, efficient, and robust outcomes in relation to sample accuracy of panel data, and extracts both the haul effects. In addition, it removes the need to pre-test the order of integration and checks the serial correlation (Chudik et al., 2017).

The regression equation for CS-ARDL for this study is estimated using the following equation:

$$\Delta SDI_{it} = \mu_i + \varphi_i(APIN_{it-1} - \beta_i X_{it} - \varphi_{1i}\overline{SDI}_{t-1} - \varphi_{2i}\overline{X}_{t-1}) + \sum_{j=1}^{p-1}\lambda_{ij}\Delta SDI_{it-j} + \sum_{j=0}^{q-1}\zeta_{ij}\Delta X_{it-j} + \eta_{1i}\Delta\overline{SDI}_t + \eta_{2i}\Delta\overline{X}_t + \varepsilon_{it} \quad (7)$$

Where j and t denote the dimension of cross-section and time respectively. ΔSDI_{it} is the dependent variable, X_{it} represents all the independent variables of the long run estimate, $\overline{SDI}_{t-1}$ is the mean of the dependent variables in the long run, $\overline{X}_{t-1}$ is the mean of independent variables in the long run, ΔSDI_{it-j} is the dependent variable in the short run, ΔX_{it-j} are the independent variables in the short run, $\Delta\overline{SDI}_t$ is the mean of the dependent variable during the short run, $\Delta\overline{X}_t$ are the mean series of the independent variables in the short run, and ε_{it} is the error term. Furthermore, β_i represents the long-run coefficients of the independent variables, λ_{ij} is the short-run coefficient of the dependent variable, ζ_{ij} are the short-run coefficients of the independent variables, and η_{1i} and η_{2i} represent the means of the dependent and independent variables in the short run, respectively.

For robustness checks, Common Correlated Effects-Mean Group (CCEMG), Augmented Mean Group (AMG), and Mean Group (MG) techniques are employed. The MG technique compared to CCEMG and AMG, cannot take care of cross-sectional dependence.

4. Results and discussion

The properties of the variables reported in Table 1 depict that sustainable development is averaged at −0.6, while natural resource rents and Bayesian corruption index have the highest standard deviation, energy imports and globalization have the highest mean, respectively. Also, the lowest and highest values are −5.0 and 7.6. The statistics also show that the mean values of lnENIM are the highest for both groups, while lnSDI mean values are the lowest among all variables for both groups.

In Fig. 2, the time series plots of the mean of the variables are provided, whereas Fig. 3 provides the distribution of these variables for the full sample.

Table 2 determines the interdependence in the cross-sectional units using the cross-sectional dependence test. The results from the full sample, AE and EMDE economies show that null hypothesis of weak cross-sectional dependence can be rejected and therefore there is strong cross-sectional dependence in the data from all the three groups.

In Table 3, stationarity of variables is examined by 2 s generation unit root tests, i.e., CIPS and CADF. From the two tests, it can be determined that except for lnIG and lnRES, all variables are stationary at first difference. Both the variables lnIG and lnRES are I(0) whereas other variables are I(1). Therefore, the application of cross-sectional autoregressive distributed lag test is verified.

Table 4 lists the Westerlund cointegration test. For all the groups, the test outcomes confirm the long run cointegration among the variables since two of the four statistics reject the null of no cointegration for the full sample and four out of the four statistics reject the null of no cointegration for the group samples.

4.1. *Case study of the chosen countries*

After confirming the long run cointegration, the short and long run coefficient estimation via CS-ARDL is carried out. The results are presented in Table 5. The results show that the estimated ECT terms are negative and significant with values being larger than 1, for the full sample, AE and EMDE regions. This implies that the error correction process in the models fluctuates around the long run value in a dampening manner instead of directly and monotonically converging to the equilibrium path. But after the completion of this process, convergence occurs rapidly to the equilibrium path (Narayan and Smyth, 2006). Therefore, from the ECT values, the oscillatory convergence is confirmed.

The coefficient of energy imports indicates a negative and significant influence on sustainable development in both the short and long run from the full sample and advanced economies sample. Energy imports have significant and negative effects on sustainable development in the short run, but not in the long run for the EMDE group sample. The long run coefficient shows negative impact, yet the impact is not significant. Additionally, for all the groups, it can be observed that energy imports have more negative influence on sustainable development in the short run compared to the long run. The results are in accordance with Naimoğlu (2022), where the authors demonstrated that energy imports hurt the sustainable environment and therefore have negative consequences for sustainable development. Naimoğlu (2022) states that most of the economies in the world consist of developing economies, which lack appropriate technologies in the energy industry. Therefore, during production, transmission as well as transportation phases of energy, significant losses of energy can be observed in these economies, resulting in additional costs. As a result, these economies depend mostly on imports of energy from foreign countries. But since most of these energy sources are fossil fuel sources, they tend to increase the overall non-renewable energy consumption in the economy. The increasing share of non-renewable energy consumption harms the sustainable development of these economies by increasing CO2 emissions. The result is also in line with Sarkodie and Strezov (2018), where the authors concluded that an increase in CO2 emissions level is due to energy imports. The insignificant result for the EMDE group can be attributed to the fact that they have less dependence on energy imports compared to other regions (Jewell et al., 2016). Additionally, the lack of sufficient energy-related infrastructure and investments could be another reason behind this insignificant influence of energy imports on sustainable development in these economies (Fuso Nerini et al., 2018).

The results from natural resource rents affirm a positive yet insignificant relationship between resource rents and sustainable development for the full sample and AE group in both the short and long run. However, the same natural resources exert negative and insignificant influence on sustainable development for the EMDE group. The positive result for the full sample and AE group can be expected as natural resources offer a foundation for economic growth and development. These natural resources can enhance economic performance by providing financial resources for government capacity enhancement, human capital as well as infrastructure development (Li et al., 2022). Governments

Table 1
Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
Full Sample					
lnSDI	3840	−0.605	0.4	−2.538	−0.159
lnENIM	3840	7.542	0.205	0	7.622
lnIG	3840	4.058	0.283	2.941	4.511
lnPOPGR	3840	1.743	0.288	−5.022	3.093
lnBCI	3840	3.754	0.468	1.864	4.306
lnRES	3840	1.405	1.155	0	4.233
AE					
lnSDI	990	−0.863	0.459	−2.538	−0.218
lnENIM	990	7.582	0.079	7.003	7.622
lnIG	990	4.344	0.131	3.77	4.511
lnPOPGR	990	1.62	0.177	0.676	2.357
lnBCI	990	3.215	0.528	1.864	4.103
lnRES	990	0.397	0.514	0	2.588
EMDE					
lnSDI	2850	−0.516	0.334	−2.386	−0.159
lnENIM	2850	7.528	0.232	0	7.622
lnIG	2850	3.959	0.253	2.941	4.447
lnPOPGR	2850	1.785	0.307	−5.022	3.093
lnBCI	2850	3.941	0.25	2.628	4.306
lnRES	2850	1.755	1.109	0	4.233

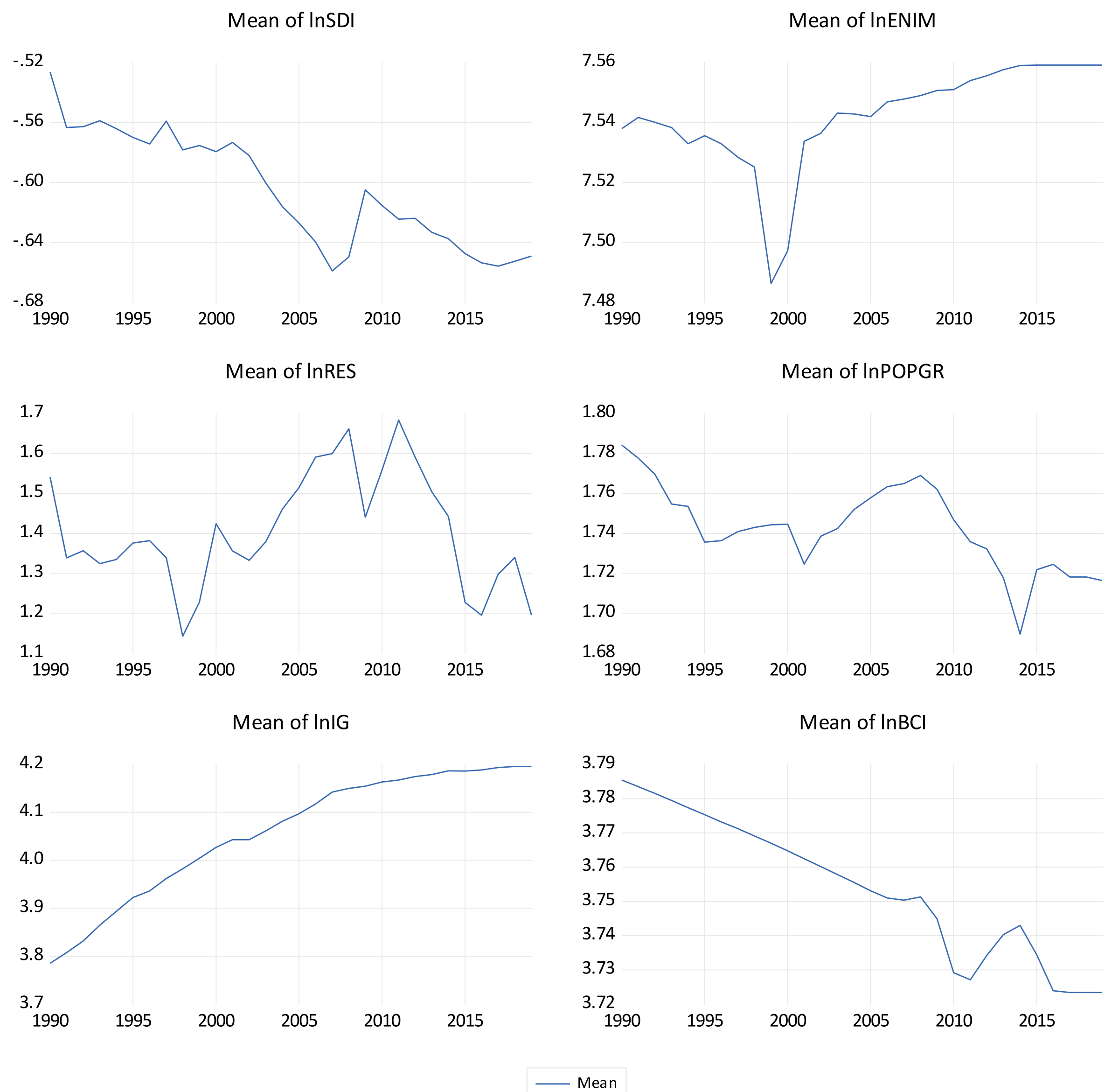

Fig. 2. Time series graphs of variables during 1990–2019.

can also collect taxes from the extraction of natural resources and sell the finished products, providing an additional source of income (Gu et al., 2023). The result for the EMDE group can be explained by the resource curse theory, which asserts that abundant natural resources can have negative development outcomes. However, for all the groups, the coefficient of natural resources is insignificant, implying that natural resources do not have sufficient capability to affect sustainable development. This could be attributed to the level of corruption existing in these economies, which affects sustainable development in such a way that natural resources cannot have their desired impact on ecological and economic development. This is supported by the analysis of corruption and sustainable development in the present study.

The globalization index has significant long and short run positive effects on sustainable development for the full sample, AE group and EMDE group. The differences in globalization coefficient across the samples can be seen since countries' peculiarities in factors such as literacy, human and economic development can have different influences on sustainable development. Globalization can reduce the scarcity of resources, assist in facilitating the global consumption of resources in an efficient way and enhance the growth of the economy as well as social welfare (Xu et al., 2020). There are three different channels through which globalization can affect sustainable development. The first channel is called the scale effect, where due to globalization, there would be extensive natural resources utilization, but this will also lead to environmental degradation. Globalization can also lead to an increased income, which can increase consumption levels that affect environmental quality. However, increased income can also enhance the awareness about environmental degradation and the health status of citizens. Additionally, increased income can encourage private and public spending on environmental quality. Globalization can also bring structural changes in the economy, which can help facilitate sustainable development (Gasimli et al., 2022). The results show that the scale effect is offset by the income effect and structural effects of globalization. This explains the positive and significant impact of globalization on sustainable development for all three groups.

Furthermore, population growth shows a positive and significant impact on sustainable development for both the full sample and EMDE economies, while it shows positive yet insignificant impact on sustainable development for the AE countries in both short and long run. Populating growth's positive impact can be supported by the fact that

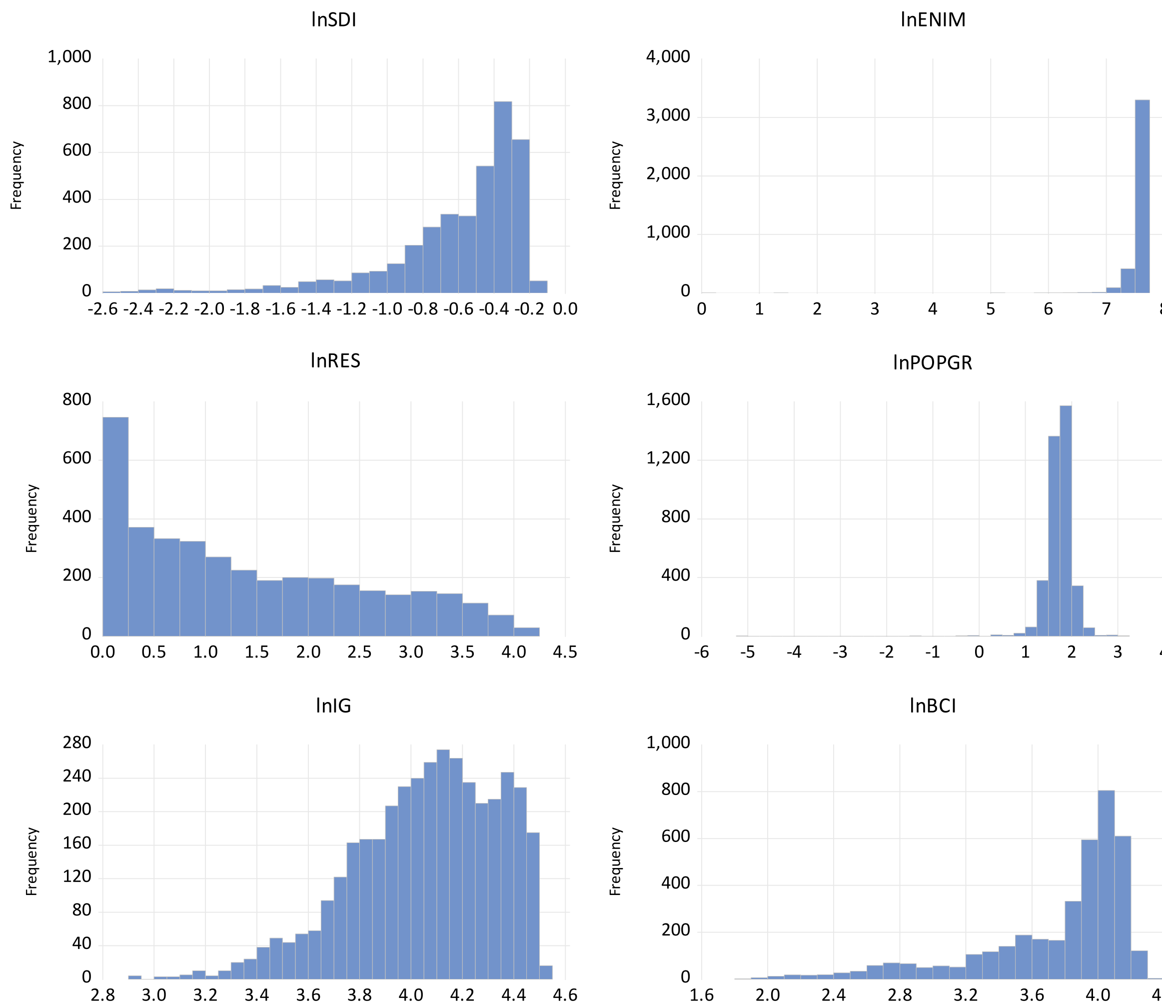

Fig. 3. Distribution of the series.

Table 2
Chudik and Pesaran (2015) CSD test.

Variables	Statistics	Variables	Statistics
Full Sample			
lnSDI	15.545***	lnENIM	50.238***
lnIG	452.270***	lnPOPGR	53.262 ***
lnRES	109.736***	lnBCI	5.734***
AE			
lnSDI	101.236***	lnENIM	8.420***
lnIG	120.708***	lnPOPGR	2.113 **
lnRES	22.205 ***	lnBCI	17.056 ***
EMDE			
lnSDI	109.330***	lnENIM	16.159 ***
lnIG	331.077***	lnPOPGR	64.049 ***
lnRES	90.851 ***	lnBCI	10.814 ***

Note *** and ** stand for 1% and 5% levels of significance.

faster growth of the population can spur economic growth and development, which can in turn encourage technological innovation (Das Gupta et al., 2011). Technological innovation, driven by rapid economic growth, can expand natural resources for indefinite periods and can also assist in driving down environmental degradation (Ahmad et al., 2020). As a result, population growth can benefit the sustainable development of these countries by spurring growth, technological innovation and by decreasing environmental degradation. Population optimists support this since growth of the populaton can provide an economy with copious labor, intellectual capital as well as spillovers of knowledge

Table 3
Second generation unit toot tests.

Variables	CIPS		CADF	
	Level	First difference	Level	First difference
Full Sample				
lnSDI	−1.853	−4.588 ***	−1.81	−3.192 **
lnENIM	−2.194	−5.009***	−2.268	−3.597 ***
lnIG	2.798***	–	2.670***	–
lnPOPGR	−2.009	−2.727 ***	−2.04	−2.588**
lnRES	2.747***	–	2.692***	–
lnBCI	−0.83	−2.572 *	−1.901	−3.504**
AE				
lnSDI	−1.965	−4.774***	−1.956	−3.355***
lnENIM	−1.337	−4.805***	−1.337	−3.711***
lnIG	−3.079***	–	−2.987***	–
lnPOPGR	−1.413	−3.856***	−1.965	−3.866***
lnRES	−2.411***	–	−2.782***	–
lnBCI	−1.127	−2.629***	−1.883	−2.504***
EMDE				
lnSDI	−2.103	−4.416***	−1.851	−2.955***
lnENIM	−2.176	−5.034***	−1.737	−3.423***
lnIG	−2.623**	–	−2.472***	–
lnPOPGR	−1.874	−4.365 ***	−1.823	−4.294***
lnRES	−2.712***	–	−2.350***	–
lnBCI	−1.765	−2.736***	−1.524	−3.114***

Note *** and ** stand for 1% and 5% levels of significance.

Table 4
Westerlund (2007) Cointegration test.

Statistic	Value	Z-value	P-value	Robust P-value
Full Sample				
Gt	−0.901	14.427	1.000	1.000
Ga	−0.94	15.89	1.000	1.000
Pt	−11.388	8.1	1.000	0.000
Pa	−1.022	9.972	1.000	0.000
AE				
Gt	−1.511	3.884	1.000	0.000
Ga	−4.201	5.628	1.000	0.000
Pt	−8.274	2.074	0.981	0.000
Pa	−4.186	2.778	0.997	0.000
EMDE				
Gt	−1.415	7.503	1.000	0.000
Ga	−4.255	9.481	1.000	0.000
Pt	−17.417	0.754	0.775	0.000
Pa	−6.074	2.4	0.992	0.000

Table 5
Result of CS-ARDL model technique.

VARIABLES	Full Sample	AE	EMDE
	Short run Estimation		
L.LNSDI	−0.256***	−0.329***	−0.624***
	(0.0122)	(0.0167)	(0.0344)
lnENIM	−2.252*	−6.245**	−0.850*
	(1.184)	(3.174)	(0.476)
lnRES	2.607	2.627	−0.0201
	(3.101)	(7.408)	(0.0249)
lnIG	0.452***	0.820***	0.331***
	(0.0752)	(0.272)	(0.0526)
lnPOPGR	0.0381***	0.0650	0.0326***
	(0.00975)	(0.111)	(0.0100)
lnBCI	−0.202***	−0.343***	−0.143***
	(0.0180)	(0.0358)	(0.0172)
	Long run Estimation		
lnENIM	−1.617**	−4.467**	−0.452
	(0.821)	(2.167)	(0.281)
lnRES	1.939	2.029	−0.0104
	(2.288)	(5.412)	(0.0121)
lnIG	0.343***	0.628***	0.193***
	(0.0547)	(0.192)	(0.0299)
lnPOPGR	0.0293***	0.0365	0.0214***
	(0.00742)	(0.0816)	(0.00696)
lnBCI	−0.154***	−0.256***	−0.0824***
	(0.0132)	(0.0261)	(0.00931)
ECT	−1.256***	−1.329***	−1.624***
	(0.0122)	(0.0167)	(0.0344)
F stat	13.12***	12.08***	9.72***
R-squared	0.086	0.092	0.112
R-squared (MG)	0.089	0.89	0.88
Number of Countries	127	33	94

Note.
Standard errors in parentheses.
***, **, and * stand for 1%, 5%, and 10% levels of significance.

(Woldegiorgis, 2023). posited that population growth can attain sustainable development through reduced carbon emissions and energy savings. However, studies such as Yeh and Lio (2017) argued that population growth has a negative effect on sustainable development through increasing CO2 emissions.

Lastly, the Bayesian corruption index shows a negative and significant effect on sustainable development for all groups. Corruption possibly can undermine the rule of law, democratic governance and adversely affect economic and sustainable development by decreasing tax revenues, increasing public spending, and hampering the productivity and competitiveness of a country (Hoinaru et al., 2020). According to the World Bank (2009), corruption is one of the greatest barriers in achieving social and economic development and in reducing world poverty. Corruption is also an obstacle for increasing investments and a critical factor for driving inefficiency in fiscal policies. In addition to having negative effects on socio-economic welfare, corruption can also significantly undermine environmental welfare by decreasing the stringent implementation and efficacy of regulations related to the environment. As a result, corruption hampers sustainable development in all the three groups we analyzed (Leal and Marques, 2021). The findings are supported by the studies of Nasreen and Riaz (2016) as well as that of Harring (2013) who have asserted that the corruption level is responsible for environmental degradation, biodiversity loss, and makes it difficult in preserving the environmental quality.

4.2. Robustness check

For robustness purpose, other second-generation estimation techniques, e.g., CCE-MG, AMG, and MG are used, and the results are reported in Tables 6–8 for the full sample, AE, and EMDE groups, respectively. The results for the full sample support the findings of long run estimates from CS-ARDL technique. In terms of AE group, the results reported in Table 7 also support the CS-ARDL outcomes. In Table 8, the results presented for the EMDE group support the findings from CS-ARDL, except for the coefficient of lnRES in MG. In a nutshell, the empirical findings of the CS-ARDL approach are found to be robust and reliable, as verified against the findings from CCE-MG, AMG, and MG estimations.

4.3. Summary of results

This study investigates the impact of energy imports and natural resource rents on sustainable development for 127 countries over 1990–2019. The 127 countries are again divided into Advanced Economies (AE) sample and Emerging and Developing Economies (EMDE) sample according to the IMF classification. To this end, globalization, population growth, and corruption are considered as controls. Second generation methods were used for estimation purposes. The summary of the results is as follows.

1. According to the Westerlund cointegration test results, there is a long-term relationship among energy imports, globalization, population, corruption, natural resource rents, and sustainable development for the full sample and two group samples.
2. CS-ARDL estimator shows short-run and long-run estimations. In the short run, sustainable development is positively affected by globalization and population growth for the full and two group samples. However, the impacts of energy imports and corruption are negative in all three cases.

Table 6
Long-run elasticity estimates (CCEMG, AMG & MG)-Full Sample.

VARIABLES	CCE-MG	AMG	MG
lnENIM	−1.834*	−4.590*	−2.313**
	(1.060)	(2.406)	(1.178)
lnRES	3.563	5.369	7.274
	(3.860)	(6.489)	(6.699)
lnIG	0.578***	0.452***	0.368***
	(0.0731)	(0.082)	(0.0923)
lnPOPGR	0.0501***	0.049***	0.0518***
	(0.0116)	(0.013)	(0.0131)
lnBCI	−0.243***	−0.216***	−0.216***
	(0.0202)	(0.021)	(0.0205)
Constant	−0.266	5.575	−1.184**
	(0.973)	(6.489)	(0.570)
Number of Countries	127	127	128
Wald Chi2	164.77***	139.72***	141.18***
Root Mean Squared Error (sigma)	0.0139	0.0248	0.0283

Note.
Standard errors in parentheses.
***, and ** stand for 1% and 5% levels of significance.

Table 7
Long-run elasticity estimates (CCEMG, AMG & MG)-AE countries result.

VARIABLES	CCE-MG	AMG	MG
lnENIM	−2.023***	−1.589***	−2.558***
	(0.551)	(0.548)	(0.877)
lnRES	0.0498	0.0355	−0.00310
	(0.0595)	(0.0366)	(0.0643)
lnIG	1.363***	1.384***	0.574**
	(0.190)	(0.152)	(0.259)
lnPOPGR	0.0246	0.00110	0.0258
	(0.0192)	(0.0128)	(0.0264)
lnBCI	−0.386***	−0.360***	−0.381***
	(0.0366)	(0.0341)	(0.0404)
Constant	−0.723	−5.161***	−1.403
	(1.775)	(0.971)	(1.304)
Number of Countries	33	33	33
Wald Chi2	178.50***	203.77***	103.57***
Root Mean Squared Error (sigma)	0.0193	0.0304	0.0464

Note.
Standard errors in parentheses.
***, and ** stand for 1% and 5% levels of significance.

Table 8
Long-run elasticity estimates (CCEMG, AMG & MG)-EMDE countries result.

VARIABLES	CCE-MG	AMG	MG
lnENIM	0.0210	0.0508	0.0565
	(0.0239)	(0.0317)	(0.0484)
lnRES	0.00119	0.00214	0.00483**
	(0.00214)	(0.00178)	(0.00202)
lnIG	0.263***	0.249***	0.305***
	(0.0421)	(0.0352)	(0.0549)
lnPOPGR	0.0266***	0.0192***	0.0155**
	(0.00675)	(0.00659)	(0.00728)
lnBCI	−0.126***	−0.102***	−0.111***
	(0.0149)	(0.0139)	(0.0184)
Constant	−0.972**	−1.484***	−1.654***
	(0.421)	(0.128)	(0.192)
Number of Countries	94	94	94
Wald Chi2	127.52***	116.52***	78.91***
Root Mean Squared Error (Sigma)	0.0106	0.0151	0.0180

Note.
Standard errors in parentheses.
***, and ** stand for 1% and 5% levels of significance.

3. For the long run, while globalization and population growth increase sustainable development, energy imports and corruption affect sustainable development negatively in all three groups. However, although negative, energy imports have insignificant impacts on sustainable development for the EMDE sample. Finally, natural resource rents have no significant impact on sustainable development in all three of them. The impacts are found to be the same in the short and long run.
4. CCEMG, AMG, and MG tests have been employed for the long-run robustness check. All tests deliver the same findings with the CS-ARDL approach. According to the findings, although population growth and globalization promote sustainable development, energy imports and corruption have a negative impact on it in the long run. Natural resource rents do not have a significant impact on sustainable development in all three groups from most of the estimations. In contrast to the full sample and AE sample, energy imports do not have any significant impacts on sustainable development from the robustness tests. Therefore, CCEMG, AMG, and MG tests prove that empirical findings are robust and reliable.

5. Conclusion and policy recommendations

5.1. Policy implications

The policy framework to attain sustainable development requires reorienting the energy-led growth pattern, and it can be achieved through energy imports and natural resource rent. Given that energy imports are negatively impacting sustainable development, policymakers need to introduce import-substitution policies for energy products. However, this might have an immediate negative impact on the economic growth pattern, as well as on the energy security of the nation. Given the prevalence of energy import signifies the inability of the domestic energy infrastructure to cater to the energy demand of the nation, the import substitution of energy products needs to be preceded by certain policy initiatives. These initiatives should be aimed at boosting renewable energy generation by gradually replacing fossil fuel solutions. This can be materialized by imposing the carbon footprint linked to *Pigouvian Taxation* on the polluting firms. The eventual rise in the cost of operations will discourage the firms from using fossil fuel solutions and the demand for renewable energy will rise. At the same time, the extraction of natural resources for energy usage might also be reduced due to the gradual rise in the renewable energy demand. Further extraction of natural resources can be reduced by strengthening the laws for protecting public goods.

The operationalization of this policy initiative should be complemented by the following phases of the policy framework. Internalization of the negative environmental externalities should be supported by the intensification of the positive social externalities. The rising renewable energy demand will be supported by the rise in renewable energy generation firms, which might be operating from the public or private sectors. A gradual rise in their operations will start creating job opportunities. This will help in improving the standard of living in these nations, while reducing the incidences of income inequality. At the same time, the materialization of suitable rehabilitation facilities for the labors laid off from the traditional energy generation sectors and providing them with the necessary training and development to get employment in the renewable energy sector will help in reducing the possibilities of any kind of social imbalance. The population growth in this regard might have a dual impact. First, the rise in the population will catalyze the rise in energy demand, and second, the newly developed renewable energy sector will have a steady supply of labor. Following the circular economy principle in a two-sector model, population growth will thus influence sustainable development by creating environmental and social impacts in an indirect way.

Stabilizing this policy framework needs international trade to be scrutinized for any kind of negative environmental externalities. The rise in renewable energy demand will increase the demand for cleaner technological solutions, and the globalization channel might be utilized to fulfill this objective. The import substitution policies for energy products will be strengthened by incorporating this provision. However, the policymakers need to ensure that the public and bureaucratic systems are free from any kind of rent-seeking mechanism, as it might hinder the ease of operation and subsequently the attainment of sustainable development. Reducing the incidences of corruption will help in improving the transparency of the regulatory system, and in turn, the effectiveness of the governance structure will improve. It will help in improving the efficacy of the other developmental policies.

5.2. Limitations and future directions

The policy framework recommended in the present study is aimed at a broad-based approach toward sustainable development. Nevertheless, this aim might appear to be an ambitious policy objective, and a developmental policy framework might suffer from unobserved nuances. So, it might be assumed to be a limitation of the study in terms of defining the scope as broad, with a narrow parameterization. Yet, it is also necessary to iterate that this narrow parameterization is purposefully chosen with a view to bringing most of the countries under the purview of this policy framework. Moreover, limiting the number of parameters in the policy framework leaves room for context-specific calibration, which gives the required generalizability to the policy framework. Therein lies the contribution of the present study. Future studies in this direction can be carried out by considering specific SDGs for chosen contexts. This will help in developing more focused and targeted policy frameworks.

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CRediT authorship contribution statement

Kui Meng: Formal analysis, Investigation, Resources, Formal analysis, Supervision. **Kaiyang Zhong:** Resources, Writing – review & editing, Supervision. **Shujaat Abbas:** Resources, Writing – original draft, Writing – review & editing. **Emrah Sofuoğlu:** Resources, Writing – original draft, Formal analysis. **Ibikunle Kaosarat Olawunmi:** Resources, Writing – original draft, Formal analysis. **Avik Sinha:** Resources, Formal analysis, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgment

None.

Appendix Table A.1

East Asia and Pacific		Europe and Central Asia		Latin America and the Caribbean		Sub-Saharan Africa	
Country	Group	Country	Group	Country	Group	Country	Group
Australia	Advanced Economies	Kazakhstan	EMDEs	Mexico	EMDEs	Angola	EMDEs
Brunei Darussalam	EMDEs	Kyrgyz Republic	EMDEs	Nicaragua	EMDEs	Benin	EMDEs
Cambodia	EMDEs	Latvia	Advanced Economies	Panama	EMDEs	Botswana	EMDEs
China	EMDEs	Lithuania	Advanced Economies	Paraguay	EMDEs	Cameroon	EMDEs
Indonesia	EMDEs	Moldova	EMDEs	Peru	EMDEs	Congo, Dem. Rep.	EMDEs
Japan	Advanced Economies	Netherlands	Advanced Economies	Suriname	EMDEs	Congo, Rep.	EMDEs
Korea, Rep.	Advanced Economies	Norway	Advanced Economies	Trinidad and Tobago	EMDEs	Cote d'Ivoire	EMDEs
Malaysia	EMDEs	Poland	EMDEs	Uruguay	EMDEs	Eritrea	EMDEs
Mongolia	EMDEs	Portugal	Advanced Economies	Venezuela, RB	EMDEs	Ethiopia	EMDEs
Myanmar	EMDEs	Romania	EMDEs	**Middle East and North Africa**		Gabon	EMDEs
New Zealand	Advanced Economies	Russian Federation	EMDEs	Algeria	EMDEs	Ghana	EMDEs
Philippines	EMDEs	Serbia	EMDEs	Bahrain	EMDEs	Kenya	EMDEs
Singapore	Advanced Economies	Slovak Republic	Advanced Economies	Egypt, Arab Rep.	EMDEs	Mauritius	EMDEs
Thailand	EMDEs	Slovenia	Advanced Economies	Iran, Islamic Rep.	EMDEs	Namibia	EMDEs
Vietnam	EMDEs	Spain	Advanced Economies	Iraq	EMDEs	Niger	EMDEs
Europe and Central Asia		Sweden	Advanced Economies	Israel	Advanced Economies	Nigeria	EMDEs
Albania	EMDEs	Switzerland	Advanced Economies	Jordan	EMDEs	Senegal	EMDEs
Armenia	EMDEs	Tajikistan	EMDEs	Kuwait	EMDEs	South Africa	EMDEs
Austria	Advanced Economies	Turkey	EMDEs	Lebanon	EMDEs	Tanzania	EMDEs
Azerbaijan	EMDEs	Ukraine	EMDEs	Libya	EMDEs	Togo	EMDEs
Belgium	Advanced Economies	United Kingdom	Advanced Economies	Malta	Advanced Economies	Zambia	EMDEs
Bosnia and Herzegovina	EMDEs	Uzbekistan	EMDEs	Oman	EMDEs	Zimbabwe	EMDEs
Bulgaria	EMDEs	**Latin America and the Caribbean**		Qatar	EMDEs		
Croatia	EMDEs	Argentina	EMDEs	Saudi Arabia	EMDEs		
Cyprus	Advanced Economies	Bolivia	EMDEs	Syrian Arab Republic	EMDEs		
Czech Republic	Advanced Economies	Brazil	EMDEs	Tunisia	EMDEs		
Denmark	Advanced Economies	Chile	EMDEs	United Arab Emirates	EMDEs		

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(continued)

East Asia and Pacific		Europe and Central Asia		Latin America and the Caribbean		Sub-Saharan Africa	
Country	Group	Country	Group	Country	Group	Country	Group
Estonia	Advanced Economies	Colombia	EMDEs	Yemen, Rep.	EMDEs		
Finland	Advanced Economies	Costa Rica	EMDEs	**North America**			
France	Advanced Economies	Cuba	EMDEs	Canada	Advanced Economies		
Georgia	EMDEs	Dominican Republic	EMDEs	United States	Advanced Economies		
Germany	Advanced Economies	Ecuador	EMDEs	**South Asia**			
Greece	Advanced Economies	El Salvador	EMDEs	Bangladesh	EMDEs		
Hungary	EMDEs	Guatemala	EMDEs	India	EMDEs		
Iceland	Advanced Economies	Haiti	EMDEs	Nepal	EMDEs		
Ireland	Advanced Economies	Honduras	EMDEs	Pakistan	EMDEs		
Italy	Advanced Economies	Jamaica	EMDEs	Sri Lanka	EMDEs		

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