Remittances Review
January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

Received: 5 December 2023, Accepted: 10 January 2024

DOI: https://doi.org/10.33282/rr.vx9il.74

Greening the Economy: Examining the Interplay of Green Finance, Financial Development, and Carbon Emission Reduction in OIC Nations

Saira Arsh
PhD scholar, Department of Economics
Lahore College for Women University Lahore (Pakistan)
e-mail: sairaarsh44@gmail.com
Hafsa Batool
Lecture in Economic, Lahore College for Women University Lahore
e-mail: batooleconomist@gmail.com
Dr. Saima Liaqat
Assistant Professor, Lahore College for Women University Lahore
e-mail: saima.liaqat@lcwu.edu.pk

Saba Gulzar

MS scholar, Department of Economics

Lahore College for Women University Lahore (Pakistan)

e-mail:

Dr. Ayza Shoukat
Lecturer in Economics, University of Sahiwal, Sahiwal. Punjab, Pakistan
e-mail: ayzashoukat@uosahiwal.edu.pk

Sania Zafar
Lecturer in Economics, University of Jhang, Jhang.
e-mail: saniazafar@uoj.edu.pk

Corresponding Author

Abstract

Various nations are striving to attain zero carbon goals by utilizing environmentally friendly technology and promoting sustainable development. Consequently, this analysis endeavors to ascertain the pivotal role of sustainable development in enhancing environmental quality. The present study investigates the influence of green finance, environmental taxes, financial development, renewable energy (REN), green growth, and income per capita on carbon emissions in 16 OIC economies over the time span from 2007 to 2021. Employing the fully modified ordinary least square (FMOLS) method, this study aims to determine the impact of green finance, environmental taxes and financial development on environmental quality, taking into account various plausible variables according to the environmental Kuznets curve (EKC) paradigm. In order to ensure robustness, the study also adoptsthe dynamic ordinary least square(DOLS) method in conjunction with FMOLS to gauge the impact of green finance, environmental taxes and financial development on environmental quality. The findings indicate that CO2 emissionis significantly influenced by green finance, environmental taxes, financial development, renewable energy, green growth, and income per capitawithin the context of OICnations. Moreover, the effect ofall independent variables (except GDP) and CO2 emissions is inversely proportional. Based on the findings, policymakers are advised to prioritize the transformation of their respective energy systems in a manner that will surpass previous expectations by significantly reducing energy-related CO2 emissions.

Keywords: Green Finance, Financial Development, Carbon Emission, OIC Nation, FMOLS.

Introduction

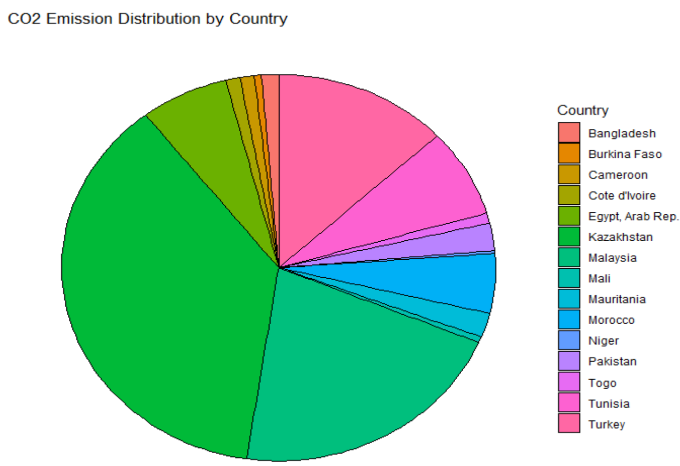
High dependence on fossil fuels for industrial and communal operations has raised concerns about carbon dioxide (CO2) emissions in the Organization of Islamic Cooperation (OIC) region. While worldwide greenhouse gas (GHG) emissions increased by 43% between 1990 and 2017, OIC GHG emissions surged by 77%, reaching 9 Gt-CO2 equivalent (SESRIC, 2022). Over time, many countries of OIC are oil producing, have witnessed a rise in CO2 emissions per person. This is primarily resultsdue to increased industrial and communal activities that depend on fossil fuels. The OIC nations should implement measures to mitigate climate

January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

change, such as adopting environmental friendly technologies. Reduction of CO_2 emission and maintenance of socioeconomic development has become a burning issue for OIC region (Irfany et al., 2022).

Figure 1 shows the distribution of CO_2 release by sample nations. Kazakhstan is the largest pollution emitter followed by Malaysia and Turkey. Mali has the lowest emission of CO_2 may be due to its small size of economy.

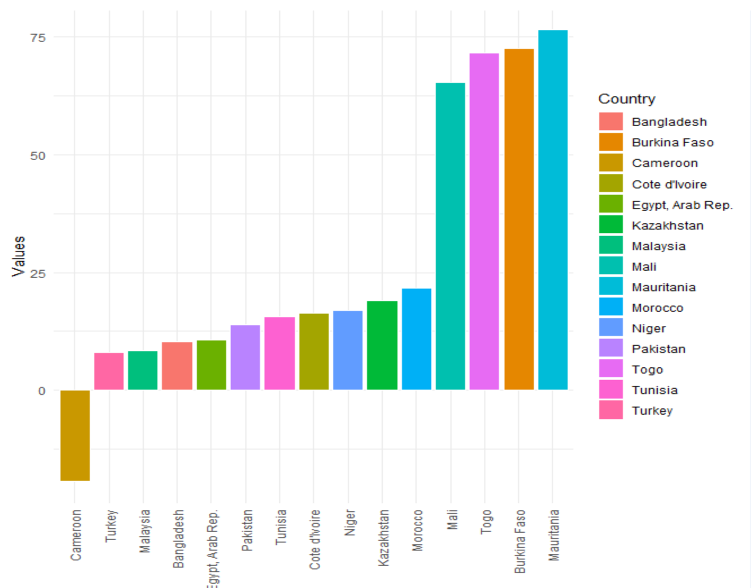
Figure 1. CO2 emission (metric tons per capita)



Source: WDI

Figure 2 makes it evident that the chosen OICnations differ significantly in terms of patents on environmentalrelated technologies.

Figure 2. Patents on ERT



Source: WDI

In the OIC region, the effects of environment taxes and patents on technologies on CO2 emissions is complicated matter. Studies indicate that the quantity of patents in environmental technologies, a measure of technological innovation, may contribute to a decrease in CO2 emissions. For example, eco-innovation is anticipated to have a positive impact on environmental qualities and is perceived as a solution to environmental issues (Hassan et al., 2023).Furthermore, research has demonstrated that a rise in technological innovation can reduce CO2 emissions(Adebayo et al., 2022).This suggests that reducing CO2 emissions in the OIC region may be possible through the creation and adoption of green technologies through patents.

January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

Patents filed with the intention of improving humanity and the environment are referred to as "green patents." Usually, they are associated with innovations that seek to lower energy usage, cut emissions, and offer further environmental benefits (GlobalData, 2024).These patents include wide range of innovations such as renewable energy technologies i.e. wind and solar energy, green transportation technologies, and other environmental friendly innovations (Leon et al., 2018). To detect and track green patents, the World Intellectual Property Organization (WIPO) and the Organization for Economic Cooperation and Development (OECD) have created classification systems i.e. the IPC Green Inventory. This allows for the tracking of technological progress in the environmental domain (Favot et al., 2023; OECD, 2024).The increase in green patents is suggestive of an increasing emphasis on creating solutions that resolve climate change issues and promote environmental sustainability (GlobalData, 2024).

The implementation of environmental taxes can also contribute to lessening in CO2 emissions. In order to provide businesses with an economic incentive to cut their emissions, environment taxes are intended to internalize the external costs of environmental harm into the price of goods and services. Although direct research on the effect of environment taxes on CO2 emissions in the OIC region is lacking, general economic theory indicates that taxes can help lower emissions by increasing the cost of carbon-intensive activities and promoting the use of cleaner technologies (Saleem et al., 2022).

In an effort to save the environment, many nations have recently made investments in energy-related technology. Likewise, many industrialized and emerging nation have been encouraged to shift their focus to green growth and sustainable economic growth due to factors such as energy supply security, climate change, energy dependency, environmental disasters, and energy price volatility (Wang and Azam, 2024).Global policy changes in recent times, however, seem to indicate that different policymakers are committed to changing the nation's energy system to a low-carbon, green growth path that will cut CO2 emissions and air pollution associated with energy use more rapidly than anticipated. Using green growth practices and technologies is playing a fundamental role on a worldwide scale, and resource depletion and protect environment. Thus, itensures that successive generations have access to a clean environment.

Green growth techniques have the potential to attain both poverty reduction and sustainable economic growth objectives. Depletion of natural resources and environmental damage can pose a threat to the economic expansionof any economy. Schmalensee, (2012), however, looked at the unfavorable relationship between environmental deterioration and economic growth. Previous studies revealed that emerging nations are ending poverty through traditional growth, and their regulations are unclear when it comes to green growth and the shift to a sustainable growth route for a clean environment (Saleem et al., 2020; Shahbaz, 2018a).

There has been less research on green growth within the context of EKC than traditional growth (GDP gross), which was the subject of much earlier writing (Saqib et al., 2022; Kar, 2022; Naveed et al., 2022; Omri et al., 2023; Kostakis et al., 2023; khan et al., 2023; Imran et al., 2023). As a result, this study offers academics and policymakers fresh perspectives. Additionally, existing researches have focused on the effect of FD and use of REN on CO2 release in OIC nations (Salahodjaev et al., 2023). Umar and Safi, (2023) analyzed the impact of green financing and green innovation on CO2 release in OECD nations.

Thus, there is a vacuum and the current research is an endeavor to fill this vacuum by contributing to the importance of the green financing-green growth-CO2 emission relationship through distinct aspects. (i) Our research extends the study of Salahodjaev et al., (2023) through examining the effect of green financing, environment taxes and green growth on CO2 release in 16 OIC nation. The relationship between green growth and environmental quality to promote sustained economic growth for OIC nations is not discussed extensively in the previous literature except (Saleem et al., 2022). Although, several studies have discussed the relation between environmental taxes, green innovation, renewable energy, and CO2 emission (Saleem et al., 2022; Salahodjaev et al., 2023), their findings are ambiguous. A more profound analysis is needed to reassess the relation among green financing-green growth-CO2 emission nexus in OIC nations. Further, OIC nations are not considered in previous researches (Can et al., 2021; Hao et

January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

al., 2021). (ii) We have exploited the latest data (2007-2021) for green finance, environmental taxes, and green growth to highlight the importance of technological advancement motivated by environmental concerns, renewable energy innovations, GDP, green growth, patents for eco-friendly projects, and environmental taxes within the framework of Environmental Kuznets Curve. (iii) Modern panel data econometric techniquesi.e. Pesaran, (2007) unit root test, Westerlund, (2007) cointegration test, FMOLS, and DOLS areemployed in the analysis to achieve the stated goals.Lists of abbreviations and countries are provided in Appendix (see Table A1 and A2, repectively).

Rest of the paper is as following, section 2 presents literature review, section 3 presents data and methods, section 4 presents results and discussion and finally section 5 presents conclusionalong with policy implications.

Literature Review

The financial sector promotes environmental cleanliness via technological changes for eco-friendly production. Energy efficiency policies additionally lower capital costs (Saleem et al., 2020). Environment sustainability is influenced by several factors, including greenhouse gas (CO2) emissions, GDP growth,FD, (Shoaib et al., 2020), FDI inflow, renewable energy usage(Erdogan, 2014), technological innovation (Ahmad and Raza, 2020), and relationship betweeneconomic growth, population, energy usage, and CO2 release (Rahman et al., 2017).

Green financing-Green technology and CO2

Technological innovations significantly contribute to energy-related growth, supportingendogenous growth theory. Innovation externality (Romer, 1990) reduces environmental pollution by improving air quality. Technological improvements can leads to increasing returns in the long term; progressively reduces pollution in the EKC framework. Studies, including Lin et al., (2016), Balsalobre et al., (2018), and Sarkodie and Ozturk, (2020), discussed the implication of EKC framework for enhanced production capacity and cleaner technology, fostering improved environmental quality.

Andreoni and Levinson, (1998) argued that decontamination process is dependent on technological improvement, greater investment in innovation leads to reduce air pollution. Thus, the process of energy innovation accelerates environmental improvement. Researchers have found that technological innovation led the reduction in use of fossils in Malaysia.Jones, (1995) also found the same result. Fang, (2011) and Inglesi-Lotz, (2015) argued that expenditure on R & D and economic growth have direct relationship. Technological innovation leads to energy efficiency and reduces energy consumption (Sohag et al., 2015).

Lazarashvili, (2020) and Fedotova et al., (2022) argued that financial investment in environmentally sustainable growth is significant, particularly in the context of "green" financing. The development of a green economy is dependent on green financing, which can mitigate resource depletion and reduces environmental risks. Wen et al., (2021) analyzed the association between green innovation and environmental quality in South Asiaover 1990 to 2014.The results revealed that green technology improves environmental quality significantly in South Asia.

Zhang et al., (2021) examined the impact of green credit on environmental quality in China from 2007 to 2016. Using fixed effect model,the results showed that green credit improves environmental quality overall by reducing environmental pollution. Jahanger et al., (2023) investigated the mitigating role of green finance and clean energy in carbon emissions in ASEAN countries over the time of 2000-2020. Using NARDLthey found that positive shocks in green finance and clean energy improve air quality.Zhou et al., (2020), Huang and Chen, (2022), Su et al., (2022), Li et al., (2022) and Zeng et al., (2022) exploredthe effect of green financing on environmental conservation in China.They found that green financing has positive effect on environmental quality. Similarly, Kahraman, (2022) also supported that green finance promotes environmental quality. Pizzol and Andersen, (2022), utilizedgreen patents to investigate the challenges faced in introducing green technologies to the market. The study highlighted that upscaling green technology innovations is a challenging and enduring process, often more difficult than expected by inventors, the public, and policymakers.

Environmental Taxes and CO2

Facilitating investment in clean energy and reducing CO2 emissions involves controlling non-renewable energy prices and implementing taxes on them (Saleem et al., 2020). Many countries are adopting environmental taxes for this purpose. Gerlagh and Van der Zwaan, (2006) in their study underlined the significance of taxes on carbon emission using energy consumption model. Using general equilibrium simulation model, Bruvoll and Larsen, (2004) investigated the role of carbon taxes in CO2 reduction in Norway. Likewise, Xia et al., (2007) explored the indirect link between environment tax and carbonrelease, underscoring the significant effect of carbon taxes and economic growth as essential environmental degradationpredictors.

Nakata and Lamont, (2001) highlighted environmental protection programs in Japan, specifying the taxes on carbon release, for improved environment quality. Wissema and Dellink, (2007) addressed environmental condition in Ireland, signifying that carbon taxes can significantly reduce future carbon emissions. Earlierresearch work byHao et al., (2021) have concentrated on growth, carbon release, and carbon tax due to their growingsignificance in economic expansion and environmental cleanliness. These empirical researches consistently report similar findings regarding causal relationship between carbon tax and pollution.

Financial Development and CO2

Diverse economies can achieve sustainability by implementing policies related to financial liberalization to address environmental pollution (Saleem et al., 2022). FD is critical factor that affects environment quality. A strong financial sector promotes economic growth but may have harmfulconsequences for environmental quality. However, it can also contribute to environmental protection through financial aid (Nassani et al., 2017). The financial sector supports environmental cleanliness through technological changes, enabling eco-friendly production processes. Implementing energy efficiency policies can also effectively lower capital costs (Szabo and Jager-Waldau, 2008).

January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

Environmental quality could be achieved through efficient utilization of financial resources for energy-efficient industries (Saleem et al., 2020; Shahbaz et al., 2013d). Dogan and Turkekul, (2016) found the unidirectional causality from CO2release to financial sector growth in USA. Aye and Edoja, (2017) studied bidirectional causality between CO2 emissions and FD in selected emergingnations. Li et al., (2020) examinedhow environmental regulation and FDaffect green technological advancement in Chinese enterprises, with the aim of promoting economic transformation towards sustainability in China. The study found that FD and environmental regulationslead to green technological progress. Xu et al., (2021) studied the influence ofFDon environment quality in China from 2001 to 2017.Employing panel smooth transition regression,findings reveal that FD indirectly affects environmental pollution. In regions with inadequate FD,there is environmental contamination. While in more developed regions, FD has mixed effects, improving environmental quality through technological innovation while decreasing it by supporting industries.

Green growth and CO2

Achieving MDGs is imperative. Energy is closely related to economic growth, transportation, and employment (Karekezi et al., 2012). Global agreements to combat climate changes force nations to decide between prioritizing economic growth and reducing energy to limit CO2 emission. Focusing on the causal nexus among energy, the economy, and the environment is crucial for sustainable growth. The UN and the PCCC prioritize green growth, alternative energy, and global warming reduction for sustainable development (Renewable Global Status Report, 2017). Thus, investigation into the relationship between CO2 emissionsand green growth is vital for environmental safety and SDGs. The main objectives include reducing the global temperature to below 2 °C and stressing upon green growth. Wei et al., (2023)examined the impact of green growth on environment sustainability in top 10 green future economies from 1990-2018. Yikun et al., (2022) investigated the trends in sustainable development goals (SDGs) in G7 countries. The results of both studiesrevealed that technological innovations and green growth encourage environmental sustainability.

January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

Nevertheless, literature regarding the relationships amongst energy consumption, CO2 emission, green growth, andeconomic growth is limited. In currentera, green growth has become significant variable in research on the nexus between carbon emission andeconomic growth, as evident in studies by Sohag et al., (2019), Hao et al., (2021), and Wei et al., (2023).

Renewable energy (REN) consumption and CO2

Jos et al., (2012) state that heavy reliance on fossil fuels has led to a significant increase in CO2 emissions. According to Jos et al., (2012), above 90% of CO2 emission result due to fossil fuels combustion. The EU Joint Research Centre reports a substantial rise in CO2 emissions due to the heavy use of fossil fuels. The IEA, (2014) report highlights that historically, fast economic expansion in industrialized nations has notably deteriorated environment quality and several emerging nations have recently made significant contributions to CO2 emissions.

Tan and Cao, (2022) examined the effect of green technology innovation and renewable energy (REN) consumption on environmental quality in 81 nations from 2001 to 2020. The findings showed that these factors have negative effect on carbon CO2 emissions. Moreover, the study argued that the effects of green technology innovation and REN consumption on CO2 emissions vary among different country groups. Specifically, they significantly affect CO2 emissions in non-Belt and Road (B&R) and high-income nations, while they have no effect in middle- and low-income and B&R nations.

The reduction infossil fuel reliance could be alleviated through the production and utilization of renewable energy(REN) (Saleem et al., 2022). Consequently, advancements in technology within the energy sector have the potential to stimulate economic expansion. Several prior empirical analyses conducted for various nations have employed data on economic growth and REN, as demonstrated by Halkos and Tzeremes, (2014) andAzlina et al., (2014). Particularly, Lu, (2017), Amri, (2017), Troster et al., (2018), andSaad and Taleb, (2018)have recently engaged in extensive discussions on the consumption of REN and its impact on growth. Moreover, the research conducted by Pata, (2018), Saleem et al., (2020) and Hao et al., (2021)

January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

have underscored the crucial role ofREN, technological advancements, and progress in enhancing environment quality.

Nepal et al., (2020) explored the relationship between economic growth and environmental quality in Asia from 2000 to 2018. They concluded that economic growth positively affects environmental quality, supporting the EKC hypothesis. Saleem et al., (2022) analyzed the effect of GDP on CO2 emission in 12 Asian nations from 1990 to 2018. Using CS-ARDL, the study found that at first GDP increase carbon emission but square of GDP leads to decrease carbon emission leading to support EKC hypothesis.

Research Gap

The reviewed studies emphasize the complex relationship between various factors and their influence on environmental sustainability. Technological innovations, as demonstrated by Lin et al., (2016), Sarkodie and Ozturk, (2020), positively affect energy-related growth and environmental quality, leading to reduced pollution. Green financing, highlighted by Lazarashvili, (2020) and Wen et al., (2021), drives environmentally sustainable growth, mitigating resource depletion and reducing environmental risks. Environmental taxes are effective in controlling non-renewable energy prices and reducing CO2 emissions, as suggested by Gerlagh and Van der Zwaan, (2006) and Wissema and Dellink, (2007). Additionally, financial development promotes economic growth and contributes to environmental protection through technological innovation (Li et al., (2020); Xu et al., 2021). Green growth is prioritized in achieving sustainable development goals (Wei et al., 2023; Yikun et al.,2022) highlighting its positive impact on environmental sustainability. Furthermore, renewable energy consumption negatively affects CO2 emissions, supporting the idea that reducing reliance on fossil fuels improves environmental quality, as evidenced by Tan and Cao, (2022) and Saleem et al., (2022). Overall, these findings stress the need for a comprehensive approach involving financial mechanisms, technological innovation, and sustainable policies to address the challenges of environmental sustainability and climate change.

January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

There are few studies that are conducted in OIC nations (Salahodjaev et al., 2023). However, there is a lack of a synthesized outlook that examines the interactions and potential trade-offs among these components in context of OIC nations. Thus, current study extends the model of Salahodjaev et al., (2023) by incorporating the effect of green fiancé, environmental taxes, and green growth explicitly.

Model, Data and Method

Theoretical framework

Multiple input and output variables make up the production function form, and the model needs to have a specific mathematical form (Yang et al., 2021). Consequently, in light of objective of the current study, we employ the model of neoclassical. The following is the production function model:

$$Y(t) = A(t).f(K(t), L(t))........(1)$$

Where Y stands for output, L stands for labor, and K stands for capital.A represents the proportion of production inputs in total productivities.Environmental pollution results from the production and consumption of inputs in a number of economic sectors, including services, agriculture, and manufacturing. The following represents the equation for pollution emission (Hao et al., 2021);

$$PEM_t = Y(t)_t \sum_{i=1}^{N} \phi_{i,t} QPEM_{i,t} ....(2)$$

Equation (2) denotes the total pollution emissions from various economic sectors as PEMt, the aggregate output of those sectors as Y(t)t, the proportion of each sector's production to the aggregate production as $\phi_{i,t}$, and the share of each commercial sector to the emission as QPEMi,t.

Three stages of development i.e. "scale effect, composition effect, and technique effect" are described by the EKC analysis. If composition and technology stay the same in a given

January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

scaling effects validate the positive association between growth and environmental quality in a country (in the first stage), whereby increasing economic expansion degrades environmental quality because of inefficient industry. As per Ansari and Khan, (2021), the composition effect is linked to structural change in the economy, wherein pollution rises as a result of increased energy-extensive activity ofindustries. However, when less energy intensiveeconomic sector'stransitionto the process of development, the nature and significance of technological effects can be determined by examining the association between trade openness and environmental deterioration.

Environment related policies aims to increaseenvironment quality through regulations. Technical effects in Environmental Kuznets Curve models strengthen the link between environment quality and economic growth. According tothe study of Andreoni and Levinson, (1998), increased innovation investment positively mitigates pollution, particularly in decontamination processes. Strategies with high returns to scale in innovation facilitate energy efficiency improvements.

The following is the equation for these effects and the breakdown of the emissions rate change, according to Hao et al., (2021);

$$g^{PEM} = g^{SY} + \sum_{i=1}^{N} \iota_i g^{TQE_i} + \sum_{i=1}^{N} \iota_i g^{CQ_i} ....(3)$$

Where g^{CQ_i}, g^{TQE_i}, and g^{PEM} are composition, technical and scale effect respectively. The economic sector's portion of overall CO2 emission is denoted by ι_i. Equation 3 states that if the rise in production is brought about by the employment of eco-friendly technology, the scale effect will rise without causing pollution. As long as the rate of pollution reduction exceeds or stays constant with the rate of output growth. Stated otherwise, the following is the decomposition equation;

$$g^{SY} = -g^{TQE} + g^{E} ....(4)$$

Data and methodology

Remittances Review
January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

The study aims to investigate the effect of green growth and green finance along with other control variables on environmental quality in 16 OIC countries from 2007 to 2021. The data has been collected from WDI and OECD databases. The description is provided in Table 1. Following Seleem et al., (2022), we developed 2 models presented as follows;

Model 1

$$ENV_{it} = \beta_0 + \beta_1 ET_{it} + \beta_2 GF_{it} + \beta_3 FD_{it} + \beta_4 RE_{it} + \beta_5 GG_{it} + \beta_6 GG_{it}^2 + \varepsilon_{it} ....(1)$$

Model 2

$$ENV_{it} = \gamma_0 + \gamma_1 ET_{it} + \gamma_2 GF_{it} + \gamma_3 FD_{it} + \gamma_4 RE_{it} + \gamma_5 GDP_{it} + \gamma_6 GDP_{it}^2 + \mu_{it} ....(2)$$

Where i = 1,2,3,…,10 t = 2007, 2008,…, 2021

ENV is environmental quality and we measured it with CO2 emissions (metric tons per capita). Environmental taxes (% of GDP) is used to measure green taxes. GF is green finance and is measured with green patents (patents on environmental related technologies % of all). Financial development (FD) has a dual impact on environment, driving economic growth but also deteriorating environment through increased industrial pollution. Yet, it also offers opportunities for clean environment through technological advancements and eco-friendly production practices (Saleem et al., 2022). Energy is a crucial element for GDP growth, affecting productivity. The EKC framework underscores the interplay between energy and pollution. Non-renewable energy increases air pollution, while renewable source offers a pathway to mitigate environmental impact. EKC model considers the role of renewable energy consumption in carbon emissions (Shahbaz et al., 2017; Balsoalobre et al., 2018). GG and GG^2 are linear and square of green economic growth respectively. In order to assess the existence of EKC, this study used GDP and square of GDP.

Table 2 explain the data characteristics such as mean, standard deviation, minimum, maximum, and normality. It is evident that none of the data series hasnormaldistribution, as probability values are quite significant. Correlation analysis is provided in the appendix (see appendix A).

Table 1. Data description

Variable	Measure	Unit	Source
ENV	Environment Quality	CO2 (metric tons per capita)	WDI
ET	Environmental Tax	% of GDP	OECD
GF	Patents on Environmental related Technologies	% of all technologies	OECD
FD	Domestic credit to private sector	% of GDP	WDI
RE	Renewable Energy Consumption	Total final energy consumption in %	WDI
GG	Green Growth/Production based CO2	In percentage point %	OECD
GDP	Gross Domestic Product per capita	constant 2015 US$	WDI

Note: WDI stands for World Development Indicators.

Table 2.Descriptive analysis

Variable	Mean	S.D	Min	Max	Jarque-Bera
CO2	0.4932	1.2502	-1.5234	2.7305	9.0814 (0.010)
ET	1.0706	0.2575	0.6602	1.7422	16.841 (0.000)
GF	3.2295	0.5040	2.3872	5.1220	116.027 (0.000)
FD	3.6717	0.6998	2.1144	4.8968	6.5482 (0.037)
RE	2.7027	1.2625	0.1397	4.3998	7.7337 (0.020)
GG	1.6668	0.5170	0.2623	2.6354	4.8594

					(0.088)
GG^2	3.0438	1.6688	0.0688	6.9457	10.047 (0.006)
GDP	25.477	1.3915	22.009	27.754	19.167 (0.000)
GDP^2	651.04E	69.261	484.416	770.29	14.299 (0.000)

Source: Calculated by author. Note: All variables are used in log form. Probability values are in parenthesis. S.D is standard deviation.

Methods

This study begins with cross sectional dependence test (CD). CD represents a crucial concern in case of panel data analysis, requiring its empirical examinations. The occurrence of CSD can be attributed to the presence of unobserved common shocks and progressively significant interconnection among socioeconomic factors. Consequently, the panel estimators yield inconsistent and unreliable outcomes. Thus, it is necessary to address the issue of CD, as failure to do so may give rise to serious consequences (Sarafdis and Wansbeek, 2012).This research examines the dependency among different cross sections by implementing Pesaran's parametric test, introduced by Pesaran, (2007).The test statisticis as follows:

$$CDT=\sqrt{\frac{2T}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{g=i+1}^{N}\hat{\rho}_{ig}\text{.......(3)}$$

Unit Root Tests

Increasing global economic interdependence made it difficult to quantify disturbances and their cross-sectional panel analysis challenging. In panel data analysis, independence of disturbances across cross-sections is assumed. Presence of CSD among cross sections makes traditional unit root test quite powerless. Thus, to address the issue of stationarity, this study employed the first and second-generation panel unit root(IPS and CADF)testby Pesaran,

January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

(2007)and Im et al., (2003) respectively. This analysis initially tests cross-sectional dependence (CSD) to determine joint dependence in a panel unit process. Ignoring CSD leads to invalid statistics and inefficiencies.

Panel Cointegration Tests

Time series cointegration has recently been extended to panel data, similar to the panel unit root tests.Cointegration is the systematic relationship between selected variables, which allows the examination of stable long-term association. In cointegration, non-stationary variables are acceptable, but their linear combination must be stationary. To ensure robust inferences, this study has employed the Westerlund, (2008) panel cointegration test in addition to traditional cointegration test by Pedroni, (1999, 2004). The Durbin-Hausman test relies on cointegration-based metrics for fundamental analysis. In panel cointegration analysis, considering cross-sectional dependence (CSD) and common factors determines1(1) for the dependent variable and 1(0) and 1(1) integration levels for independent variables. Testing for cointegration involves the H1 (cointegration exists) against the H0 (no cointegration exists).

Fully Modified Ordinary Least Square (FMOLS)

The subsequent stage involves estimating the coefficients of long-term cointegration parameters after verifying that all the variables exhibit cointegration relationships with each other. When applied to cointegrated panel data, fixed effects (FE), random effects (RE), and generalized method of moments (GMM) approaches may produce inconsistent and misleading results. Therefore, in order to estimate the long run models, this researchappliedFMOLS and DOLS methods. The FMOLS technique yieldsreliable results even in cases with small sample size. Furthermore,it can address the problem of distorted outcomes caused by endogeneity and heterogeneity dynamics, as stated by Pedroni, (2001). Finally, FMOLS tackles the issues of serial correlation and heteroscedasticity (Narayan and Narayan, 2004), thus leading to more efficient results when dealing with limited sample size.

Results and Discussion

Empirical outcomes of the test for CD test are presented in Table 3. In order to determine the presence of CD across the variables, two different tests are employed, namely, the Pearson CD normal test and the Friedman chi-square test. Our results indicate the existence of cross-sectional dependence in the sample, H0 is rejected. The findings of the specified cross-sectional statistics confirm the presence of cross-sectional dependency among the sample.

Table 3 also presents the results of unit root test. We have employed both IPS (first generation) unit root test by IM et al., (2003) and CADF (second-generation) unit root test by Pesaran, (2007). Outcomes of CADFtest revealthe non-stationarity of data series at level. However, they are first difference stationary.

Table 3: CSD and Unit Root

Test	**Statistic**	**Probability**	**Hypothesis**	**Decision**
Pesaran CD normal	6.449	0.000	No CSD in residuals	Reject
Friedman chi-square	40.750	0.000	No CSD in residuals	Reject
Variable	**CADF**			
	Coefficient	**p-value**	**Coefficient**	**p-value**
CO2	-1.914	0.277	-2.537	0.008
ET	-1.720	0.489	-3.089	0.000
GF	-2.069	0.149	-2.509	0.010
FD	-1.549	0.680	-2.919	0.028
RE	-1.283	0.893	-3.020	0.000
GG	-1.546	0.683	-3.168	0.000
GG^2	-1.378	0.832	-3.135	0.000
GDP	-1.377	0.833	-2.803	0.001
GDP^2	-1.332	0.864	-2.822	0.001

Source: Calculated by author.

The subsequent phase of this investigation involves the identification of cointegrationamong the variables by means of Westerlund, (2007) cointegration test. In Table 4, the statistical findings of variance ratioisgiven, and the null hypothesis isrejected, thereby accepting the alternative hypothesis that a long-term cointegrationexists among variables. For robustness check, we have also employed Pedroni cointegration test by Pedroni, (2007). Pedroni cointegration test also supports the occurrence of cointegration amongst variables of the study (see Table 5).

Table 4: Westrlund Cointegration

	t-statistic	**Probability**
Model 1	1.739	0.041
Model 2	-1.348	0.088

Source: Calculated by author.

Table 5: Pedroni Cointegration

Within-dimension				
	Model 1		**Model 2**	
	Statistic	**Probability**	**Statistic**	**Probability.**
Weighted Panel v-Statistic	-1.6181	0.9472	-1.2927	0.9020
Weighted Panel rho-Statistic	2.3890	0.9916	3.1040	0.9990
Weighted Panel PP-Statistic	-1.9867	0.0235	-2.4303	0.0075
Weighted Panel ADF-Statistic	-1.4454	0.0742	-2.9715	0.0015
Between-dimension				
Group rho-Statistic	3.5712	0.9998	3.9816	1.0000
Group PP-Statistic	-2.559862	0.0052	-5.7679	0.0000
Group ADF-Statistic	-1.884565	0.0297	-1.9653	0.0247

Source: Calculated by author.

Remittances Review
January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

Following the objective of our study, we have employed the FMOLS and DOLS to explain the influence of green finance, green growth and FD on environmental quality. We have also investigated the effect of GDP and square of GDP on CO2 emission within the Environmental Kuznets Curve (EKC) framework. The outcomesof the FMOLS and DOLS are reported in Table 6, which indicates that ET, GF, FD, RE, GG, and GDP significantly influence CO2 emissions, in the context of OICnations. Notably, all variables except for GDP (economic growth) demonstrate an inverse relationship with CO2 emissions.

To achieve the environmental efficiency and effectiveness,it is necessary to implement environment taxes, whereby they have inverse relation to the CO2 emission. The industrial sector has the potential to change its framework from fossil fuel consumption to the employment of renewable technologies. Through the efficient utilization of eco-innovative technologies, industries can combat the CO2 emissions. Thus, the implementation of environmental taxes can urge investors to engage in eco-friendly projects. Consequently, the application of environmentally friendly production methods will contribute to the CO2 reduction through the enforcement of environmental taxes. According to the empirical findings, an increase of 1% in ET leads to a decrease of 0.18% and 0.12% in CO2 in model 1 and 2 respectively. These findings are in line with the research conducted by Criqui et al., (2019), Andersson, (2019) and Saleem et al., (2022).

The findings also indicate that green finance enhances environmental qualitysignificantly. Holding rest of the factors fixed, a 1% increase in green finance (patents on environmental related technologies) results in a decrease of 0.08% and 0.05% in CO2 in model 1 model 2 respectively. ManyOICnations are making efforts to reduce the level of CO2 emissions. This finding accords with Liu et al., (2020), Umar et al., (2020b), and Saleem et al., (2022).

The relationship between CO2 emissions and financial development is inversely correlated. A 1% increase in FDleads to a significant decrease of CO2 emissions by 0.17% and 0.15% in model 1 and model 2, respectively. This finding is consistent with prior researches by Shahbaz et al., (2013c), Al-Mulali et al., (2015, 2016), Saleem (2020), and Saleem et al., (2022).

Moreover, the utilization of renewable energy is found to mitigate the adverse effects of environmental degradation. 1% increase in use of renewable energy is associated with CO2 reduction of 0.15% in model 1 and 1.16% in model 2. Prior studies supportour finding(Liu et al., 2020;Saleem 2020; and Saleem et al., 2022).

Sustainable developmentis highly correlated with the concept of green growth.Environmental deterioration can be reduced through the implementation of green growth strategies. Consequently, the outcomes of green growth initiatives demonstrate an inverse relation with the emission of CO2. According our empirical findings, a 1% increase in the GG and its square value result in reduction of CO2 emission of 0.61% and -0.05% respectively, as indicated by model 1 (see Table 6, column 1). These findings are in line with the research conducted by Jouvet and de Perthuis, (2013), Hao et al., (2021), and Saleem et al., (2022). Moreover, model 1 reveals an inverse relationship between GG and the square value of GG, which aligns with the concave EKC framework. It is evident that green growth has adverse effect on CO2 emission, thereby significantly mitigating it in OIC nations.

In light of this, it is evident that green growth plays afundamental role in achieving sustainable development goals and promoting eco-friendly strategies. The future of OIC economies stands to reap substantial social and economic benefits with the efficient implementation of green growth strategies. There is also inverse relationship between GDP2 and CO2 emission;however, GDP has positive impact on CO2 emission, suggesting the presence of an inverted U-shaped EKC in OIC nations. This is similar to the findings of Saleem et al., (2020, 2022).

The key objective of many economies is to achieve economic growth and development, resultingmajor focus on the production at the expense of environmental deterioration. However, once economies have achieved the peakpoint of economic expansion, they seek to maintainthe growth while keepingenvironment clean through investment in eco-friendly initiatives. This findingis supported by the studies of Saleem et al., (2020), Mania, (2020), Shahbaz et al., (2018a, 2018b), and Saleem et al., (2022).

January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

At first, increase GDP leads to a corresponding increase in CO2 emissions. Specifically, a 1% rise in GDP and GDPsquare lead to increase and decrease CO2 emission by 0.53% and 0.52%, respectively, in model 2 (see Table 6). These results align with the outcomes of Ahmad et al., (2020) and Saleem et al., (2022).

Finally, we have employed DOLS methodto verify the robustness of the outcomes. As demonstrated in Table 6, the statistical findings reveal that, excluding the GDP growth rate, all variables have reducing effecton the level of CO2 emission.

Table 6: FMOLS and DOLS (dependent variable is CO2 emission).

Variable	**FMOLS**				**DOLS**			
	Model 1		**Model 2**		**Model 1**		**Model 2**	
	Coef.	**p-value**	**Coef.**	**p-value**	**Coef.**	**p-value**	**Coef.**	**p-value**
LET	-0.1810	0.000	-0.1208	0.015	-1.4429	0.000	-1.1123	0.002
LGF	-0.0887	0.000	-0.0556	0.009	-0.0020	0.097	-0.5033	0.002
LFD	-0.1783	0.000	-0.1549	0.022	-0.4346	0.000	-0.2542	0.090
LRENN	-0.1596	0.000	-1.1631	0.000	-0.8036	0.000	-1.8551	0.000
LGG	-0.1672	0.000	-	-	-0.8237	0.049	-	-
LGG^2	-0.0583	0.000	-	-	-0.2876	0.034	-	-
LGDP			0.5321	0.011			1.2560	0.009
$LGDP^2$			-0.5236	0.018			-0.0506	0.011

Source: Calculated by author. Note: Coef = Coefficient value.

Conclusion

Many nations are striving to attain carbon neutrality goals by utilizing environmentally friendly technology and promoting sustainable development. Consequently, this analysis endeavors to ascertain the pivotal role of sustainable development in enhancing environmental quality. To this end, this research investigated the complex relationships between green finance, environmental taxes, green growth, renewable energy consumption, financial development, and

January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

GDP and CO2 emissions in 16 OIC countriesover the time span of 2007 to 2021. For empirical estimation, we started with CSD test to check the cross sectional dependence among cross sections. We have used IPS and CADF unit root tests to check the stationarity property of data series. Before estimating long run parameters, we applied Pedroni and Westerlund cointegration test for the long run association among variables of our study. Finally, we used FMOLS and DOLS methods to get numerical estimates of study parameters.

Outcomes of IPS and CADF tests showed that all the variables are first differencestationary. Results of FMOLS and DOLS showed that all the variables have statistically significant and negative impact on carbon emissions (CO2) except GDP per capita. GDP per capita has positive impact on carbon emissions suggesting the inverted U-shaped relationship between independent variables GDP and GDP squared and CO2. Green finance (patent on environmental related technologies), environmental taxes, financial development, green growth and renewable energy consumption have decreasing effect of CO2 emissions. This implies that these variables are helpful in achieving environmental sustainability.

These findings have significant implications for policymakers striving to align regional development with Sustainable Development Goal 13, emphasizing climate action. The negative impact of study variables underscores the potential of targeted interventions in these areas to mitigate CO2 emissions. Based on current findings, we suggest that governments of OIC nations should grant patents on environmental related technologies. Patents act as incentives for innovators and businesses to invest in the development of environmental friendly technologies. By granting exclusive rights to inventors, patents create a competitive environment that promotes continuous research and development in the field of green technologies. Which, in turn, contributes to the creation of more efficient and sustainable solutions for reducing carbon emissions.

Secondly, patents and environmental taxes work in together to align economic incentives with environmental objectives. Governments can strategically use both devices to support a transition towards a low-carbon economy. By providing legal protection through patents and

January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

imposing taxes on carbon intensive activities, policymakers create a framework that fosters the development and adoption of environmental friendly technologies.

Thirdly, OIC governments should take initiatives to improve financial institutions, which can work in collaboration with governments to develop and implement policies that encourage green growth and the transition to renewable energy. This may involve supporting regulatory frameworks that incentivize clean energy projects and penalize carbon intensive activities. Finally, governments should also undertake green growth initiatives as they prioritize energy efficiency in various sectors. Moreover, green growth schemes may involve the implementation of carbon capture and storage technologies. These technologies capture CO2 emissions from industrial processes and power plants, preventing them from entering the atmosphere.

However, it is essential to acknowledge the limitations of the study, such as. These factors warrant cautious interpretation of the results and underscore the need for further research to address these gaps.

Remittances Review
January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

Abbreviation	
LET	Log of Environment Taxes
LGF	Log of Green Finance
LFD	Log of Financial Development
LREN	Log of Renewable Energy Consumption
LGG	Log of Green Growth
LGG^2	Log of Green growth Square
LGDP	Log of Gross Domestic Product
$LGDP^2$	Log of Gross Domestic Product square
FMOLS	Fully Modified OLS
DOLS	Dynamic Ordinary Least Square
CADF	Cross Sectional Augmented Dicky Fuller Test
CSD	Cross Sectional Dependence
H0	Null hypothesis
H1	Alternative hypothesis
PCCC	Paris Climate Change Conference
FD	Financial Development
REN	Renewable energy
ERT	Environmental related technologies

Table A1: list of abbreviation

Table A2: List of sample countries

Sr.no	Countries	Sr.no	Countries
1	Bangladesh	9	Malaysia
2	Burkina Faso	10	Mali
3	Cameroon	11	Mauritania
4	Cote d'Ivoire	12	Morocco
5	Egypt	13	Niger
6	Arab Republic	14	Pakistan
7	Kazakhstan	15	Togo
8	Tunisia	16	Turkey

Reference

Adebayo, T. S., Oladipupo, S. D., Adeshola, I., & Rjoub, H. (2022). Wavelet analysis of impact of renewable energy consumption and technological innovation on CO2 emissions: evidence from Portugal. *Environmental Science and Pollution Research, 29*(16), 23887-23904.

Ahmad, M., & Raza, M. Y. (2020). Role of public-private partnerships investment in energy and technological innovations in driving climate change: evidence from Brazil. *Environmental Science and Pollution Research, 27*, 30638-30648.

Al-Mulali, U., Solarin, S. A., & Ozturk, I. (2016). Investigating the presence of the environmental Kuznets curve (EKC) hypothesis in Kenya: an autoregressive distributed lag (ARDL) approach. *Natural Hazards, 80*, 1729-1747.

Amri, F. (2017). The relationship amongst energy consumption (renewable and non-renewable), and GDP in Algeria. *Renewable and Sustainable Energy Reviews*, *76*, 62-71.

Andersson, J. J. (2019). Carbon taxes and CO2 emissions: Sweden as a case study. *American Economic Journal: Economic Policy*, *11*(4), 1-30.

Andreoni, J., & Levinson, A. (2001). The simple analytics of the environmental Kuznets curve. *Journal of public economics*, *80*(2), 269-286.

Ansari, M. A., & Khan, N. (2021). Decomposing the trade-environment nexus for high income, upper and lower middle income countries: What do the composition, scale, and technique effect indicate? *Ecological Indicators, 121*, 107122.

Aye, G. C., & Edoja, P. E. (2017). Effect of economic growth on CO2 emission in developing countries: Evidence from a dynamic panel threshold model. *Cogent Economics & Finance, 5*(1), 1379239.

Azlina, A., Law, S. H., & Mustapha, N. H. N. (2014). Dynamic linkages among transport energy consumption, income and CO2 emission in Malaysia. *Energy policy*, *73*, 598-606.

Balsalobre-Lorente, D., Shahbaz, M., Roubaud, D., & Farhani, S. (2018). How economic growth, renewable electricity and natural resources contribute to CO2 emissions? *Energy policy*, *113*, 356-367.

Bruvoll, A., & Larsen, B. M. (2017). Greenhouse gas emissions in Norway: do carbon taxes work? In *Environmental taxation in practice* (pp. 545-557): Routledge.

Can, M., Ahmed, Z., Mercan, M., & Kalugina, O. A. (2021). The role of trading environment-friendly goods in environmental sustainability: Does green openness matter for OECD countries? *Journal of Environmental Management, 295*, 113038.

Criqui, P., Jaccard, M., & Sterner, T. (2019). Carbon taxation: A tale of three countries. *Sustainability, 11*(22), 6280.

Dogan, E., & Turkekul, B. (2016). CO 2 emissions, real output, energy consumption, trade, urbanization and financial development: testing the EKC hypothesis for the USA. *Environmental Science and Pollution Research, 23*, 1203-1213.

Erdogan, A. M. (2014). Foreign direct investment and environmental regulations: a survey. *Journal of Economic Surveys, 28*(5), 943-955.

Fang, Y. (2011). Economic welfare impacts from renewable energy consumption: The China experience. *Renewable and Sustainable Energy Reviews, 15*(9), 5120-5128.

Fedotova, G., Nesterenko, Y. N., & Magomadov, E. (2022). *"Green" funding of new eco-technological trends development.* Paper presented at the IOP Conference Series: Earth and Environmental Science.

Gerlagh, R., & Zwaan, B. v. d. (2006). Options and instruments for a deep cut in CO2 emissions: Carbon dioxide capture or renewables, taxes or subsidies? *The energy journal, 27*(3), 25-48.

GlobalData. (2024). Patents Filed across Top 10 Environmental Themes over the Last Five Years. Retrieved from https://www.globaldata.com/esg/environment/patents/signals/

Halkos, G. E., & Tzeremes, N. G. (2014). The effect of electricity consumption from renewable sources on countries′ economic growth levels: Evidence from advanced, emerging and developing economies. *Renewable and Sustainable Energy Reviews, 39*, 166-173.

Hao, L.-N., Umar, M., Khan, Z., & Ali, W. (2021). Green growth and low carbon emission in G7 countries: how critical the network of environmental taxes, renewable energy and human capital is? *Science of the Total Environment, 752*, 141853.

Hassan, A., Yang, J., Usman, A., Bilal, A., & Ullah, S. (2023). Green growth as a determinant of ecological footprint: Do ICT diffusion, environmental innovation, and natural resources matter? *PLoS One, 18*(9), e0287715.

Huang, Y., & Chen, C. (2022). The spatial spillover and threshold effect of green finance on environmental quality: evidence from China. *Environmental Science and Pollution Research*, 1-12.

IEA. (2014). International Energy

Agency. CO Emissions from Fuel Combustion: Highlights. Retrieved from http://

www.iea.org/publications/freepublications/publication/CO2em

issionsFromFuelCombustionHighlights2014.

Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of econometrics, 115*(1), 53-74.

Imran, M., Zia Ur Rahman, D. H. B., Khalid, S., & Faisal, M. M. (2023). Nexus Between Environmental Quality And Economic Sustainability: Evidence From Pakistan Based On Time Series Data. *Central European Management Journal*, *31*(1), 866-877.

Inglesi-Lotz, R. (2016). The impact of renewable energy consumption to economic growth: A panel data application. *Energy Economics, 53*, 58-63.

Irfany, M. I., Tarmizi, M. M., Fitri, R., & Hasanah, N. (2022). Development and climate change in oic countries: examining causality between economic development, energy consumption, and emissions $ Mohammad Iqbal Irfany, Muhamad Mulya Tarmizi, Resfa Fitri, Neneng Hasanah. *International Journal of Energy Economics and Policy, 12*(4), 61-66.

Jahanger, A., Balsalobre-Lorente, D., Ali, M., Samour, A., Abbas, S., Tursoy, T., & Joof, F. (2023). Going away or going green in ASEAN countries: Testing the impact of green financing and energy on environmental sustainability. *Energy & Environment*, 0958305X231171346.

Jones, L. E., & Manuelli, R. (1995). A positive model of growth and pollution controls. In: National bureau of economic research Cambridge, Mass., USA.

Jos, O., Greet, J.-M., & Jeroen, P. (2012). Trends in global CO2 emissions: 2012 report.

Jouvet, P.-A., & de Perthuis, C. (2013). Green growth: From intention to implementation. *International Economics*, *134*, 29-55.

KAHRAMAN, Y. E. (2022). An overlook on the relationship between green finance and the environment. *International Journal of Chemistry and Technology, 6*(2), 122-128.

Kar, A. K. (2022). Environmental Kuznets curve for CO2 emissions in Baltic countries: an empirical investigation. *Environmental Science and Pollution Research, 29*(31), 47189-47208.

Karekezi, S., McDade, S., Boardman, B., Kimani, J., & Lustig, N. (2012). Energy, poverty, and development. *Global Energy Assessment–Toward a Sustainable Future [Johansson, TB, N. Nakicenovic, A. Patwardhan, and L. Gomez-Echeverri (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria*, 151-190.

Khan, S. U., Sheikh, M. R., Dimen, L., Batool, H., Abbas, A., & Nuta, A. C. (2023). Nexus between health poverty and climatic variability in Pakistan: a geospatial analysis. *Frontiers in Environmental Science*, *11*, 621.

Kostakis, I., Armaos, S., Abeliotis, K., & Theodoropoulou, E. (2023). The investigation of EKC within CO2 emissions framework: Empirical evidence from selected cross-correlated countries. *Sustainability Analytics and Modeling, 3*, 100015.

Lazarashvili, T. (2020). ECONOMIC GROWTH “GREEN” FINANCING: CONCEPTS AND PROBLEMS. *Globalization & Business*.

León, L. R., Bergquist, K., Wunsch-Vincent, S., Xu, N., & Fushimi, K. (2018). Measuring innovation in energy technologies: green patents as captured by WIPO’s IPC green inventory. *Economic Research Working Paper, 44*.

Li, C., Chen, Z., Wu, Y., Zuo, X., Jin, H., Xu, Y., . . . Wan, Y. (2022). Impact of green finance on China's high-quality economic development, environmental pollution, and energy consumption. *Frontiers in Environmental Science, 10*, 1032586.

Li, C., Liu, X., Bai, X., & Umar, M. (2020). Financial development and environmental regulations: the two pillars of green transformation in China. *International Journal of Environmental Research and Public Health, 17*(24), 9242.

Lin, B., Omoju, O. E., Nwakeze, N. M., Okonkwo, J. U., & Megbowon, E. T. (2016). Is the environmental Kuznets curve hypothesis a sound basis for environmental policy in Africa? *Journal of Cleaner Production, 133*, 712-724.

Liu, H., Islam, M. A., Khan, M. A., Hossain, M. I., & Pervaiz, K. (2020). Does financial deepening attract foreign direct investment? Fresh evidence from panel threshold analysis. *Research in International Business and Finance, 53*, 101198.

Lu, W.-C. (2017). Renewable energy, carbon emissions, and economic growth in 24 Asian countries: evidence from panel cointegration analysis. *Environmental Science and Pollution Research, 24*, 26006-26015.

Mania, E. (2020). Export diversification and CO2 emissions: an augmented environmental Kuznets curve. *Journal of International Development, 32*(2), 168-185.

Narayan, S., & Narayan, P. K. (2004). Determinants of demand for Fiji's exports: an empirical investigation. *The Developing Economies, 42*(1), 95-112.

Nassani, A. A., Aldakhil, A. M., Abro, M. M. Q., & Zaman, K. (2017). Environmental Kuznets curve among BRICS countries: spot lightening finance, transport, energy and growth factors. *Journal of Cleaner Production, 154*, 474-487.

Naveed, A., Ahmad, N., Aghdam, R. F., & Menegaki, A. N. (2022). What have we learned from Environmental Kuznets Curve hypothesis? A citation-based systematic literature review and content analysis. *Energy Strategy Reviews, 44*, 100946.

Nepal, R., Taghizadeh-Hesary, F., & Musibau, H. (2020). *Greenfield investments as a source of sustainable green finance? On the relationships between greenfield investments, environmental performance, and asian economic growth*. Retrieved from

OECD. (2024). Retrieved from https://www.oecd.org/env/indicators-modelling-outlooks/green-patents.htm

Omri, A., Dhahri, S., & Afi, H. (2023). Investigating the EKC hypothesis with disaggregated energy use and multi-sector production. *Environmental Science and Pollution Research*, 1-15.

Pedroni, P. (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and statistics, 61*(S1), 653-670.

Pedroni, P. (2001). Fully modified OLS for heterogeneous cointegrated panels. In *Nonstationary panels, panel cointegration, and dynamic panels* (pp. 93-130): Emerald Group Publishing Limited.

Pedroni, P. (2004). Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric theory, 20*(3), 597-625.

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of applied econometrics, 22*(2), 265-312.

Pizzol, M., & Andersen, M. S. (2022). Green Tech for Green Growth? Insights from Nordic Environmental Innovation. In *Business Models for the Circular Economy: A European Perspective* (pp. 193-218): Springer.

Rahman, M. M., & Kashem, M. A. (2017). Carbon emissions, energy consumption and industrial growth in Bangladesh: Empirical evidence from ARDL cointegration and Granger causality analysis. *Energy policy, 110*, 600-608.

Romer, P. M. (1990). Endogenous technological change. *Journal of political Economy, 98*(5, Part 2), S71-S102.

Saad, W., & Taleb, A. (2018). The causal relationship between renewable energy consumption and economic growth: evidence from Europe. *Clean Technologies and Environmental Policy, 20*, 127-136.

Salahodjaev, R., Djalilov, B., Kobiljonov, I., Otajonov, S., & Kasimova, N. (2023). Industrialization and CO2 Emissions: Accounting for the role of Renewable Energy in OIC Member States. *International Journal of Energy Economics and Policy, 13*(5), 37.

Saleem, H., Khan, M. B., & Mahdavian, S. M. (2022). The role of green growth, green financing, and eco-friendly technology in achieving environmental quality: evidence from selected Asian economies. *Environmental Science and Pollution Research, 29*(38), 57720-57739.

Saleem, H., Khan, M. B., & Shabbir, M. S. (2020). The role of financial development, energy demand, and technological change in environmental sustainability agenda: evidence from selected Asian countries. *Environmental Science and Pollution Research, 27*, 5266-5280.

Saqib, N., Usman, M., Radulescu, M., Sinisi, C. I., Secara, C. G., & Tolea, C. (2022). Revisiting EKC hypothesis in context of renewable energy, human development and moderating role of technological innovations in E-7 countries? *Frontiers in Environmental Science, 10*, 2509.

Sarafidis, V., & Wansbeek, T. (2012). Cross-sectional dependence in panel data analysis. *Econometric Reviews, 31*(5), 483-531.

Sarkodie, S. A., & Ozturk, I. (2020). Investigating the environmental Kuznets curve hypothesis in Kenya: a multivariate analysis. *Renewable and Sustainable Energy Reviews, 117*, 109481.

Schmalensee, R. (2012). From "Green Growth" to sound policies: An overview. *Energy Economics, 34*, S2-S6.

SESRIC. (2022). OIC Environment Report 2021. Retrieved from https://clck.showmelinks.com/VKYCGK

Shahbaz, M., Shahzad, S. J. H., & Mahalik, M. K. (2018). Is globalization detrimental to CO 2 emissions in Japan? New threshold analysis. *Environmental Modeling & Assessment, 23*, 557-568.

Shahbaz, M., Solarin, S. A., Hammoudeh, S., & Shahzad, S. J. H. (2017). Bounds testing approach to analyzing the environment Kuznets curve hypothesis with structural beaks:

the role of biomass energy consumption in the United States. *Energy Economics, 68*, 548-565.

Shahbaz, M., Solarin, S. A., Mahmood, H., & Arouri, M. (2013). Does financial development reduce CO2 emissions in Malaysian economy? A time series analysis. *Economic Modelling, 35*, 145-152.

Shahbaz, M., Tiwari, A. K., & Nasir, M. (2013). The effects of financial development, economic growth, coal consumption and trade openness on CO2 emissions in South Africa. *Energy policy, 61*, 1452-1459.

Shahbaz, M., Zakaria, M., Shahzad, S. J. H., & Mahalik, M. K. (2018). The energy consumption and economic growth nexus in top ten energy-consuming countries: Fresh evidence from using the quantile-on-quantile approach. *Energy Economics, 71*, 282-301.

Shoaib, H. M., Rafique, M. Z., Nadeem, A. M., & Huang, S. (2020). Impact of financial development on CO 2 emissions: a comparative analysis of developing countries (D 8) and developed countries (G 8). *Environmental Science and Pollution Research, 27*, 12461-12475.

Sohag, K., Begum, R. A., Abdullah, S. M. S., & Jaafar, M. (2015). Dynamics of energy use, technological innovation, economic growth and trade openness in Malaysia. *Energy, 90*, 1497-1507.

Sohag, K., Taşkın, F. D., & Malik, M. N. (2019). Green economic growth, cleaner energy and militarization: Evidence from Turkey. *Resources Policy, 63*, 101407.

Su, C.-W., Umar, M., & Gao, R. (2022). Save the environment, get financing! How China is protecting the environment with green credit policies? *Journal of Environmental Management, 323*, 116178.

Szabo, S., & Jäger-Waldau, A. (2008). More competition: Threat or chance for financing renewable electricity? *Energy policy, 36*(4), 1436-1447.

Tan, W., & Cao, T. (2022). Do Green Technology Innovation, Renewable Energy Consumption and Renewable Energy Investment Improve Environmental Quality? *Journal of Environmental Assessment Policy and Management, 24*(03), 2250031.

Troster, V., Shahbaz, M., & Uddin, G. S. (2018). Renewable energy, oil prices, and economic activity: A Granger-causality in quantiles analysis. *Energy Economics, 70*, 440-452.

Umar, M., Ji, X., Kirikkaleli, D., & Xu, Q. (2020). COP21 Roadmap: Do innovation, financial development, and transportation infrastructure matter for environmental sustainability in China? *Journal of Environmental Management, 271*, 111026.

Umar, M., & Safi, A. (2023). Do green finance and innovation matter for environmental protection? A case of OECD economies. *Energy Economics, 119*, 106560.

Wang, J., & Azam, W. (2024). Natural resource scarcity, fossil fuel energy consumption, and total greenhouse gas emissions in top emitting countries. *Geoscience Frontiers, 15*(2), 101757.

Wei, S., Jiandong, W., & Saleem, H. (2023). The impact of renewable energy transition, green growth, green trade and green innovation on environmental quality: Evidence from top 10 green future countries. *Frontiers in Environmental Science, 10*, 1076859.

January, 2024
Volume: 9, No: 1, pp. 1503-1535
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

Wen, J., Ali, W., Hussain, J., Khan, N. A., Hussain, H., Ali, N., & Akhtar, R. (2021). Dynamics between green innovation and environmental quality: new insights into South Asian economies. *Economia Politica*, 1-23.

Westerlund, J. (2007). Testing for error correction in panel data. *Oxford Bulletin of Economics and statistics*, *69*(6), 709-748.

Westerlund, J. (2008). Panel cointegration tests of the Fisher effect. *Journal of applied econometrics*, *23*(2), 193-233.

Wissema, W., & Dellink, R. (2007). AGE analysis of the impact of a carbon energy tax on the Irish economy. *Ecological economics*, *61*(4), 671-683.

Xia, X.-H., Jia, Z.-J., Yu, Y., Liang, Y., Wang, Z., & Ma, L.-L. (2007). Preparation of multi-walled carbon nanotube supported TiO2 and its photocatalytic activity in the reduction of CO2 with H2O. *carbon, 45*(4), 717-721.

Xu, X., Huang, S., An, H., Vigne, S., & Lucey, B. (2021). The influence pathways of financial development on environmental quality: New evidence from smooth transition regression models. *Renewable and Sustainable Energy Reviews, 151*, 111576.

Yang, X., Jia, Z., & Yang, Z. (2021). How does technological progress impact transportation green total factor productivity: A spatial econometric perspective. *Energy Reports, 7*, 3935-3950.

Yikun, Z., Leong, L. W., Abu-Rumman, A., Shraah, A. A., & Hishan, S. S. (2023). Green growth, governance, and green technology innovation. How effective towards SDGs in G7 countries? *Economic research-Ekonomska istraživanja, 36*(2).

Zeng, Y., Wang, F., & Wu, J. (2022). The impact of green finance on urban haze pollution in China: a technological innovation perspective. *Energies*, *15*(3), 801.

Zhang, K., Li, Y., Qi, Y., & Shao, S. (2021). Can green credit policy improve environmental quality? Evidence from China. *Journal of Environmental Management, 298*, 113445.

Zhou, X., Tang, X., & Zhang, R. (2020). Impact of green finance on economic development and environmental quality: a study based on provincial panel data from China. *Environmental Science and Pollution Research, 27*, 19915-19932.