Available Online
Journal of Economic Impact
ISSN: 2664-9764 (Online), 2664-9756 (Print)
https://www.scienceimpactpub.com/jei

VALIDITY OF ENVIRONMENTAL KUZNETS CURVE IN THE MALAYSIAN ECONOMY: A FRESH EVIDENCE

Saeed Ur Rahman *, **Zia Ur Rahman, Maryam Ibrahim**

Department of Economics, Ghazi University, Dera Ghazi Khan, Pakistan

ARTICLE INFO

Article history
Received: September 16, 2022
Revised: December 07, 2022
Accepted: December 19, 2022

Keywords
Environment Kuznets Curve
Globalization
Energy consumption
Fiscal development
Malaysia

ABSTRACT

It is acknowledged that environmental degradation, climate change and the atmosphere's temperature are increasing due to the emission of greenhouse gasses. Therefore, a speedy response is required to lessen the severe effects of greenhouse gases. The present study has analyzed the influence of electric consumption, fiscal development, globalization, and trade openness on carbon emission using the latest dataset and modern econometric techniques. To accomplish the said objectives, the study has employed Johansen cointegration, autoregressive distributed lag model (ARDK), and block exogeneity. The results specify that with the 1% increase in electric consumption, fiscal development, globalization and trade openness, the carbon dioxide emission increases by 0.01%, 0.04%, 0.68%, and 0.25%, respectively. Moreover, the results also indicated that the environmental Kuznets curve is prevailing in the Malaysian economy because an inverted U-shape connection occurs between carbon and GDP^2. On the basis of data diagnostics, it is determined that the ARDL model is credible, stable, and reliable. Further, block exogeneity affirms the long-term affiliation among the factors and concludes that all the factors under analysis contribute to the environmental deterioration in the Malaysian economy. Therefore, the government may design an environmental or pollution tax policy to minimize carbon emissions. Green energy should be produced and consumed as it is environmental friendly and helps to reduce temperature and atmospheric pollution.

Email: srehman@gudgk.edu.pk
https://doi.org/10.52223/jei4032214

INTRODUCTION

Greenhouse gases (GHGs) cause environmental degradation, climate change, and an upsurge in the atmosphere's temperature (Ur Rahman, 2019). These gases are emitted into the atmosphere and trap heat from the sun, increasing the Earth's average surface temperature. This phenomenon, known as the greenhouse effect, is a natural process that helps to keep the Earth's surface warm enough for life (Arnaut and Lidman, 2021). However, the concentration of GHGs in the atmosphere has increased significantly in recent decades due to human activities such as burning fossil fuels and deforestation. As a result, these human activities increase the earth's average surface temperature, known as global warming (Danish et al., 2019).

The main GHGs are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These gases are emitted into the atmosphere through various human activities, including burning fossil fuels for energy production, industrial processes, transportation, and energy consumption in agricultural activities (Khezri et al., 2022). According to World Bank data, global GHG emissions reached a record-high 49.2 billion metric tons of CO_2 equivalent in 2019 (Su et al., 2021). It represents a significant increase from previous decades and is found to be a major contributor to global warming. Malaysia is a country located in Southeast Asia that has a relatively high level of carbon emissions. According to World Bank, in 2019, Malaysia's total carbon dioxide emissions were about 114 million metric tons. It is the equivalent of about 0.3% of global carbon dioxide emissions (Hoang, 2021).

Most of Malaysia's carbon emissions come from the energy sector, mainly from burning fossil fuels such as coal, oil, and natural gas. Other significant sources of carbon emissions in Malaysia include transportation, industrial processes, and waste (Khan et al., 2021). Malaysia has implemented several policies and initiatives to address its carbon emissions. For example, the country has set a target to reduce its carbon intensity (the amount of carbon emitted per unit of GDP) by 45% by 2030 (Haldar and Sethi, 2022). In addition, it has established many renewable energy projects, such as hydroelectric, solar, and wind power. Malaysia has also implemented energy efficiency measures and set targets for using renewable energy in transportation (Solaymani, 2022). Malaysia is committed to achieving various sustainable developments goals (SDGs) such as carbon neutrality, environment protection, responsible energy consumption and clean, green energy production and as well as fostering economic growth

Energy consumption and carbon emissions are closely linked in Malaysia, as the country's energy sector significantly

contributes to its carbon emissions (Munir and Ameer, 2018). According to World Bank, in 2019, the energy sector was responsible for about 73% of Malaysia's total carbon dioxide emissions (Nurgazina et al., 2021) by using fossil fuels, such as coal, oil, and natural gas, fuel energy consumption. These energy sources are relatively cheap and easily accessible but also contribute significantly to carbon emissions. Fossil fuels accounted for about 88% of Malaysia's total primary energy consumption in 2019 (Abd Razak et al., 2021).

One of Malaysia's key drivers of economic development has been its export-oriented manufacturing sector, which has benefited from the country's robust infrastructure, relatively low labor costs, and favorable business environment. The government is a major exporter of electronics, textiles, and other manufactured goods, contributing to its economic growth. In addition to manufacturing, tourism, finance, telecommunications industries and services sector are also significant contributors to Malaysia's economy.

Moreover, globalization has increased the interconnectedness and interdependence of the economy through the exchange of goods, services and information (Etokakpan et al., 2020). In recent decades, globalization has led to rapid economic growth and increased trade and investment among various countries. In Malaysia, globalization has contributed to an increase in carbon emissions. As the government has industrialized and become more integrated into the global economy, its energy consumption and carbon emissions have increased (Aslam et al., 2021). The energy sector is a significant contributor to Malaysia's carbon emissions, and the country's reliance on fossil fuels, such as coal, oil, and natural gas, has contributed to this trend (Sharif et al., 2020).

The Malaysian economy is open to international trade and investment (Rambeli et al., 2021). Trade openness has likely contributed to an increase in the country's carbon emissions. As the government has industrialized and become more integrated into the global economy, its energy consumption and carbon emissions have increased (Aslam et al., 2022). The energy sector is a significant contributor to Malaysia's carbon emissions, and the country's reliance on fossil fuels, such as coal, oil, and natural gas, has contributed to this trend (Sarkodie and Owusu, 2021)

Numerous research employed odd and even factors to measure the emitter of Carbon Dioxide (CO_2) in the environment. But the current study organized the latest dataset, with GDP, GDP^2, energy consumption, globalization, financial development, and trade openness from the perspective of Malaysia. The study assesses whether or not the environmental Kuznets curve (EKC) prevails in the economy. Does globalization affect carbon emissions? Moreover, trade openness and fiscal development play their role in increasing carbon emissions. EKC is an economic theory that suggests an inverse relationship between a country's level of economic development and its environmental quality (Abd Razak et al., 2021). Specifically, the theory proposes that as a country's income increases, its ecological quality initially declines but eventually improves as it becomes more developed (Noor and Saputra, 2020). This study contributes to the economics literature by utilizing modern techniques like Johansen co-integration, ARDL Bound, ARDL and Block exogeneity to assess a fresh economic perspective.

The actions of humans in manufacturing create severe problems for the environment and disrupt ecosystems (Kuronuma et al., 2018). As the principal culprit, CO_2 is accompanied by numerous dangerous gases and is a crucial element in increasing the earth's general temperature (Haikola et al., 2021). A widely held belief holds that pollution is the primary cause of around 60% of the greenhouse effect.

However, an imperative approach that beautifully explores the paradigm of growth with the environment is known as EKC (Danish et al., 2021). EKC declares that at the beginning of economic growth, the level of CO_2 increases in the atmosphere and declines with the passage of time because of the development of environmental technologies when an economy achieves economic prosperity (Terrell, 2021). Moreover, such a strategy does not hold across the nation in the long term. However, some researchers attempted to resolve the issue by employing some economic features, i.e., financial development, trade openness, energy consumption and urbanization (Ur Rahman, 2019).

The 19th edition of World Energy Markets Observatory 2017 states that Malaysia is in the second position in emitting carbon (264 million tonnes of oil equivalent) in the region (Nurgazina et al., 2021). In contrast, Taiwan and Singapore emit approximately 276 million tonnes and 221 million tonnes of carbon annually. The report also explains that renewable resources generate about 4.6% of energy; the rest is produced from fossil fuels such as coal, natural gas, and oil (Muhammad and Saad, 2018). The main reason for depleting the ozone layer is the CO_2 emission from power generation and automobiles. It makes the way smooth for the greenhouse effect and indirectly creates waves and storms in the ocean, such as Penang (Farabi et al., 2019). Malaysia also plans to reduce greenhouse gas emissions while installing the Green Technology Master Plan 2017-2030 (Ali et al., 2018; Sulaiman and Shabri, 2021)).

In a careful calculation, carbon dioxide is the primary component of greenhouse gasses and the primary cause of climate variation and global warming (Rambeli-Ramli et al., 2018). In layperson's terms, the amount of carbon dioxide in the atmosphere has increased significantly (Yuaningsih et al., 2021). The increased energy usage in the eight emerging economies significantly contributes to the increased emissions of CO_2 and the expansion of their economies (Au Yong, 2018). According to Saudi et al. (2019), the amount of energy consumed is directly associated with the amount of CO_2 emitted per person.

When newly industrialized countries boost their business by 1%, CO_2 productivity in the country reduces by 0.2% (Arifah and Haryono, 2021). For example, if Nigeria's commerce grew by 1%, CO_2 emissions in the economy would decline by 0.3% (Abdul-Latif et al., 2020). According to Raihan et al. (2021), there was no correlation between commerce and the emission of CO_2 in Pakistan. High commercial freedom in Central and Eastern Europe is possible in this scenario. According to Yuaningsih et al. (2021), long-term CO_2 production is expected to be modest.

On the contrary, Deqiang et al. (2021) claimed that trade expansion enhances the environmental carbon ratio. A panel study based on the causality determines a negative short-run association between trade openness and CO_2 emission in the surroundings (Yan et al., 2020). As for as Pakistan's scenario is concerned, if financial development grows by about 1 percent CO_2 emission will increase by about 0.17 percent in the Economy (Shahzad et al., 2017). Tsaurai (2019) stated that financial development enhances the country's economic prosperity and reduces environmental depletion. In contrast, Ehigiamusoe and Lean (2019) found that increased financial growth negatively influences the surroundings and enhances the Nigerian economy's emission level.

Globalization, on the contrary, assists a country while transferring new technology from the developed to the emerging economy, enhancing the utilization of labor and the relative benefits among them (Shahbaz et al., 2019). Due to globalization, a nation can improve its resource utilization. Moreover, globalization creates the opportunity for capital mobilization through foreign direct investment and empowers the capital market (Saint Akadiri et al., 2020). Globalization directly influences growth through trade openness and increasing energy utilization.

Therefore, we can say that numerous researchers employed odd and even factors to capture the influence of carbon emissions. The current study used globalization, trade openness, financial development, electric consumption, and gross domestic product, and for the EKC, GDP^2 is employed. The main objective is to measure the influence of carbon emissions on globalization, trade openness, financial development, electric consumption and gross domestic product. So, the study arranged a time series dataset spanning from 1971 to 2019. The task is completed using cutting-edge methods. This study considered all potential factors that may impact or call attention to the carbon emission issue. Recent data and modern econometric evaluation methods provided a fresh perspective to this work.

METHODOLOGY

A time series data set is organized to capture the influence of globalization, trade openness, and financial development on the carbon emanation and the presence of EKC in the Malaysian economy. Various approaches were employed to measure the influence on carbon emission, but this study employed the method of Shahbaz (2022), Jiang et al. (2021) and Saint Akadiri et al. (2020) while reframing regarding study factors. The Cobb-Douglas functions have various advantages that make them useful in multiple contexts. For example, the calculation is quite simple. Since it can handle many data inputs (Shahbaz, 2022), it can use econometric techniques like multicollinearity, serial correlation, and heteroscedasticity (Saint Akadiri et al., 2020). It is possible to express the basic non-linear form.

$$CO_2 = AGDP^{\alpha 1} EC^{\alpha 2} Glob^{\alpha 3} Trad^{\alpha 4} Fis^{\alpha 5} \eta \quad (1)$$

GDP, Eng, Urbz, Trad, and Fis represent the real GDP per capita, energy consumption, urbanization, trade openness, and financial development. At the same time, 'A' and 'η' are the residual parameters. Where α1...α5 are the constant returns to scale allied with the stated variables. The previous model is replaced with the log model by taking the log of all the variables, implying that parameters will assess the receptiveness of CO2 emissions with all the variables being elastic. Finally, the linear model is expressed as;

$$1nCO_{2t} = 1nA + \alpha^1 lnGDP_t + \alpha^2 1nEC_t + \alpha^3 1nGlob_t + \alpha^4 1nT_t + \alpha^5 1nF_t + \varepsilon_t \quad (2)$$

$$\text{Replaced } \ln A = \alpha_0$$

$$1nCO_{2t} = \alpha_0 + \alpha^1 lnGDP_t + \alpha^2 1nEC_t + \alpha^3 1nGlob_t + \alpha^4 1nT_t + \alpha^5 1nF_t + \varepsilon_t \quad (3)$$

Where CO_2 is measured in metric tons per person, GDP in constant 2010 US dollars, E in kilograms of oil equivalent, and U is the percentage of the population that lives in urban areas. The exports and imports of commodities and services are used to compute T and measured as a % of GDP. Finally, the private sector's share of domestic credit or 'F' is measured as (% of GDP). The figures were compiled using indicators from 1970 to 2019. In addition, a new mix of criteria was used to examine whether or not the EKC hypothesis is dominating in economics.

$$1nCO_{2t} = \alpha_0 + \alpha_1 lnGDP_t + \alpha_2 lnGDP_t^2 + \alpha_3 1nE_t + \alpha_4 1nU_t + \alpha_5 1nT_t + \alpha_6 1nF_t + \varepsilon_t \quad (4)$$

However, t stands for time trend, α_0 shows the fixed effect, and the ε_t denotes the error term. Whereas: α_1 ... α_6 explains the long-term flexibilities (elastic) of the study's concerning variables. As stated before, parameters 1 and 2 should have positive and negative coefficients in light of the EKC method (Thio et al., 2022), depending on the economic progress or the panel of nations, parameter 4 fluctuates from one country to the next. Further, it demonstrates how urbanization boosts energy use, which encourages the emission of CO_2. By collecting environmentally friendly technologies and raising production efficiency, urbanization, on the contrary, promotes economic development by reducing environmental degradation (Noor and Saputra, 2020).

Furthermore, the impact of the α5 is conditional on the stage of development through which the economy is moving. It's terrible for developed nations since they buy environmentally damaging products from countries with lax environmental regulations (Terrell, 2021; Xia and Wang, 2020). Growth economies, on the contrary, are a good indicator since they boost output without taking precautions or adhering to legislation meant to safeguard the environment. Since developing countries are primarily responsible for environmental degradation, a high degree of trade openness and a considerable deal of carbon dioxide has been added to the atmosphere as a result (Neagu, 2019; Shikwambana et al., 2021; Bibi and Jamil, 2021).

RESULTS AND DISCUSSION

This study is organized to measure the influence of globalization, financial development, and GDP on carbon emissions and capture the existence of EKC using a time series dataset from the World Development Indicators (WDI). First,

to present an overview of study factors, descriptive analysis is applied, and outcomes are reported in Table 1. All the variables are presented descriptively and demonstrate that the Malaysian economy produces between 2.105 and 0.301, i.e., 1.33-kilo ton (kt) of carbon dioxide per year. In contrast, the average gross domestic product (GDP) is around US $ 49.509. While the EC, FD, Glob, and TO ratios are 7.309, 4.379, 4.096, and 4.922, which lie in the maximum and minimum range, respectively. Additionally, in Figure 1, the historical trend of data is portrayed.

Figure 1 discloses the trend of all the variables except trade openness; the remaining factors have an increasing trend. Moreover, Augmented Dicky Fuller (ADF) and Philips Perron (PP) tests are used to finding the stationarity. The dataset must have a unit root before applying any other method. The outcomes of ADF and PP tests are reported in Table 2.

The outcome elaborates that all factors have zero mean and constant variance at the first difference at ADF and PP. In simple words, energy consumption, financial development, trade openness, globalization, and real GDP are integrated with I(1). However, GDP and FC have stationery at a level in ADF. While in the PP test, GDP and FD have a unit root. But at first difference all the factors are stationary. Moreover, the Johansen cointegration approach is employed to measure the association among the factors under analysis, which is known to capture long-term connections among the variables in the time series dataset; results are described in Table 4.

The abovementioned information elaborates that the Johansen cointegration test has two segments (i.e., Trace and Max-Eigen values). Trace finds four cointegration equations, while max-Eigen finds three cointegration equations, indicating that all the factors have a long-term affiliation with carbon emission. Moreover, it also elaborates that the globe is negatively associated with CO2 while GDP, EC, FD, and TO are positively associated with carbon dioxide. Increase in the globe, and carbon emanation is reduced while GDP, EC, FD, and TO increase the carbon dioxide emanation in the Malaysian economy in the long term. When time series are I(0), I(1), or jointly ARDL bounds, testing can estimate level relationships. Bound testing, an extension of ARDL modeling, employs F and t-statistics to evaluate the relevance of the lagged levels of variables in a univariate equilibrium correction system when it is uncertain if a time series is a trend or first difference stationary. The ARDL model is used to analyze the short-term and long-term affiliation of the variables. The outcome of the ARDL bound is reported in Table 4.

Table 1. Descriptive analysis of the variables.

Variables	Mean	Median	Maximum	Minimum	Std Dev	Skewness	Kurtosis	Jarq-Bera
CO2	1.338	1.548	2.105	0.301	0.609	-0.223	1.491	4.950
GDP	7.034	7.066	7.286	6.644	0.179	-0.409	2.305	2.304
GDP2	49.509	49.928	53.09	44.150	2.017	-0.365	2.256	2.177
EC	7.309	7.418	8.042	3.687	0.575	-0.382	1.812	3.989
FD	4.379	4.631	5.065	3.058	0.568	-1.004	2.746	8.204
Glob	4.096	4.106	4.396	3.687	0.247	-0.262	1.557	4.711
TO	4.922	4.945	5.395	4.299	0.314	-0.195	1.870	2.858

Source: Author(s) calculations.

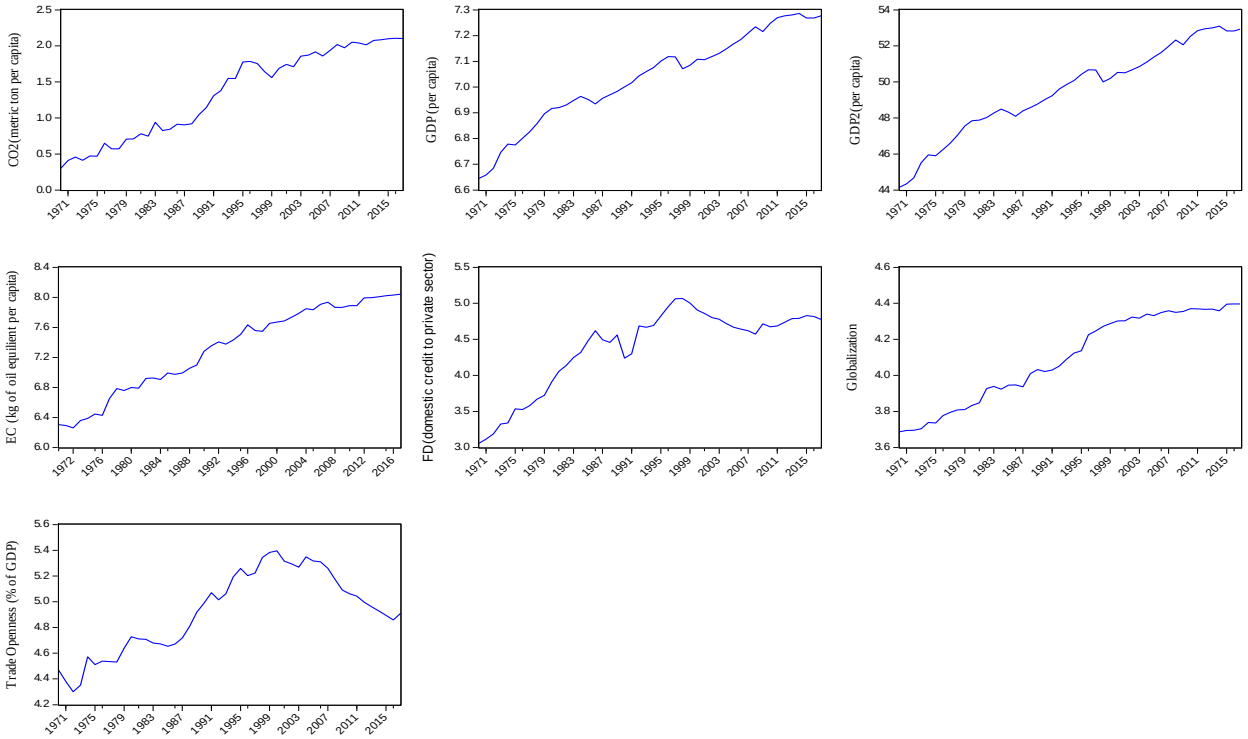

Figure 1. Trend of the variables; Source: Author(s) calculations.

Table 2. Augmented Dickey-Fuller Test.

Variables	Constant (at level)	Trend & Constant (at level)	1st Difference
CO2	-1.210	-1.731	-8.221***
GDP	-2.781*	-2.520	-5.102***
GDP2	-2.592	-2.492	-5.191***
EC	-1.393	-1.391	-7.132***
GLOB	-1.372	-0.650	-6.891***
FC	-2.761*	-1.401	-5.992***
TR	-1.930	-0.142	-5.112***
PP Result			
CO2	-1.210	-1.691	-8.161***
GDP	-2.732***	-2.532	-5.132***
GDP2	-2.551	-2.511	-5.221***
Ec	-2.142	-1.110	-7.231***
FD	-2.741*	-1.411	-5.992***
Glob	-1.432	-6.892***	-0.551***
TO	-1.461	-0.212	-5.112***

Note: ***, **&* 10, 5 & 1% Significance Level respectively. Source: Author(s) calculations.

Table 3. Trace values.

Null Hypothesis	Alternative Hypothesis	Eigenvalue	Trace Statistic	5% Critical Value	Prob.**	Hypothesized No. of CE(s)
Ho: k = 0	H1: k ≤ 1	0.591	121.011	95.751	0.00	None*
H1: k ≤ 1	H1: k ≤ 2	0.462	79.282	69.812	0.00	At most1*
H1: k ≤ 2	H1: k ≤ 3	0.392	50.812	47.853	0.02	At most2*
H1: k ≤ 3	H1: k ≤ 4	0.321	28.023	29.792	0.07	At most3*
Maxi-Eigen Value						
Ho: k = 0	H1: k ≤ 1	0.590	41.731	40.071	0.03	None *
H1: k ≤ 1	H1: k ≤ 2	0.462	28.462	27.492	0.01	At most1*
H1: k ≤ 2	H1: k ≤ 3	0.391	50.813	57.853	0.12	At most2
H1: k ≤ 3	H1: k ≤ 4	0.323	28.022	25.291	0.07	At most3*

Normalized Co-Integration						
1 Cointegration Equation(s)		Log-likelihood	4.13.4696			
Normalized cointegration Coefficient (standard error in parentheses)						
CO_2	GDP	GDP^2	EC	FD	TO	GLOB
	0.101	0.052	0.431	0.122	0.272	-4.960
1.000000	0.132	0.061	0.412	0.101	0.181	0.731

Source: Author(s) calculations.

Table 4. ARDL Bound Testing Estimations.

Dependent Factors	$\Delta \ln CO_2$ (without GDP^2)	$\Delta \ln CO_2$ (with GDP^2)
Number of Lags	1, 1, 0, 1, 0, 0	1, 0, 0, 1, 0, 0
F-Stat	3.401	5.851
R^2	0.892	0.921
Adjusted R^2	0.792	0.851

Source: Author(s) calculation.

However, the estimation reveals that fiscal development, trade openness, and globalization upsurged CO_2 emissions by 0.042% and 0.251% and decreased by 0.681%, respectively. Simplifying that trade openness and fiscal development increased the carbon emission, the finding are consistent with Wang and Wang, (2021), Ur Rahman, (2019), Sun et al.,(2020), Sun et al.,(2019), and Paramati et al. (2021).

There are also indirect ways in which globalization can contribute to carbon emissions. For example, as countries become more interconnected, they may adopt more energy-intensive production methods or consume more goods and services that are produced using fossil fuels (Wang et al., 2019). Additionally, globalization can lead to urbanization and the concentration of people and businesses in cities, increasing the demand for energy and transportation and contributing to higher levels of carbon emissions (Huang et al., 2021), indicating that globalization has a positive and negative influence on carbon emissions. However, the current study found a negative affiliation of globalization with carbon emission, suggesting that interconnection among the nation increased in Malaysia. The findings are consistent with Sun et al. (2021), Wang et al., (2020), Zaidi et al., (2019), and Shahbaz et al., (2018).

At the same time, the ECT term elaborates that the speed of adjustment toward equilibrium is very high (0.79), meaning that in each period, about 0.79% of adjustments are made

toward the equilibrium. However, numerous residuals, coefficients and stability tests were employed to empower the finding. The results are mentioned in Table 6. The estimation state that the model is free from serial correlation, heteroskedastic, and normality is in favor of the study. At the same time, Ramsey RESET elaborates the model's functionality is also in favour of the study. However, the CUSUM and CUSUM Square procedures were used to verify the parameters' dependability, as shown in the accompanying Figures 2 and 3.

Table 5. ARDL Estimation.

Variables	Coefficients	Std. Err.	t- stat	p-value
Short Run				
GDP	1.801	1.251	-1.651	0.10
GDP^2	-2.280	1.382	-1.650	0.10
EC	0.801*	0.192	4.192	0.00
FD	0.092	0.101	0.941	0.35
Glob	-0.110	0.501	-0.221	0.82
TO	0.251	0.172	1.462	0.15
Long Run Coefficient				
GDP	2.901**	1.241	2.032	0.04
GDP^2	-1.992*	1.112	-2.791	0.05
EC	0.621*	0.231	2.652	0.01
FD	0.042*	0.082	3.551	0.06
Glob	-0.681*	0.461	-1.472	0.04
TO	0.251*	0.181	2.391	0.04
ECT	-0.791*			0.05
Adjusted R^2	0.89			
AIC	-2.35			
HQC	-2.11			

Source: Author(s) calculations.

Table 6. Residual, Coefficient, and the Stability test.

Heteroskedastic: Breusch- Pagan- Godfrey Test	prob (0.01)
Breusch- Godfrey serial Correlation LM Test	prob (0.02)
Jarque Bera Test	prob (0.03)
Ramsey RESET Test	prob (0.01)

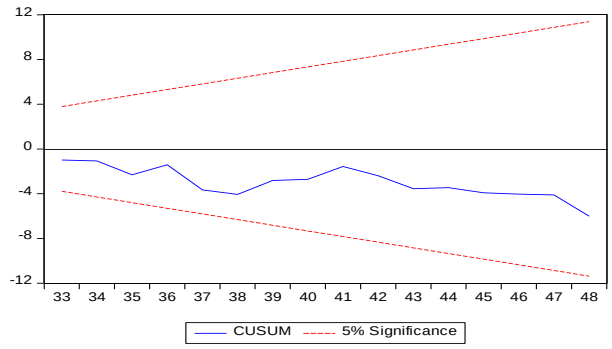

Figure 2. CUSUM Result.

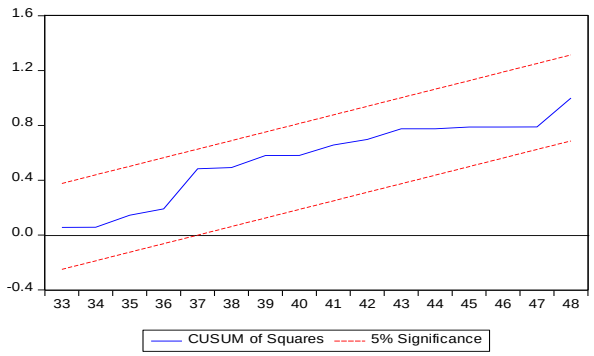

Figure 3. CUSUMSQ Result.

Table 7. VAR Estimations.

Variables	CO_2	GDP	EC	FD	TO	GLOB
C (-1)	0.621	0.251	0.261	-0.041	-0.061	0.022
Std.err	0.162	0.260	0.132	0.221	0.132	0.043
T stat	3.692	0.932	1.991	-0.181	-0.472	0.612
Prob.	0.021	0.011	0.032	0.042	0.031	0.021

Source: Author(s) calculation.

Table 8. Dependent Variable: CO_2

Excluded	Chi. Sq.	Df	Prob.
GDP	0.381	2	0.82
EC	14.910	2	0.00
FD	1.301	2	0.52
TO	0.801	2	0.66
GLO	0.851	2	0.65
Over- All	25.771	10	0.00
Dependent Variable: GDP			
C	0.901	2	0.63
EC	6.891	2	0.03
FD	1.782	2	0.41
TO	0.331	2	0.84
GLOB	0.121	2	0.93
Over- All	13.151	10	0.21
Dependent Variable: EC			
NC	4.491	2	0.10
GDP	4.301	2	0.11
FD	1.441	2	0.48
TO	4.312	2	0.11
GLOB	3.661	2	0.16
Over- All	20.651	10	0.02
Dependent Variable: FD			
C	2.251	2	0.32
GDP	2.712	2	0.25
EC	0.821	2	0.66
TO	3.652	2	0.16
GLO	14.271	2	0.00
Over- All	21.661	10	0.01
Dependent Variable: TO			
C	3.821	2	0.14
GDP	9.621	2	0.00
EC	1.692	2	0.42
FD	15.381	2	0.00
GLO	1.462	2	0.48
Over- All	19.931	10	0.02
Dependent Variable: GLOB			
C	10.252	2	0.00
GDP	1.501	2	0.47
EC	0.582	2	0.74
FD	4.521	2	0.10
TO	4.471	2	0.10
Over- All	28.592	10	0.00

The abovementioned model is strengthened by stability diagnostic (Figures 2 and 3), which shows that its parameters are significant at the 5% level. Furthermore, the study uses a method developed by Sims (1980) called vector auto-regressive (VAR) to capture the dynamic and adaptable behavior of the model's variables. The brilliance of this method lies in the fact that all variables are used in tandem. There is no distinction between internal and external factors. Economists use this tactic as a policy experiment to alter a variable's trajectory and provide insight into hidden information in the data. Table 7 comprises the output of the VAR model.

The results of VAR reveal that all the factors have a significant long-term affiliation with carbon emissions. Moreover, data carry a lot of information. Therefore, policymakers utilized various approaches to extract that information to design a suitable policy for sustainable economic development. That's why the study employed the block exogeneity approach, which employed the independent variable as a dependent one and revealed their influence on the dependent factor. Moreover, block exogeneity also shows the granger causality among the elements. The outcomes of block exogeneity are reported in Table 8.

Table 8 discloses that there exists a long-term affiliation among the factors. Moreover, the study utilizes the Block Exogeneity test to extract more information. This methodology divides all the elements in the different models listed in Table 8. When carbon is dependent, all the other variables are independent except CO_2. Therefore, block homogeneity states that energy consumption is the only factor that causes the carbon dioxide produced in the economy. In simple words, energy consumption predicts that an increase in energy utilization will increase the CO_2 emanation in the

economy and expects the one-way causality from EC to CO_2. However, gross domestic product, fiscal development, trade openness, and globalization individually have no granger cause with the CO_2 productivity. But collectively, all the variables granger cause the carbon dioxide produced.

When GDP is dependent, the VAR Granger causality noted that energy consumption has the granger causality with the GDP because the p-value confirms the one-way causality from EC to the GDP. In contrast, all other variables (C, FD, TO & GLO) have no granger causality with the GDP. However, it noted that energy consumption would promote the GDP in the economy in the coming time frame. Moreover, all the variables except EC individually have no granger causality towards GDP and no granger cause collectively. When EC is dependent, the VAR granger depicts that individually C, GDP, FD, TO, and GLOB have no granger causality with the EC. But collectively, all the variables have a granger cause with Ln EC, meaning that in the coming time frame, all the variables will upsurge the energy consumption application in the country.

When FD is dependent, the model introduced by the VAR granger causality presents that in this model, globalization has the granger causality with the fiscal development and has a one-way association GLO to FD. In contrast, all the other factors in the model individually have no granger causality with the LNFD. However, all the variables, such as C, GDP, EC, and TO have causality with the FD, which means they collectively affect the behavior of the FD in the coming period.

When TO is dependent, the result of the VAR granger with the TO dependent variable states that globalization and the gross domestic product cause the economy's trade openness. The estimations also say the relation is one way from GDP to TO and the FD towards the GDP, while the individual influence of the C, EC, and GLO have no granger cause. However, if talking about the collective impact, the results explain that all the factors have a granger cause on trade openness, meaning that all the variables influence the TO's behavior in the coming time frame.

When Glob is a dependent variable, the VAR granger test states that CO_2 granger causes globalization, meaning that globalization will increase carbon production at the world level in the future. In comparison, the individual influence of all the factors in table 16 on globalization has no granger causality. However, all variable collectively granger causes globalization in the Malaysian economy.

CONCLUSIONS AND RECOMMENDATIONS

Climate change, world temperature, and environmental degradation are increasing with the passage of time. Therefore, the relationship between carbon emanation and the predicted parameters is explored in this research. Factors such as real GDP, energy consumption, GDP^2, trade openness, financial development and globalization have been employed as possible determinants of CO_2 emanation. EKC is often used when the investigation covers the environment. Therefore, the gross domestic product square was also included in this paper. All the information was mined from the World Development Indicator, a collection that spans 1970 to 2019.

The Cobb-Douglas production methodology was utilized because it dominated other tactics. The research used the ADF and PP tests for stationary, and both tests reveal that series have zero mean and constant variance. Johansen's cointegration affirms the long-term connection between GDP, GDP^2, FD, EC, TO, and globalization. In comparison, ARDL confirmed the presence of EKC in the Malaysian economy. Moreover, the ARDL elasticities elaborate that energy consumption, GDP, trade openness, financial development, and globalization play a significant role in carbon emissions.

Diagnosis of residuals, coefficients and stability approaches show that the model is devoid of heteroscedasticity and serial correlation. Model specification is valid, residual distribution is normal and stable parameters. Furthermore, the VAR block exogeneity approach indicates that carbon dioxide, real GDP, energy consumption, trade openness, financial development and globalization contribute to Malaysia's environmental depletion.

An immense response policy should be designed to minimize carbon emissions. Many countries are introducing carbon taxes or environmental tax policies to attain zero carbon in the future. However, political intervention is needed to enforce regulations and create environmental awareness. In addition, environmentally-friendly technology is also accessible to lessen the carbon dioxide threat. Therefore, the government should implement a better-off policy for the environment.

There are limitations to the study as well. The present investigation made use of the time series dataset as an example. Despite this, further research might be conducted using a panel dataset. In addition, a wide range of carbon emanation factors may be utilized to present a comprehensive picture of the deterioration of the environment. Last, the structural VAR method may be implemented for more research, resulting in a wide range of model constraints.

REFERENCES

Abd Razak, F.D., Khalid, N., Ali, M.H., 2021. Asymmetric impact of institutional quality on environmental degradation: Evidence of the environmental kuznets curve. Sustain. 13. https://doi.org/10.3390/su132212507.

Abdul-Latif, N.I.S., Ong, M.Y., Nomanbhay, S., Salman, B., Show, P.L., 2020. Estimation of carbon dioxide (CO2) reduction by utilization of algal biomass bioplastic in Malaysia using carbon emission pinch analysis (CEPA). Bioengineered 11, 154–164. https://doi.org/10.1080/21655979.2020.1718471.

Ambrose, H., Kendall, A., Lozano, M., Wachche, S., Fulton, L., 2020. Trends in life cycle greenhouse gas emissions of future light duty electric vehicles. Transp. Res. Part D Transp. Environ. 81. https://doi.org/10.1016/j.trd.2020.102287.

Arifah, N., Haryono, S., 2021. Analisis Determinan Pengungkapan Emisi Karbon (Studi Perbandingan Perusahaan di Indonesia dan Malaysia Periode 2013-2018). At-Taradhi J. Stud. Ekon. 12, 1. https://doi.org/10.18592/at-taradhi.v12i1.4654.

Arnaut, J., Lidman, J., 2021. Environmental sustainability and economic growth in greenland: Testing the environmental kuznets curve. Sustain. 13, 1–14. https://doi.org/10.3390/su13031228.

Aslam, B., Hu, J., Ali, S., AlGarni, T.S., Abdullah, M.A., 2022. Malaysia's economic growth, consumption of oil,

industry and CO2 emissions: evidence from the ARDL model. Int. J. Environ. Sci. Technol. 19, 3189–3200. https://doi.org/10.1007/s13762-021-03279-1.

Aslam, B., Hu, J., Hafeez, M., Ma, D., AlGarni, T.S., Saeed, M., Abdullah, M.A., Hussain, S., 2021. Applying environmental Kuznets curve framework to assess the nexus of industry, globalization, and CO2 emission. Environ. Technol. Innov. 21. https://doi.org/10.1016/j.eti.2021.101377.

Au Yong, H.N., 2018. The Impact of Electric Power Consumption on Green Economy Development in Malaysia. J. KATHA 14, 73–95. https://doi.org/10.22452/katha.vol14no1.4.

Balsalobre-Lorente, D., Leitão, N.C., Bekun, F.V., 2021. Fresh validation of the low carbon development hypothesis under the ekc scheme in portugal, italy, greece and spain. Energies 14. https://doi.org/10.3390/en14010250.

Bibi, F., Jamil, M., 2021. Testing environment Kuznets curve (EKC) hypothesis in different regions. Environ. Sci. Pollut. Res. 28, 13581–13594. https://doi.org/10.1007/s11356-020-11516-2.

Danish, Baloch, M.A., Wang, B., 2019. Analyzing the role of governance in CO2 emissions mitigation: The BRICS experience. Struct. Chang. Econ. Dyn. 51, 119–125. https://doi.org/10.1016/j.strueco.2019.08.007.

Danish, Ozcan, B., Ulucak, R., 2021. An empirical investigation of nuclear energy consumption and carbon dioxide (CO2) emission in India: Bridging IPAT and EKC hypotheses. Nucl. Eng. Technol. 53, 2056–2065. https://doi.org/10.1016/j.net.2020.12.008.

Deqiang, S., Zhijun, C., Hajduk-Stelmachowicz, M., Larik, A.R., Rafique, M.Z., 2021. The Role of the Global Value Chain in Improving Trade and the Sustainable Competitive Advantage: Evidence From China's Manufacturing Industry. Front. Environ. Sci. 9. https://doi.org/10.3389/fenvs.2021.779295.

Ehigiamusoe, K.U., Lean, H.H., 2019. Effects of energy consumption, economic growth, and financial development on carbon emissions: evidence from heterogeneous income groups. Environ. Sci. Pollut. Res. 26, 22611–22624. https://doi.org/10.1007/s11356-019-05309-5.

Etokakpan, M.U., Solarin, S.A., Yorucu, V., Bekun, F.V., Sarkodie, S.A., 2020. Modeling natural gas consumption, capital formation, globalization, CO2 emissions and economic growth nexus in Malaysia: Fresh evidence from combined cointegration and causality analysis. Energy Strateg. Rev. 31. https://doi.org/10.1016/j.esr.2020.100526.

Farabi, A., Abdullah, A., Setianto, R.H., 2019. Energy consumption, carbon emissions and economic growth in Indonesia and Malaysia. Int. J. Energy Econ. Policy 9, 338–345. https://doi.org/10.32479/ijeep.6573.

Gabrielli, P., Poluzzi, A., Kramer, G.J., Spiers, C., Mazzotti, M., Gazzani, M., 2020. Seasonal energy storage for zero-emissions multi-energy systems via underground hydrogen storage. Renew. Sustain. Energy Rev. 121. https://doi.org/10.1016/j.rser.2019.109629.

Haikola, S., Anshelm, J., Hansson, A., 2021. Limits to climate action - Narratives of bioenergy with carbon capture and storage. Polit. Geogr. 88. https://doi.org/10.1016/j.polgeo.2021.102416.

Haldar, A., Sethi, N., 2022. Environmental effects of Information and Communication Technology - Exploring the roles of renewable energy, innovation, trade and financial development. Renew. Sustain. Energy Rev. 153. https://doi.org/10.1016/j.rser.2021.111754.

Hoang, C.N., 2021. The effects of economic integration on co2 emission: A view from institutions in emerging economies. Int. J. Energy Econ. Policy 11, 374–383. https://doi.org/10.32479/ijeep.10718.

Huang, Y., Wu, H., Zhu, H., 2021. Time-frequency relationship between R&D intensity, globalization, and carbon emissions in G7 countries: evidence from wavelet coherence analysis. Environ. Sci. Pollut. Res. 28, 51908–51927. https://doi.org/10.1007/s11356-021-14369-5.

Jiang, Y., Khaskheli, A., Raza, S.A., Qureshi, M.A., Ahmed, M., 2021. Threshold non-linear relationship between globalization, renewable energy consumption, and environmental degradation: evidence from smooth transition models. Environ. Sci. Pollut. Res. 28, 13323–13339. https://doi.org/10.1007/s11356-020-11537-x.

Khan, S., Khan, M.K., Muhammad, B., 2021. Impact of financial development and energy consumption on environmental degradation in 184 countries using a dynamic panel model. Environ. Sci. Pollut. Res. 28, 9542–9557. https://doi.org/10.1007/s11356-020-11239-4.

Khezri, M., Heshmati, A., Khodaei, M., 2022. Environmental implications of economic complexity and its role in determining how renewable energies affect CO2 emissions. Appl. Energy 306. https://doi.org/10.1016/j.apenergy.2021.117948.

Kuronuma, T., Watanabe, H., Ishihara, T., Kou, D., Toushima, K., Ando, M., Shindo, S., 2018. CO2 Payoffof extensive green roofs with different vegetation species. Sustain. 10. https://doi.org/10.3390/su10072256.

Li, H., Li, F.Y., Yu, X., 2018. China's contributions to global green energy and low-carbon development: Empirical evidence under the belt and road framework. Energies 11. https://doi.org/10.3390/en11061527.

Ma, Y., Wang, H., Hong, F., Yang, J., Chen, Z., Cui, H., Feng, J., 2021. Modeling and optimization of combined heat and power with power-to-gas and carbon capture system in integrated energy system. Energy 236. https://doi.org/10.1016/j.energy.2021.121392.

Muhammad, F.L., Saad, N.M., 2018. A Review of Energy Efficiency on Carbon Dioxide Emission in Malaysia. Glob. Bus. Manag. Res. 10, 1064–1070.

Munir, K., Ameer, A., 2018. Effect of economic growth, trade openness, urbanization, and technology on environment of Asian emerging economies. Manag. Environ. Qual. An Int. J. 29, 1123–1134. https://doi.org/10.1108/MEQ-05-2018-0087.

Neagu, O., 2019. The link between economic complexity and carbon emissions in the European Union countries: A model based on the Environmental Kuznets Curve (EKC) approach. Sustain. https://doi.org/10.3390/su11174753.

Noor, M.A., Saputra, P.M.A., 2020. Emisi Karbon dan Produk Domestik Bruto: Investigasi Hipotesis Environmental Kuznets Curve (EKC) pada Negara Berpendapatan

Menengah di Kawasan ASEAN. J. Wil. dan Lingkung. 8, 230–246. https://doi.org/10.14710/jwl.8.3.230-246.

Nurgazina, Z., Ullah, A., Ali, U., Koondhar, M.A., Lu, Q., 2021. The impact of economic growth, energy consumption, trade openness, and financial development on carbon emissions: empirical evidence from Malaysia. Environ. Sci. Pollut. Res. 28, 60195–60208. https://doi.org/10.1007/s11356-021-14930-2.

Olubusoye, O.E., Musa, D., 2020. Carbon Emissions and Economic Growth in Africa: Are They Related? Cogent Econ. Financ. 8. https://doi.org/10.1080/23322039.2020.1850400.

Paramati, S.R., Mo, D., Huang, R., 2021. The role of financial deepening and green technology on carbon emissions: Evidence from major OECD economies. Financ. Res. Lett. 41. https://doi.org/10.1016/j.frl.2020.101794.

Ur Rahman, Z.U., 2019. Does CO2 and Its Possible Determinants are Playing Their Role in the Environmental Degradation in Turkey. Environment Kuznets Curve Does Exist in Turkey. J. Wellbeing Manag. Appl. Psychol. 2, 19–37. https://doi.org/10.13106/jwmap.2019.vol2.no2.19.

Raihan, A., Begum, R.A., Said, M.N.M., Pereira, J.J., 2021. Assessment of carbon stock in forest biomass and emission reduction potential in Malaysia. Forests 12. https://doi.org/10.3390/f12101294.

Rambeli-Ramli, N., Jalil, N.A., Hashim, E., Mahdinezhad, M., Hashim, A., Belee, Bakri, S.M., 2018. The impact of selected macroeconomic variables on Carbon Dioxide (Co2) emission in Malaysia. Int. J. Eng. Technol. 7, 204–208. https://doi.org/10.14419/ijet.v7i4.15.21447.

Rambeli, N., Marikan, D.A.A., Hashim, E., Ariffin, S.Z.M., Hashim, A., Podivinsky, J.M., 2021. The determinants of carbon dioxide emissions in Malaysia and Singapore. J. Ekon. Malaysia 55, 107–119. https://doi.org/10.17576/JEM-2021-5502-9.

Ren, X., Shao, Q., Zhong, R., 2020. Nexus between green finance, non-fossil energy use, and carbon intensity: Empirical evidence from China based on a vector error correction model. J. Clean. Prod. 277. https://doi.org/10.1016/j.jclepro.2020.122844.

Saint Akadiri, S., Adewale Alola, A., Olasehinde-Williams, G., Udom Etokakpan, M., 2020. The role of electricity consumption, globalization and economic growth in carbon dioxide emissions and its implications for environmental sustainability targets. Sci. Total Environ. 708. https://doi.org/10.1016/j.scitotenv.2019.134653.

Sarkodie, S.A., Owusu, P.A., 2021. Escalation effect of fossil-based CO2 emissions improves green energy innovation. Sci. Total Environ. 785. https://doi.org/10.1016/j.scitotenv.2021.147257.

Saudi, M.H.M., Sinaga, O., Jabarullah, N.H., 2019. The role of renewable, non-renewable energy consumption and technology innovation in testing environmental Kuznets curve in Malaysia. Int. J. Energy Econ. Policy 9, 299–307. https://doi.org/10.32479/ijeep.7327.

Shahbaz, M., 2022. Globalization–Emissions Nexus: Testing the EKC Hypothesis in Next-11 Countries. Glob. Bus. Rev. 23, 75–100. https://doi.org/10.1177/0972150919858490

Shahbaz, M., Kumar Mahalik, M., Jawad Hussain Shahzad, S., Hammoudeh, S., 2019. Testing the globalization-driven carbon emissions hypothesis: International evidence. Int. Econ. 158, 25–38. https://doi.org/10.1016/j.inteco.2019.02.002.

Shahbaz, M., Shahzad, S.J.H., Mahalik, M.K., Hammoudeh, S., 2018. Does Globalisation Worsen Environmental Quality in Developed Economies? Environ. Model. Assess. 23, 141–156. https://doi.org/10.1007/s10666-017-9574-2

Shahbaz, M., Sinha, A., 2019. Environmental Kuznets curve for CO2 emissions: a literature survey. J. Econ. Stud. https://doi.org/10.1108/JES-09-2017-0249.

Shahzad, S.J.H., Kumar, R.R., Zakaria, M., Hurr, M., 2017. Carbon emission, energy consumption, trade openness and financial development in Pakistan: A revisit. Renew. Sustain. Energy Rev. https://doi.org/10.1016/j.rser.2016.11.042.

Shan, S., Genç, S.Y., Kamran, H.W., Dinca, G., 2021. Role of green technology innovation and renewable energy in carbon neutrality: A sustainable investigation from Turkey. J. Environ. Manage. 294. https://doi.org/10.1016/j.jenvman.2021.113004.

Sharif, A., Afshan, S., Chrea, S., Amel, A., Khan, S.A.R., 2020. The role of tourism, transportation and globalization in testing environmental Kuznets curve in Malaysia: new insights from quantile ARDL approach. Environ. Sci. Pollut. Res. 27, 25494–25509. https://doi.org/10.1007/s11356-020-08782-5.

Shikwambana, L., Mhangara, P., Kganyago, M., 2021. Assessing the relationship between economic growth and emissions levels in south africa between 1994 and 2019. Sustain. 13, 1–15. https://doi.org/10.3390/su13052645.

Sims, C.A., 1980. Macroeconomics and reality. Econom. J. Econom. Soc. 1–48.

Solaymani, S., 2022. CO2 Emissions and The Transport Sector in Malaysia. Front. Environ. Sci. 9. https://doi.org/10.3389/fenvs.2021.774164.

Su, C.W., Xie, Y., Shahab, S., Faisal, C.M.N., Hafeez, M., Qamri, G.M., 2021. Towards achieving sustainable development: Role of technology innovation, technology adoption and co2 emission for brics. Int. J. Environ. Res. Public Health 18, 1–14. https://doi.org/10.3390/ijerph18010277.

Sulaiman, A.S.M., Shabri, A., 2021. Forecasting carbon dioxide emissions for Malaysia using grey model with Cramer's rule. Malaysian J. Fundam. Appl. Sci. 17, 437–445. https://doi.org/10.11113/MJFAS.V17N4.2091.

Sun, C., Ma, T., Ouyang, X., Wang, R., 2021. Does Service Trade Globalization Promote Trade and Low-Carbon Globalization? Evidence from 30 Countries. Emerg. Mark. Financ. Trade 57, 1455–1473. https://doi.org/10.1080/1540496X.2019.1627517.

Sun, H., Clottey, S.A., Geng, Y., Fang, K., Amissah, J.C.K., 2019. Trade openness and carbon emissions: Evidence from belt and road countries. Sustain. 11. https://doi.org/10.3390/su11092682.

Sun, H., Enna, L., Monney, A., Tran, D.K., Rasoulinezhad, E., Taghizadeh-Hesary, F., 2020. The long-run effects of trade openness on carbon emissions in sub-saharan african countries. Energies 13. https://doi.org/10.3390/en13205295.

Sun, Y., Yesilada, F., Andlib, Z., Ajaz, T., 2021. The role of eco-innovation and globalization towards carbon neutrality

in the USA. J. Environ. Manage. 299. https://doi.org/10.1016/j.jenvman.2021.113568.

Terrell, T.D., 2021. Carbon flux and N- and M-shaped environmental Kuznets curves: evidence from international land use change. J. Environ. Econ. Policy 10, 155–174. https://doi.org/10.1080/21606544.2020.1809527.

Thio, E., Tan, M.X., Li, L., Salman, M., Long, X., Sun, H., Zhu, B., 2022. Correction to: The estimation of influencing factors for carbon emissions based on EKC hypothesis and STIRPAT model: Evidence from top 10 countries (Environment, Development and Sustainability, (2021), 10.1007/s10668-021-01905-z). Environ. Dev. Sustain. https://doi.org/10.1007/s10668-022-02221-w.

Tsaurai, K., 2019. The impact of financial development on carbon emissions in Africa. Int. J. Energy Econ. Policy 9, 144–153. https://doi.org/10.32479/ijeep.7073.

Wang, G., Chao, Y., Cao, Y., Jiang, T., Han, W., Chen, Z., 2022. A comprehensive review of research works based on evolutionary game theory for sustainable energy development. Energy Reports. https://doi.org/10.1016/j.egyr.2021.11.231.

Wang, L., Vo, X.V., Shahbaz, M., Ak, A., 2020. Globalization and carbon emissions: Is there any role of agriculture value-added, financial development, and natural resource rent in the aftermath of COP21? J. Environ. Manage. 268. https://doi.org/10.1016/j.jenvman.2020.110712.

Wang, Q., Wang, L., 2021. How does trade openness impact carbon intensity? J. Clean. Prod. 295. https://doi.org/10.1016/j.jclepro.2021.126370.

Wang, Y., Zhou, T., Chen, H., Rong, Z., 2019. Environmental homogenization or heterogenization? The effects of globalization on carbon dioxide emissions, 1970-2014. Sustain. 11. https://doi.org/10.3390/su11102752.

Xia, C., Wang, Z., 2020. The effect of fossil fuel and hydropower on carbon dioxide emissions: EKC validation with structural breaks. J. Environ. Eng. Landsc. Manag. 28, 36–47. https://doi.org/10.3846/jeelm.2020.11832.

Yan, Y., Wang, R., Zheng, X., Zhao, Z., 2020. Carbon endowment and trade-embodied carbon emissions in global value chains: Evidence from China. Appl. Energy 277. https://doi.org/10.1016/j.apenergy.2020.115592.

Yuaningsih, L., Febrianti, R.A.M., Ahmad, M.J., 2021. Examining the factors affecting co2 emissions from road transportation in Malaysia. Int. J. Energy Econ. Policy 11, 152–159. https://doi.org/10.32479/ijeep.10957.

Zaidi, S.A.H., Zafar, M.W., Shahbaz, M., Hou, F., 2019. Dynamic linkages between globalization, financial development and carbon emissions: Evidence from Asia Pacific Economic Cooperation countries. J. Clean. Prod. 228, 533–543. https://doi.org/10.1016/j.jclepro.2019.04.210.