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The Impact of Globalization on CO_2 Emissions in Malaysia*

Soo Cheng CHUAH[1], Chai Li CHEAM[2], Saliza SULAIMAN[3]

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Abstract

This study investigates the impact of globalization, coal consumption, and economic growth on CO_2 emissions in Malaysia by applying the Kuznets Environmental Curve model. The study employed the Autoregressive Distributed Lag modeling technique on time series data over the period of 1970–2018 to determine the short and long-run relationship between CO_2 emissions and a number of variables, including globalization, coal consumption, and economic growth. The results show that globalization increase CO_2 emissions in both the short and long run in Malaysia. Furthermore, the results reveal that economic growth and coal consumption degrade the environmental quality by accelerating the CO_2 emissions in the short-run and long run. As a result, the findings validate the Kuznets Environmental Curve hypothesis of an inverted U-shaped relationship between economic growth and CO_2 emissions in the long run for Malaysia. The findings of this study suggest that higher globalization levels and usage of coal consumption degrade the environmental quality in Malaysia. The findings also indicate the effect of economic growth on environmental degradation is positive at the initial stage but improves after the economy achieves a threshold level of income per capita in the economic development process with an inverted U-shaped pattern in the long run.

Keywords: CO_2 Emissions, Globalization, Environmental Kuznets Curve

JEL Classification Code: F43, F64, Q43, Q50

1. Introduction

Although the rapid industrialization worldwide has engendered economic growth, it has also spurred environmental degradation. Rapid economic development brings about negative effects on the environment quality, with a massive increase in greenhouse gas (GHG) emissions, particularly CO_2 emissions (Zhang, 2011). The significant increase in CO_2 emissions has been a matter of concern for researchers and policymakers. The association between economic development and the environment has been explained in the EKC hypothesis (Grossman & Krueger, 1991). The EKC posits that at an early stage of economic growth, environmental degradation increases with an increase in income per capita. However, beyond a threshold level of income per capita, environmental deterioration begins to subside with an increase in income per capita. This denotes that environmental quality is an inverted U-shaped function of per-capita income. A large number of studies have examined the association between CO_2 emissions and economic growth in light of the EKC hypothesis, albeit the lack of consensus on their outcomes. While some studies confirmed the inverted U-shaped curve of the EKC hypothesis (Aslam et al., 2021; Boutabba, 2014; Jalil & Mahmud, 2009; Ridzuan et al., 2020; Saboori et al., 2012; Shahbaz et al., 2014; Tang & Tan, 2015), others found an N-shaped EKC (Akbostanci et al., 2009; Friedl & Getzner, 2003; Koc & Bulus, 2020).

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[1]First Author. Senior Lecturer, Department of Economics and Financial Studies, Faculty of Business and Management, MARA University of Technology, Selangor Campus, Malaysia. ORCID ID: 0000-003-4613-5413. Email: chuahsc@uitm.edu.my

[2]Corresponding Author. Senior Lecturer, Faculty of Business and Management, Universiti Teknologi MARA Kelantan, Malaysia. ORCID ID: 0000-0003-4231-1096. [Postal Address: 18500 Bukit Ilmu, Machang, Kelantan, Malaysia]
Email: chailicheam@uitm.edu.my

[3]Senior Lecturer, Department of Economics and Financial Studies, Faculty of Business and Management, MARA University of Technology, Selangor Campus, Malaysia. ORCID ID: 0000-003-3949-9307. Email: saliza421@uitm.edu.my

Globalization has been recognized as one of the economic factors that induce a country's economic growth and development. Globalized activities facilitate economic growth through trade openness, foreign direct investment, and a financial integration-driven industrialization process. On the other hand, the globalization process may impend the environmental sustainability (Shahbaz et al., 2017), as industrialization induces high energy (fossil fuel) consumption, resulting in increased CO_2 emissions and environmental degradation. The recent globalization of international markets has further heightened the concern for environmental sustainability. Grossman and Krueger (1991) found that international trade has a beneficial and negative impact on environmental degradation in both developing and developed countries. Hence, this research experimentally investigates the existence of EKC to determine the extent to which the current globalization trend has impacted Malaysia.

As a globalized developing country, Malaysia is well connected to the world economy; this was possible due to its implementation of export-led policies, which had resulted in a high level of trade openness and foreign direct investment in the country since the 1970/the 80s. However, the country's push for industrialization has raised its energy demand substantially, thus resulting in the generation of vast greenhouse gases (CO_2 emissions). The annual CO_2 emissions have increased from 1.35 tonnes per capita in 1970 to 7.90 tonnes per capita in 2018, corresponding with the increase in per-capita income from US$358 to US$11,380. Also, the consumption of energy (coal) resources has increased from 0.19 terawatt-hour (TWh) in 1970 to 257.6 TWh in 2018.

Generally, coal is the world's second-largest energy source, accounting for close to 30% of total energy production, and is largely used for power generation—accounting for more than 40% of global electricity generation (Adedoyin et al., 2020). Increased energy pollutants are released as a result of rising coal consumption, posing a risk to human health and the environment. Environmental pollution is a global issue, and the planet faces challenges as a result of the deterioration of environmental conditions (Adebayo, 2021). Malaysia continues to be reliant on fossil fuels such as natural gas, coal, and oil (Oh et al., 2018), and with rising energy demand to support the country's economic growth in the future, CO_2 emissions will inevitably arise. Due to rising awareness of GHG emissions and their influence on air quality, the relationship between energy consumption and economic growth, as well as economic growth and environmental pollution, has sparked interest in recent years.

This study empirically investigates the EKC hypothesis by examining the relationship between globalization, coal consumption, and CO_2 emissions in Malaysia for the period 1970–2018. The econometric method of ARDL was applied to examine the cointegration of the series in terms of short and long-run estimation. The results confirmed the inverted U-shaped EKC for the relationship between per-capita income and CO_2 emissions. In other words, coal consumption negatively impacts CO_2 emissions, while the overall globalization index positively impacts CO_2 emissions.

The rest of the paper is organized as follows: Section 2 provides the literature review, and Section 3 advances the methodology of the study. Section 4 provides empirical results and discussions, and Section 5 presents the conclusion and policy recommendations.

2. Literature Review

In the pursuit of quick economic growth, emerging countries have disregarded the issue of environmental degradation, jeopardizing ongoing environmental preservation initiatives. Environmental deterioration is linked to increased economic growth and a variety of developmental indices (Ahmad et al., 2016). Since the mid-1990s, the topic of economic growth and environmental degradation has gained prominence. With rapid economic growth and development over the last century, CO_2 emissions have risen dramatically. The relationship between environmental quality and economic growth has been extensively researched in the literature in light of the EKC hypothesis discovered by Kuznets (1955). According to the EKC hypothesis, emissions rise in tandem with wealth during the early stages of economic expansion. However, as an economy achieves a certain level of per-capita income, emissions start to decline. Grossman and Krueger (1991) pioneered the study on environmental degradation and economic growth and proposed the inverted U-shaped link between environmental quality and income per capita for the first time. The inverted U-shaped relationship between economic growth and environmental degradation is further supported by Shafik (1994), Grossman and Krueger (1995), Carson et al. (1997), and Suri and Chapman (1998).

Kaufmann et al. (1998), however, failed to find an inverted U-shaped relationship between environmental degradation and economic growth. Moreover, Friedl and Getzner (2003) found that the link between economic growth and CO_2 emissions was initially positive, then becomes negative, and finally positive, resulting in an N-shaped association between CO_2 emissions and economic expansion. Thus, Spangenberg (2001) argued that the EKC might exist in certain circumstances but not all. In other words, evidence of an inverted U-shaped relationship between economic expansion and environmental degradation remains inconclusive. Similarly, when statistical methods were used to examine the EKC, Perman, and Stern (2003) discovered that it did not exist. Using the VAR model, Islam et al. (2017) also confirm the validity of the EKC model of the U-shaped relationship between income per capita and CO_2 emissions in Bangladesh. Although EKC proposes an inverted U-shaped

relationship between environmental degradation and real GDP, the empirical literature offers inconsistent outcomes.

Globalization has been found to facilitate the transition of modern technologies, stimulate the division of labor, and increase the economic advantage of different countries through foreign direct investment and technological transfer from developed to developing countries. With that, it is crucial to examine the most up-to-date indices of globalization and its impact on CO_2 emissions. Studies done by Christmann and Taylor (2001) found that China's environmental contamination remains unaffected by globalization. They also confirmed that China's environmental rules have resulted in better air quality. Lee and Min (2014) looked at a large panel of data from developing and developed countries and observed that globalization reduces air pollution. Later, Shahbaz et al. (2017) discovered that globalization benefits the Australian economy. Paramati et al. (2017) investigated the impact of political globalization on CO_2 emissions and discovered that it improves the environment by lowering CO_2 emissions. Shahbaz et al. (2017) recently analyzed the effect of globalization sub-indices (political, economic, and social) on CO_2 emissions and demonstrated that globalization enhances the environmental performance of the Chinese economy. Vu and Huang (2020) and Nguyen (2020) proved the positive impact of trade and FDI on CO_2 emissions in Vietnam in the short run.

Recent research, on the other hand, has discovered that globalization has a considerable impact on environmental degradation and climate change (Shahbaz et al., 2018; Wang et al., 2018; Xu et al., 2018). The relationship between globalization and CO_2 emissions in the G7 countries was investigated by Liu et al. (2020). Their findings revealed an inverted U-shaped relationship between globalization and CO_2 emissions, which is highly consistent with the EKC hypothesis. Nguyen and Le (2020) investigated how globalization affected CO_2 emissions in Vietnam. Using time-series data from 1990 to 2017, their findings showed that globalization drives an increase in CO_2 emissions in Vietnam, indicating that globalization is not beneficial to the country's long-term environmental health. In contrast, Khan et al. (2019) used the dynamic ARDL simulation model to examine the impact of globalization, economic conditions, and energy use on CO_2 emissions in Pakistan from 1971 to 2016. They observed that energy usage, financial expansion, foreign direct investment, commerce, economic globalization, political globalization, and social globalization have a major impact on CO_2 emissions in Pakistan. Mehmood and Tariq (2020) used annual data from 1972 to 2013 to investigate an inverted U-shaped EKC hypothesis in South Asia. It was observed that globalization is less likely to raise CO_2 emissions in the short term than it is in the long term. However, if short-term elasticity surpasses long-term elasticity, the association between globalization and CO_2 emissions will be negative. Similarly, a panel study by Phong (2019) on globalization's influence on environmental deterioration in ASEAN-5 economies from 1971 to 2014 validated the EKC hypothesis, suggesting that growth and ecological deterioration have an inverted U-shaped relationship in selected countries.

In the Malaysian context, Sharif et al. (2020) and Suki et al. (2020) investigated the inverted U-shaped EKC using quarterly data and the QARDL technique and found that globalization has a favorable social and political impact on environmental stability. Bekhet et al. (2020) incorporated economic growth, energy consumption, financial development, urbanization, and CO_2 emissions into their study of the relationship between EKC and UET theories in Malaysia from 1970 to 2013. The results revealed that energy consumption, economic growth, and FD have a positive effect on CO_2 emissions, whereas urbanization has a negative effect, using the F-bounds testing approach of cointegration and error-correction based Granger causality models. However, the variables have varying degrees of significance in the short term. Specifically, energy consumption, GDP, and urbanization have a positive association with emissions, whereas only the financial component has a negative relationship. According to the studies stated above, the impact of globalization on CO_2 emissions is a mix. For some countries, globalization is beneficial, while for others, it is detrimental.

Energy consumption and economic development have been proven to have a close link. The demand for energy rises in tandem with increasing development. Chaudhry (2010), Pao and Tsai (2010), and Siddiqui (2004) investigated the relationship between energy use, economic growth, and environmental sustainability. The majority of studies on the energy use-carbon emission nexus are conducted in industrialized countries, such as Europe and the United States (Kasman & Duman, 2015). Earlier studies on the subject highlighted that CO_2 emissions are caused by economic growth and energy use. Using data from Romania, Shahbaz et al. (2013) investigated the relationship between economic development and CO_2 emissions by integrating energy use in explaining CO_2 emissions. They discovered that the EKC hypothesis exists and that energy usage contributes to CO_2 emissions. The EKC theory is equally valid for the Indian (Tiwari et al., 2013) and Chinese economies. In this regard, Jayanthakumaran et al. (2012) examined the relationship between energy consumption, economic growth, CO_2 emissions and trade openness in China and India. The researchers confirmed the EKC hypothesis in both countries, indicating that energy consumption has a favourable impact on energy pollutants in both China and India. Begum et al. (2015) found that in Malaysia, both per-capita energy consumption and per-capita GDP have long-term positive effects on per-capita carbon emissions.

ARDL was used by Van Nguyen and Le (2020) to investigate the impact of globalisation on coal use in Vietnam from 1990 to 2017. In the long run, globalisation boosts coal use in Vietnam. This finding primarily showed that as Vietnam's level of globalisation rises, so does its coal usage. As a result, the findings of this study back prior research that suggests that globalisation has an impact on coal usage. The study also revealed that rapid economic expansion encourages increased coal usage in the short and long terms.

3. Methodology

This study assessed the effect of globalization on CO_2 emission in Malaysia using the Kuznet model. The model specification in term of semi log-linear equation used in this study is as follow:

$$\log \mathrm{CO}_2 = \alpha_0 + \alpha_1 \log \mathrm{gdpc} + \alpha_2 \log \mathrm{gdpc}^2 + \alpha_3 \log \mathrm{coal} + \alpha_4 \mathrm{kof\ gi} \quad (1)$$

where CO_2 is annual CO_2 emission per capita (tonnes), gdpc denotes GDP per capita, gdpc^2 is square of GDP per capita, coal signifies coal consumption in terawatt-hour (TWh) and kofgi represents globalization index.

This study employed annual data on CO_2 emission per capita, GDP per capita, GDP per capita squared, coal consumption, and globalization spanning the period 1970–2018. The data of GDP per capita (constant 2010 US$) was collected from the World Development Indicators of the World Bank. Annual CO_2 emission per capita and coal consumption were obtained from the Statistical Review of World Energy and the KOF globalization index published by the KOF Swiss Economic Institute were used to measure the globalization level.

This study used the ARDL model by Pesaran et al. (2001). Before the test, the unit root test was performed to check the stationary of data, as non-stationary data may lead to spurious regression. The Augmented Dickey-Fuller and Phillips–Perron tests were employed to test the null hypothesis of the presence of unit root in the time series (i.e., the time series is non-stationary) and the alternative hypothesis of the non-existence of unit root (i.e., the time series is stationary). A series is integrated at order *t*, denoted by I(t), with notations I(0) and I(1) indicating the stationary series at the level form and first difference level, respectively.

The ARDL was utilized to analyze the long-run relationship via a bound cointegration testing procedure. The ARDL bound test is useful for relatively small sizes and appropriate for variables with either I(0) or I(1), but not I(2). The ARDL bound test approach of equation 1 is as follows:

$$\begin{aligned}\Delta \log \mathrm{CO}_2 = {} & \beta_0 + \sum_{i=1}^{p} \gamma_1 \Delta \mathrm{CO}_2 + \sum_{i=1}^{q_1} \gamma_2 \Delta \log \mathrm{gdpc}_{t-i} \\ & + \sum_{i=1}^{q_2} \gamma_3 \Delta \log \mathrm{gdpc}^2_{t-i} + \sum_{i=1}^{q_3} \gamma_4 \Delta \log \mathrm{coal}_{t-i} \\ & + \sum_{i=1}^{q_4} \gamma_5 \Delta \mathrm{kof\ gi}_{t-i} + \theta_1 \mathrm{CO}_{2\,t-i} \\ & + \theta_2 \log \mathrm{gdpc}_{t-i} + \theta_3 \log \mathrm{gdpc}^2_{t-i} \\ & + \theta_4 \log \mathrm{coal}_{t-i} + \theta_5 \mathrm{kof\ gi}_{t-i} + \varepsilon_t\end{aligned} \quad (2)$$

where $\gamma_1, \gamma_2, \gamma_3, \gamma_4, \gamma_5, \gamma_6$ are coefficients for short-term, θ_1, $\theta_2, \theta_3, \theta_4, \theta_5, \theta_6$, are the coefficients for long-term, is the first difference operator and is the residual term.

The test of ARDL model cointegration was tested for the null hypothesis of no cointegration, H0: $\theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = 0$ and alternative hypothesis of cointegration, H0: $\theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq \theta_5 \neq 0$. The existence of the long-term cointegration of variables was assessed using the Pesaran et al. (2001) bound test. The *F*-statistics derived was examined with the critical *F*-statistic value. The null hypothesis of no cointegration can be rejected if the calculated *F*-statistic bound test is greater than the upper critical value, while the null hypothesis of cointegration cannot be rejected if the calculated *F*-statistic bound test is below the lower critical value. The analysis is inconclusive if the calculated *F*-statistic falls between the lower and upper critical values.

After confirming the ARDL cointegration of the variables, the following estimation for the long-run model was considered:

$$\begin{aligned}\log \mathrm{CO}_2 = {} & \beta_0 + \sum_{i=1}^{p} \gamma_1 \Delta \mathrm{CO}_2 + \sum_{i=1}^{q_1} \gamma_2 \Delta \log \mathrm{gdpc}_{t-i} \\ & + \sum_{i=1}^{q_2} \gamma_3 \Delta \log \mathrm{gdpc}^2_{t-i} + \sum_{i=1}^{q_3} \gamma_4 \Delta \log \mathrm{coal}_{t-i} \\ & + \sum_{i=1}^{q_4} \gamma_5 \Delta\, \mathrm{kof\ gi}_{t-i} + \varepsilon_t\end{aligned} \quad (3)$$

The short-run relationship of the coefficients was estimated using the Error Correction Model (ECM) as follows:

$$\begin{aligned}\log \mathrm{CO}_2 = {} & \beta_0 + \sum_{i=1}^{p} \gamma_1 \Delta \mathrm{CO}_2 + \sum_{i=1}^{q_1} \gamma_2 \Delta \log \mathrm{gdpc}_{t-i} \\ & + \sum_{i=1}^{q_2} \gamma_3 \Delta \log \mathrm{gdpc}^2_{t-i} + \sum_{i=1}^{q_3} \gamma_4 \Delta \log \mathrm{coal}_{t-i} \\ & + \sum_{i=1}^{q_4} \gamma_5 \Delta\, \mathrm{kof\ gi}_{t-i} + \theta_1 \mathrm{CO}_{2\,t-1} + \theta_2 \log \mathrm{gdpc}_{t-i} \\ & + \theta_3 \log \mathrm{gdpc}^2_{t-i} + \theta_4 \log \mathrm{coal}_{t-i} + \theta_5 \mathrm{kofgi}_{t-i} \\ & + \lambda\, \mathrm{ECT}_{t-1} + \varepsilon_t\end{aligned} \quad (4)$$

where ECT_{t-1} is the lagged error correction term, λ indicates the speed of adjustment to the equilibrium after a shock and the coefficient of ECT is a negative value.

To avoid the issue of parameter bias, the estimated model was checked for serial correlation, heteroskedasticity, model misspecification, and normality using the Breusch-Godfrey test, Breusch and Pagan test, Ramsey's RESET test, the ARCH, and Jarque-Bera test, respectively. The stability of the model was assessed using Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Square of Recursive Residuals (CUSUMSQ).

4. Results and Discussion

The unit root test was tested to determine the stationary properties of the time series. ADF and PP methods were applied to determine the stationary properties of time series for level and first differences of all variables. The results in Table 1 indicated that all variables (CO_2 emissions, log(gdpc), log($gdpc^2$), log(lcoal), and kofgi) is stationary at the first difference and integrated at order 1 and not a second-order, suggesting that the ARDL model was appropriately applied to test the model of the study.

The stationary test was conducted using the ADF and PP tests to determine the stationary properties, and the results are shown in Table 1. The results showed that all variables are integrated of the first order, I(1), indicating stationarity at first differences. As all variables are not integrated into the second-order, I(2), the ARDL test is appropriate (Pesaran et al., 2001) to assess the presence of cointegration among the variables in the study.

The ARDL model was estimated by selecting the optimal lag length using the Akaike Information Criterion (AIC) for a small-sample size, and the maximum lag for annual data is 2 (Van Nguyen & Le, 2020). The optimal model ARDL (1, 1, 0, 2, 1) was estimated.

Next, the bound test was carried out to determine the presence of cointegration among explanatory variables. The result of the bound test is presented in Table 2. The calculated *F*-statistics (5.6344) was compared with the critical lower and upper bound of Narayan (2005), and it was greater than the critical upper bound value at a 1% significance level.

The results for ARDL long-run coefficients are shown in Table 3. The ARDL long-run estimations showed a significant positive impact of globalization on CO_2 emissions in Malaysia at 10% significance level, indicating that higher globalization level increases the CO_2 emissions. These findings are in line with those of Nguyen and Le (2020) and Khan et al. (2019). According to our findings, an increase of one index point in globalization will increase the emission of CO_2 by 0.043 tonnes. Globalizations induce trade and industrialization, which leads to greater negative externalities effects on the environment due to high consumption of energy in the production process. Malaysia

Table 2: ARDL Bound Test for Cointegration

***k* = 4**	**ICO$_2$| lgdpc lgdpc2 lcoal kofgi**	
F-statistic	5.6344	
Significance	**I(0)**	**I(1)**
1%	3.29	4.37
5%	2.56	3.49
10%	2.2	3.09

Table 1: Unit Root Test Results

Variables		**At Level**		**The First Difference**		**Integrated Order**
		ADF	**PP**	**ADF**	**PP**	
logCO_2	Intercept	–0.162	–0.255	–8.463***	–8.388***	I(1)
	Trend and Intercept	–2.474	–2.467	–8.377***	–8.308***	I(1)
log(GDPC)	Intercept	–1.736	–1.17	–5.934***	–5.933***	I(1)
	Trend and Intercept	–2.556	–2.662	–6.026***	–6.028	I(1)
log(GDPC2)	Intercept	–1.18	–1.166	–6.087***	–6.088***	I(1)
	Trend and Intercept	–2.591	–2.75	–6.079***	–6.081***	I(1)
log(COAL)	Intercept	–0.45	–1.113	–5.128***	–7.402***	I(1)
	Trend and Intercept	–4.028***	–2.887	–5.062***	–7.279***	I(1)
KOFGI	Intercept	–1.435	–1.447	–6.649***	–6.672***	I(1)
	Trend and Intercept	–0.613	–0.747	–6.836***	–6.836***	I(1)

Note: *** denotes the 1% significant level.

is highly dependent on non-renewable energy including natural gas and coal for electricity generation, which results in high emission of CO_2. The significant positive effect of the non-renewable energy of coal on CO_2 emissions found in this study is consistent with the findings of Tiwari et al. (2013) and Shahbaz et al. (2017). Coal is the second major fossil fuel used for electric power generation in Malaysia, and its consumption is still growing. Based on our results, an increase of 1% in coal consumption will increase the release of CO_2 by 0.047%.

The ARDL results confirm the EKC hypothesis in the long run, given the positive significant coefficient of GDPC (1.619) and negative significant coefficient of GDPC2 (–0.104). The result indicated that a 1% increase in GDP per capita will raise CO_2 emissions by 1.619%. The negative coefficient value of GDPC2 also validates the EKC hypothesis, which suggests that environmental quality improves as income per capita increases beyond a threshold level. The confirmation of the EKC hypothesis is consistent with the findings of earlier studies (Aslam et al., 2021; Jalil & Mahmud, 2009; Mehmood, 2021; Tiwari et al., 2013; Islam et al., 2017)

The short-run coefficient estimation results are presented in Table 4. The short-run coefficients of all explanatory variables are statistically significant. The estimated coefficient of globalization (D[KOFGI]) has a positive significant effect on CO_2 emissions in the short run. Also, change in the lagged coal consumption, i.e., D(logcoal)(–1), has a significant positive effect on CO_2 emissions at a 10% significance level. The estimated results showed that D(LGDPC) and L(GDPC2) are positively and negatively related to CO_2 emissions, respectively. The lagged error-correction has a statistically significant negative sign (–0.777), indicating that the disequilibrium in the short run is adjusted at the speed of 77.7% per year towards the equilibrium point in the long run.

Table 5 presents the results of the diagnostic test. The findings indicate the absence of heteroscedasticity, normality, serial correlation, and specification problems in the model. The stability of the model was tested by CUSUM and CUSUMSQ tests as shown in Figure 1. The estimated model is stable, as the plot of CUSUM and CUSUMSQ statistics were within the critical bounds of a 5% confidence interval, with the presence of a cointegration relationship among variables.

Table 3: Estimated ARDL Long-Run Coefficients

Variables	Coefficient	*t*-statistic
LGDPC	1.619	1.961*
LGDPC2	–0.104	–2.177**
LCOAL	0.047	3.278***
KOFGI	0.043	7.189***
C	–7.766	–2.174

Note: *, **, *** denote the 10%, 5% and 1% significant level, respectively.

Table 4: Estimated ARDL Short-Run Coefficients

Variables	Coefficient	*t*-statistic
D(LGDPC)	1.834	7.312***
D(LGDPC2)	–0.104	–2.177**
D(LCOAL)	0.024	1.817*
D(LCOAL(–1))	–0.039	–3.265***
D(KOFGI)	0.013	1.802*
ECT(–1)*	–0.777	–6.195***

Note: *, **, *** denote the 10%, 5% and 1% significant levels, respectively.

$$ECT_{t-1} = LCO_2CAP - (1.6192 * LGDPC - 0.1040 * LGDPC_2 + 0.0472 * LCOAL + 0.0426 * KOFGI - 7.7659)$$

5. Conclusion

The aim of this paper is to examine the validity of the EKC hypothesis by investigating the impact of coal consumption and globalization on CO_2 emissions over the period of 1970 to 2018 in Malaysia. The ARDL econometric method was used to estimate the short and long-run cointegration of the series. The inverted U-shaped EKC hypothesis for the association between per-capita income and CO_2 emissions was validated by the findings of this study. Also, globalization and coal consumption were found to favorably influence CO_2 emissions. These findings will not only help the government, policymakers, and industries understand the gravity of carbon emissions associated with

Table 5: Results of the Diagnostic Test

Test Method	Statistic Value	*p*-value
Breusch-Godfrey Serial Correlation LM Test (3 lags)	0.911	0.446
Breusch-Godfrey Serial Correlation LM Test (6 lags)	0.509	0.797
Breusch-Pagan-Godfrey Heteroskedasticity Test	1.762	0.109
ARCH Test (1 lags)	0.437	0.512
ARCH Test (2 lags)	0.243	0.786
Jarque-Bera Test	0.999	0.607
Ramsey RESET Test	1.032	0.391

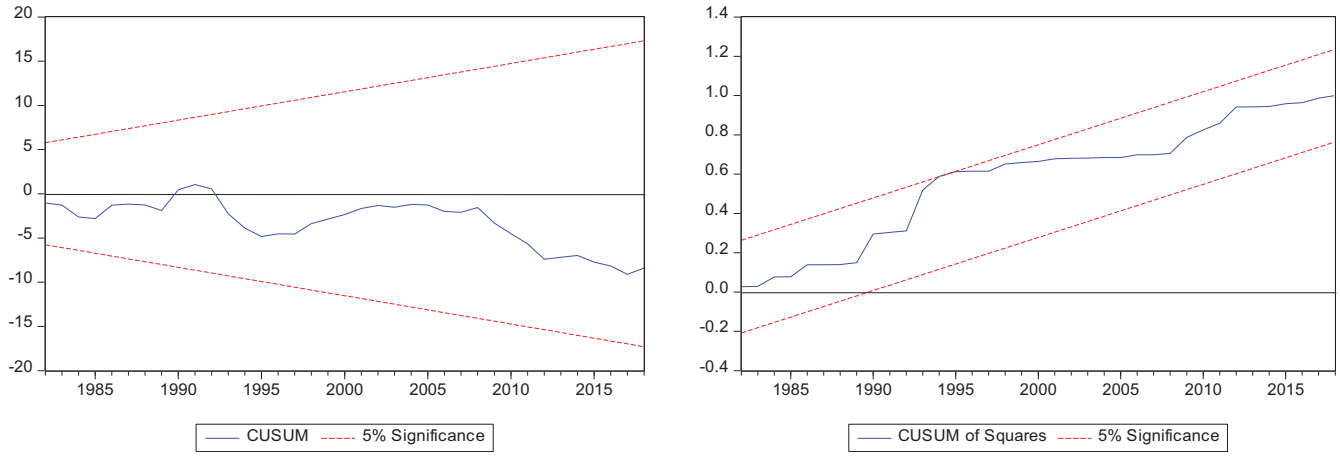

Figure 1: CUSUM and CUSUMSQ Plots at a 5% Significance Level

their daily operations, but also instigate them to develop environmental conservation initiatives.

As Malaysia's industrial and power sectors are still reliant on fossil fuels, such as natural gas and coal, the country is prone to generate higher CO_2 emissions. Hence, the government may need to devote more attention to curbing the country's growing environmental deterioration by enacting conservation policies relating to coal, gas, electricity, and oil usage while simultaneously encouraging the use of renewable energy to promote economic growth. In other words, the government should prioritize environmental conservation in its economic development drive. Also, the government can play a part in environmental protection by only supporting environmentally friendly projects. Similarly, by awarding business loans with the condition of reducing CO_2 emissions, the finance sector would help to boost Malaysia's economic growth and environmental sustainability.

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