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Environmental Degradation-Education Nexus in Malaysia

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Abstract

This study aims to examine the role of education on CO_2 emissions in Malaysia from 1974 to 2014. The unit root tests indicated that the variables were integrated in the same order. As such, the Johansen Co-integration Approach can be employed in this empirical analysis to analyze the impacts of the selected variables. The long-run estimation revealed that economic growth (GDP) and energy consumption (ENERGY) has a negative effect on CO_2 emissions. Meanwhile, secondary school education (EDU) demonstrated a significant positive relationship with environmental degradation in the long-run. This can be inferred that secondary school education has a negative effect on environmental quality. However, a negative relationship was found between CO_2 emissions and economic growth in the long-run. Besides that, this study had highlighted a positive association between gross fixed capital (GFC) and CO_2 emissions. The findings from this study shed light on the vital importance of education in affecting environmental degradation. Empirical evidence suggested that the current education system will need to be redesigned for the reduction of CO_2 emissions in the future. This is supported by the result that indicated the secondary level education promotes higher consumption of technologies that emit pollutants rather than promoting environmental awareness.

Keywords: Environmental degradation; Johansen cointegration; Education; Energy consumption

Introduction

The increase in CO_2 emissions has exerted much pressure on global environmental issues. Following this, many researchers had attempted to analyze the main causes of such increased emissions. A plethora of empirical studies has largely considered the Environmental Kuznets Curve (EKC) and other factors such as energy consumption, growth of population, trade openness, financial development, among others. Although these past studies had provided contributions that explained the determinants of CO_2 emissions, however education as an important driver in the development of human capital and clean technology was largely omitted from the analysis [1].

UNESCO [2] advocated the importance of education and learning as a catalyst in solving environmental problems. The level of education can improve the economic condition of any

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economy while raising the environmental awareness among the people [3]. Meanwhile, Pfeiffer and Mulder [4] advocated that high schooling levels can accelerate the diffusion of renewable energy technology. Similarly, Jin et al. [5] agreed that individuals that gained more skills and knowledge can create sustainable environmental technologies that would reduce pollution problems. Pablo–Romero and Sánchez–Braza [6] further supported that human capital helps to reduce environmental pollution issues by shedding light on the substitutability relationship between human capital and energy consumption.

Despite the significance of education in reducing environmental degradation, the studies that involve the education variable remain relatively scarce and limited. Besides, past researches have been reporting inconsistent and conflicting results. For example, Gangadharan and Valenzuela [7] and Hill and Magnani [8] reported a positive relationship between education and environmental pollution. Meanwhile, Danish et al. [9] concluded that human capital does not contribute to environmental quality in the long-run. Similarly, Williamson [10] and Ehrhardt-Martinez et al. [11] revealed an insignificant relationship between the two variables instead. On the other hand, Eyuboglu and Uzar [1] indicated a statistically negative relationship between education and CO_2 emissions. Hence, suggesting that higher education can be used to overcome environmental problems.

Muhammad [12] draws light to the competing theoretical possibilities of the role of human capital in determining the environmental quality of a country. For countries with very low education levels, an increase in enrolment will likely accelerate the use of non-renewable energy resources which aggravates environmental degradation. However, when the enrolment traverse to certain threshold levels, an increase in enrolment would increase the utilization of environment-friendly products and increase awareness among the population of the need to promote environmental sustainability.

This study would be similar to that of Balaguer and Cantavella [13] by considering education in the EKC model. As such, the assumption by past researches that the increase of education rates would affect the environment in a single direction will be relaxed in this study. Instead, the research will be based on the two competing theories that explained the relationship between education and environmental degradation. The main contribution of this study would be to fill the literature gap by examining the role of education on CO_2 emissions in Malaysia. This paper will further contribute to the literature by examining the influence of education on the environment within the EKC model.

Besides that, this study will particularly focus on secondary education enrolment as most populations benefited from this level of education and are more aware of environmental problems through the knowledge gained at this education level. Besides, secondary level education is the most suitable indicator to show the level of human capital stock for developing countries [14]. Lastly, this study will also seek to analyze the other determinants of environmental degradation in Malaysia. The remainder of this paper is organized as follows. Section 2 presents the literature review, Section 3 will discuss the methodology employed in this study, Section 4 presents the findings, and Section 5 provides the conclusion.

Literature review

Most of the literature in the past such as [15–16] had focused on exploring the determinants of carbon dioxide emissions by examining it against the theory of the EKC. The EKC theory indicated that there is an inverted U-shaped relationship between economic growth and CO_2 emissions. The EKC theory explained that the development of a country as it becomes more industrialized will result in higher pollutants

emission. However, the changes in the economic structure as the country becomes wealthier will lead to the reduction of emissions. This has led to several studies that had been conducted to examine the links between environmental degradation and economic growth. Chin et al. [15] had pointed out that economic growth is the main contributor to carbon emissions (CO_2) in Malaysia by employing the ordinary least squares-based autoregressive distributed lag (ARDL) method. Similarly, Mugableh [16] corroborates that EKC hypothesis supported the relationship between economic growth and CO_2 emissions in Malaysia. These studies appeared to confirm the validity of the inverse U-shape relationship between CO_2 emissions and economic growth in Malaysia.

Further studies [17–19] had included the energy consumption to test the EKC model. Sharma [17] pointed out that energy consumption has a significant positive effect on CO_2 emissions. Higher consumption of energy would contribute to the increase in emissions. In another study by Vo et al. [18], the level of CO_2 emissions was found to have a positive association with energy consumption in Malaysia and Myanmar. Similarly, Adebayo and Kalmaz [19] revealed a significant and positive interaction between energy consumption and CO_2 emissions in Egypt. This shows that energy consumption deteriorates the environmental quality. In contrast, Alkhateeb et al. [3] posited that energy consumption has a negative short-run effect on the CO_2 emissions in Saudi Arabia.

Meanwhile, some studies have also included gross capital formation in their investigation of the EKC theory. On a separate note, Adebayo and Kalmaz [19] shed light that there is no evidence of a significant link between gross capital formation and CO_2 emissions. Meanwhile, Etokakpan et al. [20] indicated a positive and statistically significant trend association is observed between gross capital formation and CO_2 emissions. This finding seems to be consistent with the explanation by Yao et al. [21]. If physical capital investment is used to implement innovations, it could exacerbate CO_2 emissions [20]. The increase of physical capital investment therefore could worsen the environmental quality instead.

Higher education attainment has a positive effect on environmental quality as an educated population would be more likely to demand green products [22]. Besides, investment in human capital through education may decrease energy used in the production process. Education is required for people to understand better of environmental risks [23]. Besides, human capital helps improve techniques as well as promote innovations [24]. The positive impact of human capital on CO_2 emissions was supported by a number of studies such as Gangadharan and Valenzuela [7] and Cole et al. [25]. It is cited, therefore, that the increasing levels of education may raise environmental awareness that contributes to the emergence of the EKC theory. Hence, there is a need to include human capital within the analysis to test the EKC model.

Table 1 Summary of literature review

Author(s)	Sample	Method	Finding
Economic growth – Carbon dioxide emissions			
Chin et al. (2018)	Malaysia	Autoregressive distributed lag and decomposition-type threshold method	Economic growth is the main contributor to CO_2 emissions

Table 1 Summary of literature review (*continued*)

Author(s)	Sample	Method	Finding
Mugableh (2013)	Malaysia	Autoregressive distributed lag	Energy consumption is positively associated with GDP. On the other hand, energy consumption is positively associated with CO_2 emissions. The higher GDP, therefore, increases the CO_2 emissions.
Sharma (2011)	69 countries	Panel ordinary least squares (OLS)	Per capita GDP and energy consumption have positive effects on CO_2 emissions.
Vo et al. (2019)	ASEAN countries (Indonesia, Myanmar, Malaysia, the Philippines and Thailand)	Johansen cointegration approach, the bounds-testing approach to cointegration, Granger causality test	EKC hypothesis observed in Myanmar but not in Indonesia and Malaysia.
Determinants of carbon dioxide emissions			
Adebayo and Kalmaz (2021)	Egypt	ARDL bounds test	Positive significant interaction between energy consumption and CO_2 emissions. Besides, GDP growth impact CO_2 emissions positively.
Etokakpan et al. (2020)	Malaysia	ARDL approach and Granger Ccausality approach	Increase in energy consumption increases economic growth. In addition, a positive collaboration can be found between gross capital formation and economic growth. Positive empirical evidence between economic growth and CO_2 emissions.
Alkhateeb et al. (2020)	Saudi Arabia	ARDL approach	Energy consumption has positive effect on CO_2 emissions.
Education – Carbon dioxide emissions			
Yao et al. (2020)	20 OECD countries	Linear estimation dummy variable estimation (LLDVE) method	Human capital complement physical capital formation in abating CO_2 emissions.
Goetz et al. (1998)	United States	Instrumental variables estimation	Rising education attainment has independent positive effect on environmental quality.
Ulucak and Bilgili (2018)	15 countries	CUP-FM and CUP-BC estimation	Environmental degradation will decrease as human capital increases.

Table 1 Summary of literature review (*continued*)

Author(s)	Sample	Method	Finding
Audi et al. (2016)	Lebanon	ARDL bound test method	Significant negative relationship between secondary school education with environmental degradation.
Mahmood et al. (2019)	Pakistan	Three-stage least square and ridge regression method	Human capital mitigates CO_2
Williamson (2017)	181 countries	Regression	Insignificant finding on the relationship between education levels and emission outputs.
Bashir et al. (2019)	Indonesia	Vector error correction model	No causal evidence from the human capital towards CO_2 emission in the long-run. However, human capital granger cause CO_2 emission in the short-run.
Sapkota and Bastola (2017)	Latin America	Ordinary least squares (OLS)	Increase in human capital reduces pollution for low-income countries. However, increase in human capital for high-income countries lead to higher level of pollution.

Methodology

This paper will focus on examining the influence of education on environment degradation within the EKC model. By integrating the education variable into the theory of EKC, a newly adjusted empirical model is formed to investigate the effect of education on the environment in Malaysia from 1974 to 2014.

1) Theoretical model

The EKC theory indicates the interconnection between real output and CO_2 emission that demonstrates an in-verted U-shape, suggesting that an increase in CO_2 emission as real GDP increases at the early stages of growth and a decline in pollution emissions as the real output increases [19]. It is believed that as a country begins to develop, they become more industrialized. Thereby, increasing the pollutants emissions. However, the increase of wealth will changes the economic structure eventually which then promote cleaner industrial practices [10]. Besides that, improvement in environmental regulations, technological advancement, and better public awareness could reduce environmental pollution.

Human capital is often associated with environmental services. Formal education attainment is frequently used as a measure of the stock of human capital. It is hypothesized that formal education may promote awareness and a better understanding of the cause-and-effect relationships involving environmental pollution [22]. Education levels affect the environmental awareness of a country as well as the environmental regulations that are put in place [10]. Higher education levels will lower the harmful emissions to the environment. Hence, it is hypothesized that an increase in a country's education level will shift the environmental Kuznets curve downwards due to the decreases in pollution. However, a counterintuitive finding was found by Hill [8].

It is suggested instead that the improvements in education levels have provided poor people with greater access to polluting technologies. This hypothesis is supported by Danish [9]. The non-existent role of human capital was found in reducing environmental degradation. The theoretical model presented here, therefore, suggests that education provided could in some ways impart consequences to the environment quality. The education attainment could be translated into behaviors that would either protect or harm the environment.

2) Empirical model

The EKC hypothesis suggested that the pollution level increases earlier when income increases in a country, and then after income (GDP) reaches the optimum level the pollution level will decline [27]. As the country makes economic progress, it has to rely on energy consumption. Hence, a close association between energy consumption and environmental degradation is portrayed by Kaygusuz [30] and Lise [31]. The use of primary energy which constitutes fossil fuels for economic growth will emits CO_2 emissions that contaminate the environment [32]. As such, this study's variables include both the real gross domestic product (GDP) and energy consumption (ENERGY). Literature signified that education is crucial in forming the environmental behavior of the people in the country [3]. Hence, the education variable (EDU) will be incorporated into the model of this study. Besides that, Cobb Douglas's function shed light on the contribution of physical capital input in economic development. Similar to Afolayan et al. [33], gross fixed capital formation (GFC) is included as a proxy of physical capital input. Therefore, the model developed for this study follow as Eq. 1.

This study analyzes the time series data in Malaysia over the period of 1974 until 2014. The data for all the variables are obtained from the World Development Indicators sourced by World Bank [35]. In order to investigate the long-run relationship between the variables, the Johansen co-integration approach is employed. Table 2 shows the description for each selected variable. Figure 1 presented the carbon dioxide emissions in Malaysia during the period of 1974 to 2014. Based on the figure, it is clearly observed that there is a worrying persistent increase in pollutants emissions over the past 40 years. The arising issue of concern, therefore, provided support and motivation for the study on the determinants of environmental degradation.

This study will begin by employing unit root tests such as Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) to examine the order of integration for each series [36]. This analysis is crucial to avoid spurious regression problems. The unit root tests are considered as pre-requisite in co-integration analysis. Subsequently, this study will proceed with the Johansen co-integration test to analyze the long-run relationship between the variables. The Johansen approaches allow for estimation of all possible cointegrating vectors between the set of variables and it is the most reliable test to avoid the problems that stem from the Engle and Granger procedure [36]. Additionally, a number of diagnostic tests are conducted to ensure that the selected model is free from heteroscedasticity problems, autocorrelation, and specification errors.

$$\mathrm{CO}_{2\mathrm{t}} = f(GDP_t, EDU_t, GFC_t, ENERGY_t) \quad \text{(Eq. 1)}$$

Where CO_2 represents carbon emissions, GDP denotes the real gross domestic product, EDU signifies the secondary school enrolment as education proxy, GFC is the gross fixed capital formation as a proxy of physical capital, and ENERGY indicates the fossil fuel energy consumption. For the purpose of regression and estimation, all the series will be converted into

logarithm form. Log-linear conditions provide better and more efficient results than simple linear methods [34]. Hence, the model is specified as follow:

$$\ln CO_2 = \beta_0 + \beta_1 \ln GDP_t + \beta_2 \ln EDU_t + \beta_3 \ln GFC_t + \beta_4 \ln ENERGY_t + \varepsilon_t \quad \text{(Eq. 2)}$$

Where t represents the time period and ε denotes the error term.

Table 2 Description of variables

Variable	Description of variable	Measurement of variable	Source	Expected signs (Long-run)
Carbon dioxide emissions (CO_2)	Carbon dioxide emissions are those stemming from the burning of fossil fuels, including solid, liquid, and gas fuels and gas flaring.	Kiloton	World Development Indicators	Dependent variable
Real gross domestic product (GDP) (Constant 2010)	Measurement of total production by the entire residents in a country for a certain period before deducting the allocation for fixed capital consumption.	Ringgit Malaysia	World Development Indicators	Negative
Secondary school enrolment (EDU)	Gross enrolment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.	% gross enrolment ratio (ratio of total enrolment)	World Development Indicators	Positive
Gross fixed capital formation (GFC) (Constant 2010)	Acquisition of produced assets, including the production of such assets by producers for their own use, minus disposals.	Ringgit Malaysia	World Development Indicators	Positive
Energy consumption (ENERGY)	Fossil fuel consumption which comprises coal, oil, petroleum, and natural gas products.	% of total energy consumption	World Development Indicators	Negative

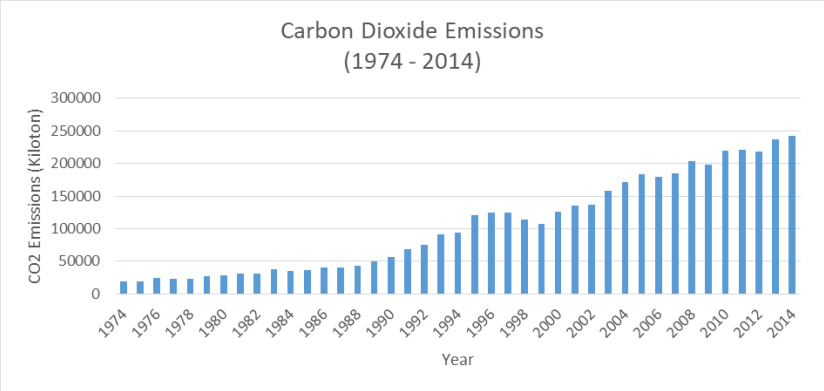

Figure 1 Carbon dioxide emissions in Malaysia.

Results

1) Estimation results based on Johansen Co-integration test

The stationary test on the variables is conducted by using both the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) test. The unit root testing is important to determine whether the variables are stationary or non-stationary and to determine their order of integration. Most macroeconomic time-series have unit roots and this yields spurious regression results. The estimates from the unit root test indicated that all the variables are non-stationary at levels but are stationary after first differencing. The result implied that the variables are integrated of order I(1). As such, the Johansen Co-integration approach will be the best method to be employed to investigate the long-run relationship between the variables without resulting in the spurious problems. Table 3 presented the Augmented Dickey-Fuller (ADF) result and Table 4 showed the Philip-Perron (PP) result.

Before proceeding with the Johansen co-integration test, the optimal lag length needs to be estimated. The lag length selection can be estimated based on the unrestricted Vector Auto-regressive (VAR) model. The following Table 5 showed the VAR lag order selection criteria. The lag length selection is vital to ensure that the research findings reflect the real economic scenario and are consistent with the economic theories.

Based on Akaike's Information Criterion (AIC), and Final Prediction Error (FPE) criterion, the selected lag length 2 was the lowest criterion value. Hence, lag order 2 was suggested to be the optimal lag length to be used to conduct the Johansen co-integration test. The following Table 6 and Table 7 depicted the result of the Johansen co-integration test. Both of the Johansen co-integration test (Trace) and Johansen co-integration test (Max Eigenvalue). The empirical result of both the trace test and maximal eigenvalue supported the existence of two co-integrating vectors in the system. Thus, implying the existence of long-run relationship between the variables carbon dioxide emissions (CO_2), gross domestic product (GDP), secondary school enrolment (EDU), gross fixed capital formation (GFC), and energy consumption (ENERGY).

The normalized co-integrating coefficients as presented by Table 8 revealed the existence of a significant long-run negative relationship between CO_2 emissions and real gross GDP. This implied that an increase in real gross domestic product will lead to a fall in CO_2 emissions in the long-run. This finding therefore supported the EKC hypothesis that there is an inverted U-shaped relationship between CO_2 emission and economic growth. The environmental pressure increases in the early stage of economic growth due to the increased emission of pollutants with extensive exploitation of resources. However, when the income rises up to a certain level, the

emission of the pollutants decreases due to the growing public awareness and concern about environmental degradation [37]. For example, there could be an introduction of production technologies that are more oriented towards green energy use when income increases. The empirical finding from this research, therefore, corroborates to Chin et al. [15], Bekhet and Othman [38].

Table 3 Augmented Dickey Fuller (ADF) test result

Augmented Dickey Fuller (ADF) test				
Variable	**Level**		**First difference**	
	Intercept	**Trend and intercept**	**Intercept**	**Trend and intercept**
$LNCO_2$	-1.109636	-1.457658	-7.224420*	-7.358537*
LNGDP	-1.296182	-1.283875	-5.492333*	-5.775816*
LNEDU	-1.403686	-4.202276**	-6.162017*	-6.070953*
LNGFC	-1.499994	-2.725697	-4.446196*	-4.448113*
LNENERGY	-3.659398*	0.897213	-5.121765*	-4.826385*

Note: * Significant at 1% significance level, ** Significant at 5% significance level

Table 4 Philip-Perron (PP) test result

Phillips Perron (PP) test				
Variable	**Level**		**First difference**	
	Intercept	**Trend and untercept**	**Intercept**	**Trend and untercept**
$LNCO_2$	-1.164859	-1.536445	-7.172768*	-7.300943*
LNGDP	-1.258504	-1.402331	-5.502389*	-5.785064*
LNEDU	-1.403762	-2.471779	-6.162664*	-6.073157*
LNGFC	-1.027243	-1.987910	-4.405700*	-4.394579*
LNENERGY	-4.465587*	-2.172468	-5.118463*	-6.145633*

Note: * Significant at 1% significance level

Table 5 VAR lag order selection criteria

VAR lag order selection criteria						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	361.9284	NA	4.78e-15	-18.78571	-18.57023	-18.70904
1	573.2047	355.8338	2.67e-19	-28.58972	-27.29689*	-28.12974*
2	601.8761	40.74346*	2.37e-19*	-28.78295*	-26.41276	-27.93965
3	614.4267	14.53228	5.54e-19	-28.12772	-24.68017	-26.90111

Note: * indicates lag order selected by the criterion (each test at 5% level), LR: sequential modified LR test statistic, FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion and HQ: Hannan-Quinn information criterion

Table 6 Johansen co-integration test (Max Eigenvalue)

Johansen co-integration test (Max Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max Eigen statistic**	**0.05 Critical value**	**Prob.****
None*	0.603013	35.10636	33.87687	0.0355
At most 1*	0.546971	30.08839	27.58434	0.0233
At most 2	0.323709	14.86301	21.13162	0.2986
At most 3	0.185884	7.814792	14.26460	0.3978
At most 4*	0.096968	3.875890	3.841465	0.0490

Note: Max-eigenvalue test indicates 2 co-integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
** MacKinnon-Haug-Michelis (1999) p-values

Table 7 Johansen co-integration test (Trace)

Johansen co-integration test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace statistic**	**0.05 Critical Value**	**Prob.****
None*	0.603013	91.74844	69.81889	0.0004
At most 1*	0.546971	56.64208	47.85613	0.0060
At most 2	0.323709	26.55369	29.79707	0.1130
At most 3	0.185884	11.69068	15.49471	0.1724
At most 4*	0.096968	3.875890	3.841465	0.0490

Note: Trace test indicates 2 co-integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 8 Normalized co-integrating coefficients

Normalized co-integrating coefficients				
Dependent variable	**Independent variables**			
$LNCO_2$	LNGDP	LNEDU	LNGFC	LNENERGY
Coefficient	-1.826850	1.649431	0.538039	-3.366895
Standard Error	(0.11987)	(0.34673)	(0.11405)	(1.03141)
t-statistic value	[-15.24026]*	[4.75710]*	[4.71757]*	[-3.26436]*

Note: * Significant at 5% significance level

In addition to this, the result also pointed out a significant negative relationship between energy consumption and CO_2 emission. This indicated that the increase of energy consumption lead to a reduction of the CO_2 emission. It has been highlighted in some studies that energy consumption has a strong relationship with CO_2 emission. According to Henriques and Borowiecki [39], the pattern of CO_2 emission is in line with the transition of energy consumption. At a low level of economic growth, the fuel consumption switch from biomass to fossil fuels. However, upon reaching a certain income threshold with the technological improvement that switch the consumption from fossil fuels to more sustainable energy instead. Thus, reducing the emission of CO_2 in the long-run. Similarly, Kim and Heo [40] had demonstrated that technology-intensive capital goods can help in lowering energy intensity and shift the energy consumption patterns towards cleaner energy instead. The negative estimated coefficient for energy consumption

(ENERGY) obtained in this study, therefore suggests that the increase of consumption of energy, in the long-run, will emit less pollutants with the introduction of new innovation that reduces the emissions through energy efficiency.

Meanwhile, the positive relationship between gross fixed capital formation (GFC) and CO_2 emissions indicated that the increase in investment resulted in higher CO_2 emissions. This finding was in conflict with findings by Hdom and Fuinhas [41] that advocated more investments in infrastructure focused on sustainable development that can reduce CO_2 emissions. The finding of a positive association between GFC and CO_2 emissions may suggest that Malaysia's investments in alternative energy resources are not sufficient to result in the hypothesized positive effect towards reducing environmental degradation. As such, the increase of gross fixed capital formation failed to reduce the CO_2 emissions. On a separate note, the estimated positive coefficient of GFC was consistent with Rahman and Ahmad [42]. This result further implied that the increase in investments on physical capital leads to the worsening of environmental degradation. It can be indicating that much of the investments have been attracted towards non-green energy sectors instead. Baek [43] further claimed that gross fixed capital formation leads to environmental issues. The weak environmental regulation could be the underlying reason that leads to the harming of the environment from the increase of investments.

Education is necessary for a country's people to understand environmental risks [22]. The significant relationship of education with CO_2 emissions provided robust support that education influence environmental quality. The inclusion of education in testing the EKC theory contributes to filling the literature gap. The result further provides confirmation that education has a significant role in changing the behavior or pattern of consumption of the people. However, the sign of the coefficient may be varied by country. The statistically significant coefficient of secondary education enrolment reported can further imply that education is one of the increasingly important factors that can affect the environmental path. This would be consistent with the hypothesis that education factors have a significant influence on the formation of the EKC theory.

However, the empirical result of this study implied that the increase of the secondary school enrolment rate fails to lower the CO_2 emissions. This finding seemingly supported Danish et al. [9] that education does not contribute to lower environmental quality in the long-run. It is likely that secondary school education was not sufficient to raise the peoples' awareness to combat environmental challenges. Besides that, the finding of positive coefficient for the education variable was in line with the past findings by Hill and Magnani [8]. They offered an explanation that in low-income countries, the improvements in education levels provide poor people with greater access to polluting technologies [8]. Hence, higher education levels increase pollution instead. This could also further suggest that the current secondary education curriculum may have failed to emphasize the importance of environmental conservation. Hence, the students fail to be equipped with the proper knowledge required on developing environmental sustainability. There would be a need for attention to be drawn towards developing a curriculum that can help in promoting environmental quality and reduces environmental pollution in the future.

2) Diagnostic tests

Diagnostic testing was carried out on the Johansen model to test for serial correlation, heteroskedasticity, normality, and stability. The model passes the diagnostic testing of the Breusch-Godfrey serial correlation LM test with no serial correlation. The model is also free from heteroskedasticity problems as indicated by the result

from the Beusch-Pagan-Godfrey Heteroskedasticiy test, ARCH test, and Glejser test. Meanwhile, both the plots of CUSUM and CUSUM square are within five percent of the critical bands. This indicated that the model is structurally stable. Jarque-Bera Normality test suggested further that the errors are normally distributed. Table 9 reported the results of the diagnostic tests.

Table 9 Diagnostic tests results for ARDL model

Breusch-Godfrey Serial Correlation LM test			
F-statistic	1.197459	Prob. F(2,24)	0.3194
Obs*R-squared	3.447894	Prob. Chi-Square(2)	0.1784
Breusch-Pagan-Godfrey Heteroskedasticity test			
F-statistic	0.873783	Prob. F(15,22)	0.5986
Obs*R-squared	14.18691	Prob. Chi-Square(15)	0.5114
ARCH Heteroskedasticity test			
F-statistic	1.241331	Prob. F(2,33)	0.3021
Obs*R-squared	2.518860	Prob. Chi-Square(2)	0.2838
Glejser Heteroskedasticity test			
F-statistic	0.766506	Prob. F(15,22)	0.6979
Obs*R-squared	13.04298	Prob. Chi-Square(15)	0.5990
Jarque-Bera test			
Jarque-Bera	0.553167	Prob.	0.758370

Conclusion

This paper mainly aims to explore the role of education on environmental degradation during the period of 1974 to 2014. Besides that, this study also sheds light on the other determinants of CO_2 emissions. The empirical findings of this study highlight the inverse relationship between environmental degradation and economic growth. The increase in the levels of CO_2 emissions emanates from human activities such as industrial production, urbanization, and other activities that translate into higher economic output [20]. However, the increase in economic growth improves the environment upon reaching a particular turning point. As the country becomes more nationalized and wealthy in the long-run, there are changes in its economic structure that promote cleaner energy consumption and the use of green technologies. Hence, the increase of economic growth, in the long-run, leads to fewer emissions. This finding was in line with the EKC theory. Besides that, the finding from this study also shed light on the importance of other factors such as gross fixed capital formation, energy consumption, and education on the formation of EKC theory. The inclusion of these factors provides useful insights into the causes of emissions. In addition, these factors could cause a change to the slope of the EKC. The long-run estimation using the Johansen Co-integration test further revealed a negative relationship between energy consumption and environmental degradation. Hence, suggesting energy efficiency technology being introduced in the long-run. As such, the consumption of energy, in the long-run, results in the release of fewer pollutants.

It is also noted that secondary school enrolment has a statistically significant positive effect on CO_2 emissions. The increase in enrolment rate raises the pollution level instead. As people become highly educated, their standard of living and earnings increases. Hence, they are able to afford more energy-consuming goods. The increase in consumption of these goods increases environmental degradation. In addition, people

are generally still lacking in terms of awareness to protect the environment despite completing secondary school education. Besides that, the empirical result also indicated that the gross fixed capital formation is positively associated with CO_2 emissions in the long-run. This finding can be interpreted that the increase of investment in physical capital fails to reduce environmental degradation. Instead, the increase of gross fixed capital increase the pollutants emissions. The analysis of this paper filled the literature gap of the studies by pointing out the impact of education on environmental degradation in Malaysia. Empirical finding from this study further corroborates the competing theories that were suggested by Muhammad [12] in explaining the relationship between education level and pollution emissions.

These findings provide some important policy implications for policy-makers to develop environmental policies that can promote environmental sustainability in the future. Higher education levels could lead to more energy consumption from non-renewable resources. Hence, the policy will need to be designed to encourage societies to shift their consumption towards renewable resources instead. The tested significant role of education would affect the policy implications of the EKC. Malaysia's Government should encourage institutions to introduce environmental awareness programmes in their curriculum. In this way, individuals would gain a better understanding of the cause-and-effect relationships involving environmental concerns. Better environmental awareness would lead to an eventual decline of harmful emissions and a decrease in the slope of EKC. Besides that, a higher education level that incorporates environmental awareness will promote higher level of clean renewable energy consumption by individuals. Next, the implication from this finding was that the increase in national incomes allows countries to develop alternative renewable energy resources and green technologies. The increase of real GDP resulted in lesser CO_2 emissions. Lastly, the increase in investment worsens environmental degradation. This could point out that the investment was financed mostly on economic activities that produce environmental pollution. As such, there is a need for policymakers to strategically devise policies that encourage investments in environmentally friendly economic activities instead.

It is ascertained from this study that besides economic growth, other factors such as education, gross fixed capital formation, energy consumption can lead to the change in the slope of EKC. The education levels have a significant impact on the formation of the EKC theory. The inclusion of education within the EKC model provides crucial insights into the causes of pollution emissions which will be very useful for future research in developing a new framework that can determine the omitted factors that are responsible for the formation of EKC theory. Besides that, the limitations of the data used in this study could lead to omitted variables. Hence, it is suggested that future studies need to be conducted to examine the relationship between different education levels and environmental degradation using a larger volume of data. Despite the limitation of this study, the empirical evidence from this study has provided important insight and robust support for future research work in this area.

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