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Globalization, Energy Use and Environmental Degradation in Thailand

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ABSTRACT

Globalization is a crucial determinant of energy consumption, so this study analyzes the effect of energy consumption in the presence of globalization on environmental degradation in Thailand. Furthermore, this study uses the EKC hypothesis. It estimates the effect of energy use, globalization, and economic growth with the dynamics of rising or falling influence in global economic degradation and Validation of the EKC hypothesis in Thailand. For this purpose, use time-series data from 1970 to 2018. First of all, check the order of integrating the variables by the Augmented Dickey-Fuller and Phillips Perron test. Results indicate that there exists a unit root at the level. Hence move the DOLS and ARDL econometrics model to analyze the impact of globalization, energy use and economic growth on environmental degradation. Results confirm the validity of the EKC hypothesis in Thailand due to positive and negative association among the GDP and Square of GDP, which also confirms that the U-shaped relationship exists there. Thus, globalization condenses environmental degradation while energy consumption boosts the level of carbon emission in Thailand. Therefore, the study suggested that their needs improvement in energy policies reduce the use of conventional energy resources and move towards modern energy like nonrenewable energy, which reduces the pollution in the country and boosts the economic development level.

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1. Introduction

According to current globalization, it continues to accelerate in several dimensions like investment and trade activities continue to expand. Ensuing this expansion, Thailand's economy is the fundamental mechanical dynamic economic structure (Rafindadi & Ozturk, 2017). This significantly increases growth and raises the question to the policymakers and government, and authors whether the burden affected by the quality of globalization of Thailand's environment is downward or upward. Generally, the association between environmental degradation and globalization is argumentative. However, from the perspective of Thailand, that linkage among had not been well recognized (Rafindadi, 2016a). The negative and positive globalization process and the environmental degradation can be examined by employing the three major parts: first is the composition effect, the second one is the special effect, and the final is the scale effect. In the scale effect, economic expansion and energy use spur due to globalization. That leads to the growth of carbon discharges (Cole, 2006; Dedeoğlu & Kaya, 2013). On the other hand, in the

composition effect, whereas reduction in energy consumption and economic activities rise while the manufacturing sector's carbon emission level goes to decrease (Stern, 2007). Lastly, the technique effect rises when energy consumption reduces by globalization and emissions of pollution will support higher economic growth as of the diffusion of clean technologies (Antweiler, Copeland, & Taylor, 2001; Dollar & Kraay, 2004).

Many empirical pieces of literature examined the association between pollution and energy under the EKC (environment Kuznets curve) theory. These studies confirm empirically and theoretically, the optimistic relationship among CO_2 productions and economic development, whereas energy usage also relates with CO_2 (Al-Mulali, Tang, & Ozturk, 2015; Apergis & Ozturk, 2015; Rafindadi, 2016a; Rafindadi, Yusof, Zaman, Kyophilavong, & Akhmat, 2014; Usman, Iorember, & Olanipekun, 2019). Additionally, the nexus between CO_2 emissions and globalization can be negative or positive, reliant on whether the globalization shock is negative or positive (Bakhtyar, Kacemi, & Nawaz, 2017). As by theoretical association among the carbon dioxide production and globalization is shown in table 1 and figure 1, according to table 1 in 1990, CO2 emission was 11.41 metric ton (mt), and globalization was 3.79%, Which is higher than 1980, which is 10.6(mt) CO2 and 3.64% globalization while in 2010 12.54 (mt) CO2 and 4.18% and finally in 2018 12.64 (mt). Globalization is 4.22% which confirms that Thailand has an increasing trend in the carbon emission and globalization rate. The passage of time and graph shows a positive affiliation among the Carbon discharge and globalization (World Bank, 2020), and globalization statistics taken from the KOF index. As exposed in research (Shahbaz, Khan, Ali, & Bhattacharya, 2017), the influence of globalization on carbon dioxide (CO2) productions is harmful in China, representing that the growth in globalization level decreases CO2 productions. On the other hand, (Shahbaz, Shahzad, Alam, & Apergis, 2018) specified that the association between globalization and energy consumption could be determined by whether the globalization shocks are negative or positive. If the shudder in globalization is optimistic, then the association will be optimistic, and if the surprise in globalization is adverse, the link will go adverse. On the other hand, Ahmed, Bhattacharya, Qazi, and Long (2016) discovered that rise in globalization upsurges demand of energy and carbon dioxide (CO_2) emissions.

Table 1
Relationship between the globalization and carbon emission in Thailand

years	CO2	Globalization
1980	10.60001	3.645489
1990	11.41648	3.791804
2000	12.10775	4.131938
2010	12.5494	4.186191
2018	12.64811	4.226229

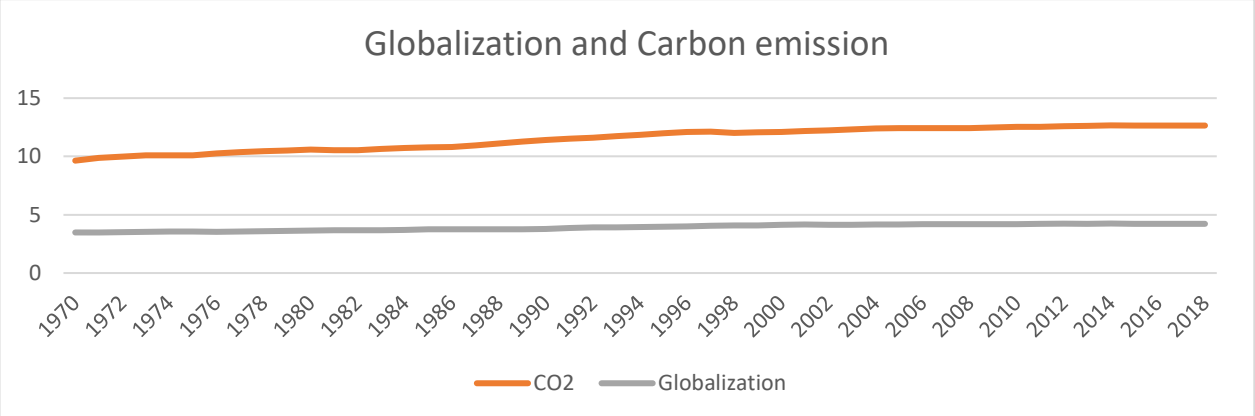

Figure 1: Theatrical relationship between Globalization and Carbon emission in Thailand

The significant aspect of this research is to include the globalization index with its dimensions like social, political and economic globalization. Furthermore, this study reexamined the EKC hypothesis under the shed of energy consumption, globalization, and economic development. This study's objective is to examine the effect of globalization on the environment because theoretically, it has a mixed effect like positive and negative. Fort this purpose, and this study used the recent econometrics technique to measure the impact

of globalization. Away from each other from the current research as well (Shahbaz, Shahzad, et al., 2018; Shahbaz, Solarin, & Ozturk, 2016), most of the comprehensive studies used imports and exports for globalization and examined its effect on the environmental Kuznets curve (EKC) (Dinda, 2006). Additionally, several pieces of research combined other trade variables as FDI (foreign direct investment) and trade openness (Copeland & Taylor, 2004; Grossman & Krueger, 1991).

Numerous researches have exposed that the higher growth boosts the level of carbon dioxide (CO2) emissions (Bekun, Emir, & Sarkodie, 2019; Zhang et al., 2018). According to the US report, Energy Information Administration delivers that emissions of CO2 raised by 1.3%. Thailand's economy ranked 14th realizing carbon emissions in the globe as it over-dependent on coal. This tendency can probably delay the fulfilment of the Sustainable Development Goals (SDGs) to be achieved by 2030 and scheduled by the United Nations in September 2015. The 17 goals are listed in SDGs, which include the problem of environment and energy. Thus, the study's outcome will deliver visions for the policymakers to support energy policies and the environment that will improve the efficiency of energy and, therefore, economic growth in Thailand.

The remaining parts of the research as followed: the related literature discuss in section 2. Then, data and methodology provide in section 3. Finally, the result and discussion discuss in section 4, whereas policy recommendations and conclusions consist of section 5 of this study.

2. Review of related literature

In the last four decades, many pieces of literature examined the environment Kuznets curve and found significant impact of growth and increased the biochemical essentials that raise the individual's wellbeing on the globe. These studies help the researchers and policymakers explore the implications that affect the environment in the presence of human development. For example, the innovative study of Grossman and Krueger (1991); Katircioğlu and Katircioğlu (2018); Rafindadi and Ozturk (2017) these studies examined the relationship between economic growth and carbon emission with the help of different econometrics models and different datasets. But these studies conclude that there exists the U-shaped association among economic development and environmental Kuznets curve (EKC) due to different consumption of energy pattern harms the environment (Nawaz et al., 2021). While Katircioglu, Katircioglu, and Kilinc (2018) discovered that the worldwide environmental Kuznets curve (EKC) was not an inverted U-shape. The researchers discussed that due to population urbanization and explosion, the Environmental Kuznets curve fell downward in Turkey.

Although the findings of the past studies, some studies argued that the EKC (environmental Kuznets curve) hypothesis is not valid in few nations. For instance, Ozturk and Acaravci (2010) explored that the framework of the environmental Kuznets curve was invalid in Turkey between 1968 and 2005. Other studies like Dietzenbacher and Mukhopadhyay (2007); Mukhopadhyay and Chakraborty (2005) stated that the EKC framework was invalid for the sample variables and time period in India. Recent researches Sarkodie and Strezov (2018) established that the premise of EKC only valid for Australia and China through the reversed U-shape but association among economic growth and carbon dioxide (CO_2) productions (Jianjun et al., 2021). The affiliation among economic development and carbon dioxide emanations is monotonic in the case of Ghana, whereas the shape is an inverted N shaped in the United States.

Shahbaz, Ozturk, Afza, and Ali (2013) delivered varied findings for South Africa. The researcher established the presence of the EKC framework. That contradicts Nasr, Gupta, and Sato (2015) they confirmed the power of the environment Kuznets curve (EKC) for South Africa over the time period 1911-2010. However, the study outcomes revealed that there was no proof to support the EKC framework. In the same way, Inglesi-Lotz and Bohlmann (2014) verified whether the framework of EKC (environmental Kuznets curve) is confirmed from the time spam of 1960-2010 for South African. The empirical findings specified no significant indication to support the EKC framework.

According to the panel data analysis, Kasman and Duman (2015) certified the nexus among CO_2 emanations and growth with a reversed U-shape pattern by using the panel data analysis for the new EU (European Union) Participants, discussing that the EKC theory is valid for those nations. The outcomes similarly disclosed that the growing consumption of energy increases in the short run, whereas economic growth, consumption of energy, trade liberalization, and urbanization contribute to the modification procedure (Mohsin, Kamran, Nawaz, Hussain, & Dahri, 2021; Nawaz, Ahmadk, Hussain, & Bhatti, 2020). Correspondingly, by present research Rafindadi, Muye, and Kaita (2018), the research outcomes showed that FDI and higher disposable income lead to advance the eminence of the environment in the GCC (Gulf Cooperation Council) in the investigation period.

Although the investigation of the EKC theory is relatively enormous, it includes the globalization channel to test the environmental Kuznets curve (EKC) with every study, giving the unconvincing findings. Shahbaz et al. (2013) were one of the new researchers. They conclude that a higher level of energy consumption boosts the level of carbon emission in Turkey. But, on the other hand, globalization reduces it. While these results are different from (Dinda, 2006), he examined the impact of globalization on the carbon dioxide (CO_2) in the developed nations of OECD, and fewer advanced economies of OECD has positive as entire the world.

Similarly, in a current study Shahbaz, Shahzad, et al. (2018) inspected the nexus between globalization and energy consumption. The results are based on either the effect of globalization is negative or positive. Besides, Shahbaz, Lahiani, Abosedra, and Hammoudeh (2018) exposed that the relationship between globalization and energy use exists in the long run. Though, in the short run, the association between demands for energy due to globalization is partial in Ireland and the Netherlands. The influence of current study in different ways, the literature reviewed is the following:

First, the current research includes the globalization and energy consumption index that deliberates social, political, and economic phases of globalization to reconsider the framework of EKC for Thailand from the time period 1970–2018. The selection of variables in research based on the agenda of Sustainable Development Goals (SDGs), which the United Nations give, can be achieved by 2030 that is very incomparable in most exceptional studies. Secondly, the current study inspects the EKC hypothesis for Thailand with energy consumption and globalization. Hence the endogenous variable is environmental degradation, and the leading indicator is economic growth, with the supporting variable are consumption of energy and globalization. Globalization has never been used in Thailand's study before, so that is a crucial and significant indicator in this study. At last, the current research gives ARDL and DOLS econometric approximation methods that are exceptional in maximum prevailing studies.

3. Data and Methodology

3.1. Data

To examine the impact of globalization within the presence of EKC theory in the case of Thailand. This study used the time series data of 48 years, taken from the World development indicators. Indicators of this study are environmental degradation, economic development, utilization of energy and the leading indicator is globalization. Furthermore, these indicators are taken from suitable development goals. According to its 6^{th} goal, energy utilization is used, highlighting efficient energy and neat and clean water. Globalization promotes the trade liberalization and transfer of technology which is according to the 7^{th} goal of SDGs. According to the 8^{th} goal, which promotes economic development without harming the environment, this purpose uses the economic development indicator.

Moreover, carbon emission is used to measure the environmental condition of the economy, which is the dependent indicator and targeting the measure of climate change in case of economic development. Before going to econometrics methodology, it is necessary to check the order of integration of the variables, so this study uses the unit root test.

3.2. Unit root test

This study obtained time-sequential data from 1970 to 2018. So, it is necessary to measure the stability of the variables, which means check whether the series has a unit root or not. For this purpose, use the two famous tests. The first one is the Augmented Dickey-Fuller test, and the second one, the Phillips Perron test. The general hypothesis of both tests is that series has a unit root.

The stationarity property of the variables is verified using (ADF) and (PP). We approve the results of this test using ADF and PP non-stationarity tests. The null hypothesis for this test is that variables are not stationary in the presence at the level.

3.3. Model Specification

This study follows the study of Stern (2007), the primary and conventional framework of EKC theory is like;

$$CO2_t = \gamma_o + \gamma_1 EGRO_t + \gamma_2 EGRO_t^2 + \mu_t \quad (1)$$

According to equation 1, the dependent variable is CO2, the carbon emanation level proxied for environmental degradation. According to EKC theory, there exists an inverted U shape relationship. To estimate the U-shaped relationship used the non-linear in variables equation. Equation 1 has two exogenous indicators: EGRO, and the second is the square of EGRO, which is due to the u-shaped relationship. And the expected sign of the $\gamma_1 \, and \, \gamma_2$ is positive and negative for the validity of the EKC hypothesis, which also verifies the U-shaped association. γ_0 represents the intercept of the equation and μ_t is the residual term of an equation, which is zero means and constant variance $\mu_t \sim IN(0, \sigma^2)$.

Recent studies empirically validate the EKC theory in the presence of trade, investment, population growth, etc. Nevertheless, this study confirms the EKC hypothesis for Thailand within globalization, which is the most determinantal indicator for trade, emery utilization, and investment. Hence the equation 1 will become;

Theoretically, it is confirmed that globalization is the determinantal indicator for trade liberalization, investment level, and urbanization. In this study, use the EKC theory within the presence of utilization of energy and globalization and consider SDGs for Thailand's growth. All the variables used in the logarithm's forms;

$$lnCO2_t = \gamma_o + \gamma_1 lnEGRO_t + \gamma_2 lnEGRO_t^2 + \gamma_3 lnEUSE + \gamma_4 lnGLOB + \epsilon_t \quad (2)$$

According to equation 2, ln shows the logarithm, EGRO represents the economic development proxied by GDP per capita, EGRO is the square of economic development. EUSE represents the utilization of energy and is proxied by the energy use, and finally, GLOB is globalization which is determined by the KOF index. The expected coefficients are $\gamma_1 > 0 \, and \, \gamma_2 < 0$ due to the U-shaped curve. $\gamma_3 > 0$ due to an increase in the utilization of energy caused environmental degradation and $< 0, \gamma_{4,} < 0$ it has both effect positive and negative both. This study uses the two crucial econometrics methiodal on is DOLS (Dynamic Ordinary Least Square), and the other is ARDL (Auto Regressive Distributive Lag). Variables are not stationary at a level, so ARDL estimates DOLS and ARDL estimate long-run estimates and short-run.

4. Results and Discussion

Table 2 Summarized the descriptive description of variables. EGRO mean value is 7.34 with the maximum value of 8.89, and the minimum value is 5.25 with the SD is 1.04, so overall, the growth performance is excellent because it is near to the maximum range. On the other hand, globalization's mean value is 3.91 with a minimum value is 3.47, and the maximum value is 4.23 with SD is 0.26. Thus, the overall performance of globalization is between the maximum and minimum value, which is also quite right because the variation in the data is relatively low compared to others. Moreover, Jarque Bera statistics

also confirmed that it follows the normal distribution. That means the performance of globalization is quite well. Hence overall, all the indicators follow the normal distribution.

Table 2
Descriptive Statistics

Variables	CO2	EGRO	EGROSQ	EUSE	GLOB
Mean	11.52875	7.345789	55.03339	6.489721	3.913539
Median	11.84337	7.564178	57.21678	6.608818	3.933122
Maximum	12.66417	8.892002	79.06769	7.59669	4.235972
Minimum	9.640546	5.25816	27.64825	4.221663	3.479522
Stdev	0.966548	1.046482	15.00681	0.880385	0.267658
Skewne	-0.374753	-0.37415	-0.167622	-1.13749	-0.20332
Kurto	1.646928	2.106506	1.947862	4.143501	1.471995
Jarque Bera	4.884819	2.773182	2.489573	13.23641	5.104482
Probability	0.086951	0.249926	0.288002	0.001336	0.077907
Observations	49	49	49	49	49

This study used the time series data, so it is necessary to confirm the stationarity of the series. Outcomes of ADF besides PP unit root test and expressed in table 3. According to both ADF and PP tests, they indicate that all the indicators have a unit root at the level. Moreover, they become stationary at the first difference level.

Table 3
Unit root tests

Tests	ADF		PP	
Variable	**t-stats**	**Prob.**	**t-stats**	**Prob.**
CO2	-0.3231	0.9876	-0.1797	0.9918
D(CO2)	-5.0997***	0.0007	-5.0854***	0.0007
EGRO	-3.0103	0.1404	-2.1168	0.5236
D(EGRO)	-4.4175**	0.0051	-4.4175**	0.0051
EUSE	-0.7695	0.9613	-0.7921	0.9592
D(EUSE)	-6.9394***	0.0000	-6.9776***	0.0000
GLOB	0.1036	0.9965	-0.2565	0.9898
D(GLOB)	-4.9863**	0.0010	-4.8620**	0.0014

Note: ***,** and * show 1%, 5% and 10% level of significance respectively.

First of all, the model is estimated by Dynamic Ordinary least square and result are given in table 4;

Table 4
Dynamic Ordinary Least Square (DOLS)

Variable	Coeff.	Std. Error	t-stats	Prob.
EGRO	1.3927	0.3537	3.9379	0.0005
EGROSQ	-0.0696	0.0229	-3.0451	0.0049
EUSE	0.0117	0.0307	0.3816	0.7055
GLOB	-2.6557	0.2346	-11.3225	0.0000
C	-5.2920	1.4521	-3.6445	0.0010
Model Diagnostics				
R-squared				0.996394
Adjusted R-squared				0.994405

Note: ***,** and * show 1%, 5% and 10% level of significance respectively.

DOLS results are expressed in table 4, and ARDL results are shown in Table 5. According to long-run estimates, it shows that EGRO and EGROSQ have positive and negative estimates, respectively, on both tables. At the same time, EUSE has a positive and insignificant effect on environmental degradation. In comparison, globalization hurts carbon emission levels in both ARDL and DOLS results.

Economic development (EGRO) has boosted the level of carbon discharge initially. According to DOLS, a 1% rise in economic development boosts the carbon emission by 1.39% and by ARDL is 1.79%. Interestingly, the effect of EGROSQ harms the carbon production level by 0.06% in DOLS and 0.07% in ARDL. This confirms that the EKC hypothesis invalid in Thailand, and also, there exists a reversed U-shaped relationship among economic development and environmental degradation level. These results are comparable with Shahbaz et al. (2013), they also established the Environment Kuznets

curve (EKC) hypothesis and also confirmed by a recent study (Aslan, Destek, & Okumus, 2018) they applied the bootstrapping method due to the instability of the parameters (a nonlinear form of the parameters) in the study and also confirmed the EKC theory and also found the U-shaped relationship within the model. Moreover, results contradict (Nasr et al., 2015) because they found that there does not exit an EKC hypothesis within the study sample.

Table 5
Auto Regressive Distributive Lag (ARDL) Long-run results

Variable	Coeff.	Std. Error	t-stats	Prob.
EGRO	1.7954**	0.7125	2.5198	0.0191
EGROSQ	-0.0781*	0.0440	-1.7730	0.0895
EUSE	0.0547	0.0373	1.4676	0.1558
GLOB	-3.5874***	0.5495	-6.5287	0.0000
C	-10.1504**	2.8481	-3.5640	0.0016
@TREND	-0.0372**	0.0162	-2.2941	0.0313
Model Diagnostics				
R-squared				0.9985
Adjusted R-squared				0.9972
Durbin-Watson stat				2.2491
LM test				0.3781
Heteroskedasticity Test				0.4066
Ramsey Reset test				0.1401

Note: ***,** and * show 1%, 5% and 10% level of significance respectively.

Furthermore, the results indicate that EUSE has no significant role in the environmental degradation in Thailand in both cases, DOLS and ARDL. At the same time, globalization minimizes the production of carbon dioxide in Thailand in DOLS and ARDL. According to DOLS, if a one percent rise in the level of globalization will lead to detracts the environmental degradation by 2.65%, and in the case of ARDL, it is 3.58%. That means that globalization makes an enormous contribution to promoting the environment healthy and clean by introducing advanced technology and technology knowledge shifted from the advanced countries. That can boost the level of economic development and promote the environment clean and healthy. So the results are similar to Gökmenoğlu and Taspinar (2016) and supported by (Rafindadi et al., 2014). They concluded a positive association among fuel use towards carbon release in 6 Asia Pacific regions. These studies also confirm the association between globalization and carbon discharge (Shahbaz, Mallick, Mahalik, & Sadorsky, 2016). They conclude that the increase in the level of globalization leads to minimizing the energy demand that ultimately results from a reduction in Co2 emission (Shafiq, ur Raheem, & Ahmed, 2020). This study result contradicts the results of (Dinda, 2006) and found the effect of globalization in the developed nation of OECD and non-OECD and concluded the globalization promotes environmental degradation.

Table 6
ARDL short-run results

Variable	Coeff.	Std. Error	t-stats	Prob.
D (CO2(-1))	-0.1754	0.2423	-0.7241	0.4763
D (CO2(-2))	-0.0021	0.2026	-0.0105	0.9917
D (CO2(-3))	-0.0105	0.1803	-0.0585	0.9539
D(EGRO)	4.6093***	1.3070	3.5266	0.0018
D(EGRO(-1))	-2.6442	1.3979	-1.8916	0.0712
D(EGRO(-2))	1.7796**	0.9116	1.9521	0.0632
D(EGROSQ)	-0.2703**	0.0838	-3.2271	0.0037
D(EGROSQ(-1))	0.1424	0.0913	1.5593	0.1326
D(EGROSQ(-2))	-0.1073*	0.0608	-1.7643	0.0910
D(EUSE)	0.0123	0.0182	0.6733	0.5075
D(EUSE(-1))	0.0100	0.0213	0.4685	0.6438
D(EUSE(-2))	0.0117	0.0212	0.5511	0.5869
D(GLOB)	1.2789	0.7744	1.6514	0.1122
D(GLOB(-1))	-1.2121	0.8369	-1.4483	0.1610
D(GLOB(-2))	-0.4612	0.6415	-0.7188	0.4795
D(@TREND())	-0.0199*	0.0105	-1.8879	0.0717
CointEq(-1)	-1.8709	0.2404	-7.7832	0.0000

Note: ***,** and * show 1%, 5% and 10% level of significance respectively.

ARDL is also used to estimate the model's short run estimates during the confirmation of the long-run association in the model. According to table 6, the ECM term indicates the significant and long-run association in-betweens model because it has a negative coefficient. This also shows that the model will move to the equilibrium level with a speed of 1.87 annually. Furthermore, it is concluded that the existence of EKC theory in the short-run results too. Because EGRO and EGROSQ has respectively, positive and negative effect on carbon emission level. And also verified that inverse U-shaped affiliation among economic development and environmental degradation in Thailand.

On the other hand, the effect of globalization on the environment is negative with a magnitude of -1.21% but are insignificant. Hence it is concluded from the short-run results is, there exists the EKC hypothesis with the inverse U-shaped association in-between the carbon emission and economic development. While energy use has positive and globalization are adverse effects on the environment, they are insignificant in the short run nature and contradict by the study of (Ahmed et al., 2016; Shahbaz et al., 2017). A reasonable explanation aimed at this alteration can be qualified to the effects of structural differences included in the model.

Results of diagnostics are displayed in the lower section of table 5. The number of tests applied, like the R-square value is 0.99, which explained that the environmental degradation is 99% explained by the explanatory factors, which is quite good. DW stats is greater than 1.65, which confirms the model is a good fit. Furthermore, it also confirmed with the help of the LM test that the model is a good fit because it does not have the problem of autocorrelation in the model. Heteroscedasticity also confirmed that there is no hetero issue in the model, and in the last Ramsey reset used to test the functional form of the model, it also verifies that the model functional form is appropriate. Hence from the model diagnostics, it is confirmed that the model is the best fit and estimates are valid.

5. Conclusion and Policy Recommendations

This study verifies the Environmental Kuznets curve (EKC) in globalization and energy utilization in Thailand. This study implies the globalization and utilization of energy with the economic development effects to the carbon production level, whose positive and negative effect is on carbon intensity because there is a U-shaped relationship between economic expansion and carbon intensity level. The majority of the researchers analyzed the EKC hypothesis for Thailand's economy, but none of the researchers used globalization as the explanatory indicator in their research. Although according to the recent studies, they had tested the EKC hypothesis and mostly used the stable and liner model, the studies neglected the structural effect. These kinds of studies highlighted the question for the economist and policymakers on the reliability of these researches, especially in Thailand. To tackle this structural problem in methodology, this current research uses annual time series data from 1970 to 2018 and applied the structural model to estimate the U-shaped relationship. Before going to analysis, this study uses the ADF and PP unit root test to examine the nature of the data. Further applied the two methods to determine the long-run coefficients of the DOLS and ARDL, and ARDL also estimates short run and cointegration level.

Empirical results indicate that all the indicators have an order of integration I (1). And further, DOLS and ARDL results verified the EKC theory in Thailand in both the short and long run and confirmed that U-shaped association in Thailand. Because EGRO and EGROSQ has positive and negative relationship respectively. Furthermore, energy consumption increased the level of environmental degradation because fossil fuel energy is the main contributor to total energy production. ARDL error correction term also verifies that there exists a long-run association in the model.

One of the goals of MDGs is to main the maximum level of production without damaging the environment. So, this study also intentions to improve the use of energy and economic development by environmental policies. In other words, conventional energy policies must remain demolished due to the consumption of energy that might be related to Thailand's increasing affluence. Renewable energy such as solar, water, wind, nuclear etc., boosts the energy level without affecting the environment to make the energy efficiency necessary for Thailand’s environmental policies to encourage investment to adopt

renewable energy (Baloch et al., 2021; Fazal, Gillani, Amjad, & Haider, 2020). This result increases the energy production level of firms and industries and reduces the carbon discharge level, which means a decrease in greenhouse emissions in Thailand.

In addition, environmental regulations must adjust the level of carbon releases from business besides industry. Every industrial outlet by extreme carbon productions must remain obliged to pay fees or taxes deprived of patience from the authorities. Furthermore, incentives such as subsidies must be provided to companies and industries that maintain normalized levels of pollutant emissions as a means of inspiration. This recommendation can be applied thru caution because more excellent tax rates can drive away business and industry. According to this, the government and its administrators must recognize to design some good environmental policies that inspire individuals (households and firms) and macro-level (business and industries). So far, we suggest that policymakers in Thailand closely examine issues related to policy instruments that are explained theoretically and scientifically (F Akpan & E Abang, 2014; Rafindadi, 2016b). Some problems are adopting the new technology that is either that policy could help attain the desired goals. And another one is the cost of that project and how much time is required to maintain the desired level. In addition, there are some questions of dynamic efficiency, equality, instrument legality, control and application, and predictability and acceptance. This instrument should promote healthy environmental infrastructure and innovation in the technology that advantage to the entire community without preference.

This must be intended within the existing legal framework of the country. In addition, monitoring and applying instruments and their costs must be accessible and reasonable, and, as such, their policies must be understandable and adopted by households, businesses, and manufacturing units. Lastly, it must be noted that the results of the current study and recommended ways to advance the quality of the environment by applying to emerging markets. Indeed, the results of the current study are according to the literature.

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