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Empirical Relationship between Economic Growth, Energy Consumption and CO_2 Emissions: Evidence from ASEAN Countries

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ABSTRACT

This study tested the EKC (environment Kuznets curve) framework for selected 9 ASEAN countries of the time period of 1970-2019. The EKC framework hypothesis checked under 2 linkages, first one is to examine the relationship between energy consumption, GDP and CO2 and the other one is energy consumption, GDP square and CO2. The study examines both long and short run effect of energy consumption, GDP, square of GDP on carbon emission. Firstly, used Levin Lin Chu and Lm Pasaran panel unit root test to check the order of integration of indicators further for short and long run estimates are examined by panel Auto Regressive Distributive lag (ARDL / PMG). Results of LLC, Lm Pesaran, reveals that the variables have mixed integration order. Due to the mixed order of integration, PMG results showed a rise in energy consumption by 1%, caused a rise in emissions by 0.8377%. Carbon emission (CO2) decreased by 0.1622%, by increase the square of economic growth while increasing economic growth by 1%, leading to boosts carbon emissions by 2.05%. The negative and positive effect of GDP and square of economic growth approve the EKC theory. Furthermore, this study suggests that to maintain sustainable economic expansion goals policy makers ensure the use of sustainable energy sources (renewable energy) to maximize growth of country and minimize carbon emission. It results carbon sequestration, protect green environment and safe lives.

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1. Introduction

Carbon emission is the main determinant of greenhouse emission and significant indicator which effect climate. To maintain carbon emission level many countries, take initiatives on domestic as well as the global levels. Economic growth in ASEAN countries is expected to rise by 4.9% in 2019 and 5% in 2020 (World Bank, 2020). For sake of sustain inclusive growth, policymakers must continue to finance in human resources (Ndambiri et al., 2012), minimizing useless resources and increase the creativity in the economy. Zeufack (2018) reported that in ASEAN economies, policymakers must be authorized to achieve the challenges to raise economic expansion. It is not the only objective; they deliberately move towards the energy system which develop a sustainable economic system. Economic development and growth cannot progress without consumption of energy. Energy is one of the key variables needed for the economic system's growth in ASEAN and throughout the world, which is confirmed in Table 1 and Figure 1.

It further shows that the carbon emission level in ASEAN nations is 8.43 metric tons in 1970, with 264.7312 GDP US Dollars and 530.22 per capita energy consumption. While in 1984 CO2 emissions fell to 2.8 and GDP and energy consumption were 3332,677 and 1477,363, which was higher than in 1970 after all of them had increased until 1990 and after CO2 declined because energy use and economic growth increase over time and after that CO2 emissions also increase beside with energy use and economic growth until 2019, which is at its peak, which is 7,652 metric tons of carbon discharges, economic development per capita and consumption of energy, respectively, $15,221.15 and $3,227.614 per capita, which is also confirmed in Figure 1 (World Bank, 2020).

Table 1
Comparison of CO_2 emissions, Economic Growth and Energy Consumption in ASEAN countries

Years	GDP	CO_2	Energy Consumption
1970	264.7312	8.436013	530.2284
1984	3332.677	2.88969	1477.363
1990	3529.717	5.038218	1576.141
1991	3907.833	4.671983	1725.256
1999	4898.3	3.916031	1886.955
2018	14139.58	7.251428	3061.315
2019	15221.15	7.652398	3227.614

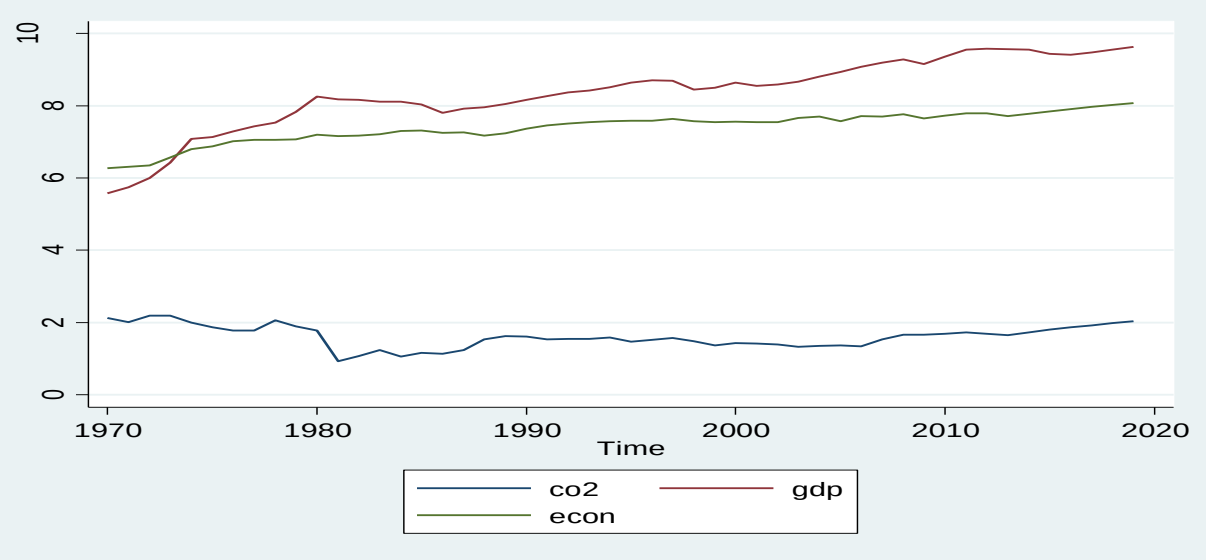

Figure 1: Energy consumption, Economic growth per capita and Carbon Emissions in ASEAN countries

Bazilian et al. (2012) described that the availability of energy resources are significant indicator for their capacity to deal with current global social and economic opposition, for instance, poverty, education, welfare, environmental challenges, food security and inequality. The reliable source of energy is an essential destination for economic activity, access to cheap energy and economic growth. Most of the studies claimed that to produce energy with fossil fuels is unfavorable. Aimed for zero or low carbon emission global decoupling of energy is necessary and also necessary for free, effective and free economic actions (Fankhauser & Jotzo, 2018). Rendering to Avila, Carvallo, Shaw, and Kammen (2017); Nawaz, Azam, and Bhatti (2019), ASEAN countries prosper related to energy resources. However, on the other side, they also face the task of distribution. More than 130 million persons depend on fossil fuels, candles, flashlights, coal, and kerosene, and additionally, nearly 620 million do not have contact with electricity. Though, with substantial energy resources, they cannot fulfill the energy demands of their residents.

Climate change is a topic that is discussed throughout the world by scientists, politicians, and individuals. Carbon dioxide is also discussed besides climate change because it is one of the main reasons for climate variation and greenhouse gas emissions. There are many initiatives to improve the climate level by eliminating the carbon emission level at individual and global levels. The Paris Agreement and the Kyoto Protocol can be called two global initiatives.

The Kyoto Protocol is an international agreement signed and ratified with various parties on December 11, 1997 and is one of humanity's first efforts to tackle climate change and reduce CO2 emissions. The Kyoto Protocol is discussed alongside the Kuznets Environmental Curve (EKC), which states that income increases with CO2 to a certain level. After that level is reached, CO2 begins to decrease while income continues to increase. The impact of the Kyoto Protocol on the EKC is one of the determining factors for countries participating in the protocol to determine the policy implications of their strategies to tackle climate change.

Numerous studies have inspected the active association between income and energy; carbon emissions and income; and carbon emissions, income, and energy by using the Environmental Kuznets Curve (EKC) as a basis for hypothetical literature. The researchers applied many econometric approaches to test this dynamic relationship, such as multivariate regression, VAR model (autoregressive vector), impulse response analysis, Johansen's cointegration test, and ADF unit root test and panel data analysis. The researchers obtained different outcomes for the EKC relationship's validity, dependent on the altered sample, methodology, and period. This study contributes in the context of energy by estimating the short as well long run estimates with the help of important macroeconomic indicators under the light of EKC hypothesis for ASEAN nations. The rest of study is based on following sections, brief literature is discussed in section 2 while appropriate panel methodology is explained in section 3. Results and discussion is briefly discussed in section 4 and section consists of conclusion and policy recommendation of this study.

2. Literature Review

The present study determined the steady-state long-term association and causation between emissions, energy consumption, and income associated with environmental Kuznets curve for economies. There are number of studies in the literature for the different countries, so the core new impact of this study is to explore the EKC (environmental Kuznets curve) for the ASEAN economies to check the causation/linkage among income, emissions, and energy consumption for these economies. Baek (2015) examined the relationship between CO2 emissions, income, and energy consumption under the shed of EKC and found there is no existence of EKC for Denmark. Acaravci and Ozturk (2010) inspected the linkage between income, energy consumption, and CO2 emissions. They found the causation in the short term due to GDP and the GDP square to Denmark's carbon emissions. Baek, Cho, and Koo (2009) observed the interlinkage between income, trade, and SO2 emissions and found EKC for Denmark. Sephton and Mann (2013) inspected the EKC among SO2 and CO2 emissions with GDP for the UK (United Kingdom) and established the EKC connection among GDP and SO2, GDP, and CO2.

Figueroa and Pastén (2009) confirmed no EKC association in the United Kingdom between GDP and SO2. Fosten, Morley, and Taylor (2012) observed the association among SO2 and CO2, GDP and energy prices and established EKC's existence in the United Kingdom's. De Bruyn, van den Bergh, and Opschoor (1998) studied the interlinkage between SO2 emissions, NOX, and CO2 emissions in the United Kingdom. De Bruyn et al. (1998) explained that there is no relationship among the EKC framework.

Ubaidillah (2011) inspected the linkage between carbon emissions and GDP due to its road transportation. Baek et al. (2009) examined the association among trade, income, and SO2 emissions and established that EKC's presence in the UK. Acaravci and Ozturk (2010) observed the nexus between energy consumption, income, and CO2 emissions then initiated no EKC hypothesis validation for the United Kingdom. Baek et al. (2009) inspected the association among trade, income, and SO2 for Spain and there exits EKC hypothesis. Figueroa and Pastén (2009) studied and established no nexus between GDP and SO_2 by using the EKC hypothesis. Roca, Padilla, Farré, and Galletto (2001) examined the EKC association among methane (CH4), nitrous oxide (N_2O), non-methane unstable organic mixtures (NMVOC), carbon dioxide (CO_2) and GDP for Spain and found no EKC validation. Balaguer and Cantavella (2016) inspected the nexus between energy, gross domestic product, and CO_2 emissions over the time period 1874 to 2011 for Spain and concluded that there exits the EKC hypothesis. Balaguer and Cantavella (2016) also established the same EKC framework for Spain and found that there exits the EKC hypothesis.

While Esteve and Tamarit (2012b); Sephton and Mann (2013) established the EKC hypothesis over the time period 1957 to 2007 for Spain, (Esteve & Tamarit, 2012a) for the same period for the economy of Spain and results confirmed that there does not exists the validation of EKC framework. The long-run association among variables are explored by taking on the ARDL bound assessment for the (Johansen, 1991) cointegration test and cointegration (Pesaran, Shin, & Smith, 2001) and causality through the Toda, (Toda & Yamamoto, 1995) the Granger causality test, and Granger non-causality test. Similarly, variance decomposition and impulse response tests are executed for developed countries to regulate independent variables' influence on dependent variables.

2.1. Literature Review on EKC And Energy-Emissions- Income Nexus

According to the Kuznets (1955) EKC (environmental Kuznets curve) study "Income Inequality and Economic Growth" described in the American Economic Review. Furthermore, the Kuznets (1955) expected to respond to the central questions of distributing income in his article. How inequality reduces or increases and measures the secular levels during a nation's economic growth and income trends inequalities. He investigated the industrialized economies such as Germany, the United States, and England. And established a U-shaped affiliation among economic development and income inequality. Firstly, income inequality rises as economic growth rises. However, after some time, income inequality reduces as economic growth rises.

In the 1990s, the EKC (environmental Kuznets curve) U-shaped used to inspect the nexus among the environment's degradation with economic growth, which starts from low income and initially it rises degradation of the environment. However, after some time, this effect becomes the opposite. Grossman and Krueger (1991); Shafik and Bandyopadhyay (1992) were amid the first research for the U shaped and the EKC framework association between the degradation of the environment and economic growth. Grossman and Krueger (1991) inspected NAFTA's influence on the environment. These studies concluded that level of smoke and sulfur dioxide are determinants of environment degradation and these are rises with the rise in GDP at the low-income level. But after some time GDP rises results minimized the level of smoke and sulfur dioxide. Shafik and Bandyopadhyay (1992) studied the nexus amid the economic growth and quality of the environment at various income levels for economies. They used carbon emissions and lack of clean water as the factor of environmental, for the sake of to explore the association amongst economic growth and environmental quality. They concluded that at low level of income, income rises and environmental factors are degraded but it improved with high level of income. Except, in high-income levels, indicator of environment degraded carbon emissions and lack of clean water had an N-shaped nexus with income.

Shafik and Bandyopadhyay (1992) determined an environmental Kuznets curve (EKC) association between environmental indicators and income in the study. And the indicators are carbon emissions, municipal waste, and drinking water in rivers. Panayotou (1993) confirmed and tested an EKC affiliation between economic development levels, environmental degradation which is measured by air pollution and deforestation for developed and developing economies. He also delivered policy recommendations for developed and developing economies for development assistance, technology transfer, and employment in his research. There are four studies emphasizing energy variables, income, and carbon emissions variables in the literature.

2.1.1. Income Environmental Degradation Relationship

The relationship between environment's degradation and income literature is inspected in two areas: first one is economic growth and carbon emission under the shed of EKC, in this area carbon emission is inspected for income. And the second area is check the causal association among income and carbon emission level under the shed of EKC hypothesis and also examined the short and long run impact of income to emission level. Hence in the EKC association the validity of EKC hypothesis is studied.

2.1.2. Income-emissions nexus

Several studies explored the short and long-run causation nexus between emissions and income, by adding some explanatory variables, while some other studies use the EKC association alone. Studies examined to prove the conservation, feedback hypotheses, growth, and neutrality hypothesis in this context. The hypothesis of conservation explains that the consumption of energy and income have a unidirectional causality affiliation. The bidirectional causation is stated in the feedback hypothesis between energy consumption and income. The hypothesis of growth also found that these variables are unidirectional causation. The hypothesis of neutrality defined that income and the consumption of energy have no causation relationship.

2.1.3. EKC Relationship

The Environmental Kuznets curve (EKC) relationship is explored in studies in different types as using only income and carbon emissions nexus or including some explanatory variables. EKC is used in literature with various types as single country study, panel studies, and multi-country studies. Some studies verified the EKC association, while others did not verify it.

2.1.4. EKC Relationship Verified

The relationships of EKC in the literature are inspected with GDP and CO2 emissions. Various studies include some explanatory variables such as renewable energy and nonrenewable energy, oil consumption, primary consumption, FDI, financial development, economic complexity index, energy consumption, trade openness, manufacturing exports, investment, manufacturing imports, industrial value-added, energy intensity, urbanization population, and urbanization. Piłatowska, Włodarczyk, and Zawada (2015) for multi-country study inspected the EKC association reliant on the knowledge level for 14 EU countries. Countries were gathered according to the ranking of Knowledge Economy Index 2008. They verified and tested EKC relations for totally high-level knowledge economies, such as the United Kingdom, Denmark, Netherlands, Finland, Sweden, and some middle-level knowledge countries, such as France and Belgium. Intended for panel studies, (Musolesi, Mazzanti, & Zoboli, 2010) inspected EKC interactions for 109 nations that contained non-OECD, OECD, G7, EU15, and most impoverished countries. They confirmed EKC connections for EU15, G7, and OECD countries, a quadratic association between GDP and CO2. Monotonic affiliations were established between GDP and CO2 for less developed states.

2.1.5. EKC Relationship Not Verified

Iwata, Okada, and Samreth (2012) designated that their research did not care about the EKC affiliations for 11 OECD nations, which were the United States, Canada, Germany, Sweden, South Korea, Switzerland, Belgium, Finland, Japan, Spain, and the United Kingdom for multi-country studies. Martinez-Zarzoso and Bengochea Morancho (2003) surveyed Caribbean and 19 Latin American nations and establish that EKC was not established for panel countries. They also establish heterogeneity for EKC associations amid 19 nations, and only limited countries displayed EKC connections. Amid 19 nations, 6 nations displayed an increasing curve, 2 states exposed a decreasing trend, 9 countries indicated an N-shaped curve and 2 countries revealed a U-shaped curve.

2.1.6. CO_2-GDP Energy NEXUS

According to the previous studies emphases in literature for energy, income besides emissions variables is the energy-emissions-income relationship. Esso and Keho (2016) deliberate short and long-run and causation association among EN, GDP, and CO2 releases for 12 sub-Saharan economies over the time period from 1971-2010 by employing the cointegration and granger causality test bounds testing econometric method in case of multi-country studies. They establish unidirectional causation between CO2 and GDP for Senegal, Ghana, the Democratic Republic of the Congo, Benin, and Nigeria. Unidirectional connection finds from GDP to CO2 for Togo, Gabon, and Nigeria and bidirectional interconnection in the short-run between GDP and CO2 for Nigeria. For panel studies, (Gmidène, Zaidi, & Ghorbel,

2016) inspected the causal associations between economic growth, renewable energy, nuclear energy consumption, and CO2 emission with panel cointegration and the Granger causality methodologies.

They determined that specialists should spend on renewable energy to decrease carbon dioxide emissions and reduce nuclear energy to decrease CO2 emissions. Farhani and Rejeb (2012); SS Wang, Zhou, Zhou, and Wang (2011) confirmed the protection suggestion in the long run for 15 Mena countries, China, and 24 African countries. For single-country studies, (Ghosh, Alam, & Osmani, 2014) considered the associations between EN, CO2, and GDP over the time period 1972-2011 in Bangladesh with the and Juselius cointegration and Johansen test and vector autoregressive (VAR) error correction methods. They establish that EN had a significant optimistic influence on GDP in the long run, and CO2 had an insignificant adverse influence on GDP. Ghosh et al. (2014) established the neutrality assumption in India's short and long run (Albiman, Suleiman, & Baka, 2015) established the neutrality hypothesis in Tasmania.

3. Econometric Methodology

3.1. Data

Environmental degradation is measured by CO_2 emissions (metric tons per capita), Economic growth is measured by GDP per capita (in constant 2010 US dollars), and energy consumption is measured by energy use (kg of oil equivalent per capita). Data is taken from the official website of the World Bank (World Bank, 2020) for the time period of 1970 to 2019 for ASEAN nations namely "Indonesia, Vietnam, Malaysia, Thailand, the Philippines, Myanmar, Cambodia, Singapore, and Brunei Darussalam".

3.2. Methodology

This study used two first generations unit root test namely Levin, Lin, and Chu (2002); Pesaran et al. (2001) to find the stationary level of each indicator, which is expressed in (Table 2). Depending on the combination of each variable's stationary levels, different methods are used to find cointegration. For variables with a stationary level with a combination of I (1) and I (0), the ARDL bound test for cointegration is used to find the cointegration between variables.

In this study, two models are used: first model is CO2, consumption of energy and GDP and second model is CO2, quadratic GDP, GDP, and energy consumption to determine cointegration and causal relationships between variables.

$$lnCO_{2_{it}} = \vartheta_o + \vartheta_1 lnGDP_{it} + \vartheta_2 lnECON_{it} + \epsilon_{it} \quad (1)$$

$\vartheta_o, \vartheta_1 \; and \; \vartheta_2$ are the estimated parameters of model 1, t is time, and i is cross-sections, and ϵ is the error term of the panel model? And the others will become:

$$lnCO_{2_{it}} = \theta_o + \theta_1 lnGDP_{it} + \theta_2 lnGDP_{it}^2 + \theta_3 lnECON_{it} + \epsilon_{it} \quad (2)$$

$\theta_o, \theta_1, \; \theta_2 \; and \; \theta_3$ are the estimated parameters of model 2, i is a cross-section, and t is time, and ϵ is the error term of the panel model? Before estimating the conditional distribution of relationships, we use the panel autoregressive distributed lag model (ARDL) for the long-term and short-term estimates of the models. For brevity, the empirical indicators of the equation can be stated as follows:

$$lnCO2_{it} = \vartheta_o + \sum_{i=1}^{p} \vartheta_1 \Delta lnCO2_{i,t-1} + \sum_{i=0}^{p} \vartheta_2 \Delta lnGDP_{i,t-1} + \sum_{i=0}^{p} \vartheta_3 \Delta lnECON_{i,t-1} + \vartheta_4 lnCO2_{i,t-1} + \vartheta_5 lnGDP_{i,t-1} + \vartheta_6 lnEC_{i,t-1} + \epsilon_{it} \quad (3)$$

$$lnCO2_{it} = \theta_o + \sum_{i=1}^{p} \theta_1 \Delta lnCO2_{i,t-1} + \sum_{i=0}^{p} \theta_2 \Delta lnGDP_{i,t-1} + \sum_{i=0}^{p} \theta_3 \Delta lnGDP_{it}^2 + \sum_{i=0}^{p} \theta_4 \Delta lnEC_{i,t-1} + \theta_5 lnCO2_{i,t-1} + \theta_6 lnGDP_{i,t-1} + \theta_7 \Delta lnGDP_{it}^2 + \theta_8 lnEC_{i,t-1} + \epsilon_{it} \quad (4)$$

According to the above equations, endogenous indicators is carbon dioxide (metric tons) and exogenous indicators are economic growth, square of economic growth, and energy consumption. $\vartheta_o \; and \; \theta_o$ represent the coefficient of the equations, while $\vartheta_1 \; to \; \vartheta_6$ and

θ_1 *to* $\theta_8$represent the long and short-run effect of independent indicators on carbon dioxide of ASEAN countries, and ϵ_{it}represents the white noise error term of ASEAN countries.

4. Results and Discussion

4.1. Unit root test

Table 2
Panel unit root test

Order	Level				First difference			
Test	Levin, Lin & Chu		Lm Pesaran & Shin		Levin, Lin & Chu		Lm Pesaran & Shin	
Variable	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
GDP	-2.2508	0.0122	-3.6102	0.0002				
CO2	0.5056	0.6934	1.2020	0.8853	-11.7904	0.0000	-11.0114	0.0000
ECON	1.5060	0.9340	2.2362	0.9873	-8.0481	0.0000	-8.1177	0.0000

Table 2 shows that CO2 emissions are not stationary at I (0) and stationary (1). However, GDP has an I(0) order of integration. The root unit test also expressed that the energy consumption (per capita) is stationary in I (1), not I (0). Therefore, as indicated by the root unit test, there exits mixed order of integration which confirms ARDL methodology, rather than the traditional econometric method. Before the transition to ARDL, the ARDL cointegration test was applied, and the ARDL results are shown in Table 3.

Table 3
ARDL long and short-run results

	Model 1			Model 2		
Variables	Coefficient	Std. Error	Prob.*	Coefficient	Std. Error	Prob.*
Long Run Estimates						
LECON	0.7505***	0.1634	0.0000	0.8377***	0.1930	0.0000
LGDP	0.3806**	0.1392	0.0065	2.0547***	0.2902	0.0000
LGDPSQ				-0.1622***	0.0214	0.0000
Short Run Estimates						
COINTEQ01	-0.0574*	0.0338	0.0904	-0.0288*	0.0218	0.0865
D(LECON)	0.6593***	0.2332	0.0049	0.7398	0.3083	0.0169
D(LGDP)	0.1180	0.0827	0.1545	0.0285	0.5108	0.9556
D(LGDPSQ)				-0.0217**	0.0377	0.5655

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

Table 3 shows that the economic sector's growth increases carbon dioxide emissions, while according to the square of GDP, the level of CO2 emissions declined in ASEAN countries. Energy consumption boosts CO2 emissions. The results report that a rise in GDP has upsurge carbon emissions level, while on the other hand rise in the square of economic growth can reduce the level of carbon emission in ASEAN countries. These outcomes support the findings (Anastacio, 2017; Bakhtyar, Kacemi, & Nawaz, 2017). These findings also confirm the inverted U-shaped EKC hypothesis. Fankhauser and Jotzo (2018) confirmed that economic development initially boosts the carbon emission, and later square of economic development will decline the level of carbon emission. According to the studies (Anastacio, 2017), the economic growth and quadratic of GDP has positive and negative effects on economic growth and approves EKC's theory.

Regarding causality among these variables investigated, and there is evidence of two-way causation between CO2 and energy use in the short term and the long run, direct causality ranging from CO2 to energy consumption. These results confirm by (Acaravci & Ozturk, 2010; Shaojian Wang, Li, Fang, & Zhou, 2016). The results of these studies suggests that a rise in energy use increases the pollution of the environment, which is similar to the results (Omri, Daly, Rault, & Chaibi, 2015), further it states that increased in energy usage and GDP significant effect on emission of carbon dioxide.

By the reduce in the level of CO2 level is to rise in energy efficiency, governments must encourage energy savings policies, and people must be sensitive, for example, turn of the lights when not in use, findings are supports by (Vickers, 2017). Shaojian Wang et al. (2016) stated that it is essential to implement and improve economic expansion and energy consumption strategies to control carbon productions. The two-way causation affiliation

between the use of energy and carbon releases suggests that carbon productions and consumption of energy interrelated in the sense that increased the consumption of energy cause a higher level of carbon releases (Ssali, Du, Hongo, & Mensah, 2018) hence, use of energy consumption boosts the level of carbon emission. Results confirms there exists direct causality from consumption of energy towards carbon productions. Besides this the long run estimates suggests that use of energy has positive and significant impact on carbon emission level in ASEAN nations.

5. Conclusion

Current climate change problem mainly caused by the ecological degradation, so the government needs to be well aware of this disaster before destroying the entire world. Researchers from around the world are interested to find out the root cause of the global climate variation. For this purpose, they used multiple variables with multiple techniques to understand the cause of this ecological changes. For this purpose, understanding of variables are much important task because it benefits from developing the right strategy. Having supposed that, this research is the most exceptional research that benefits humanity. We do not use traditional tests to avoid suspicious results.

The findings of the study confirm that the EKC hypothesis is valid in ASEAN nations, economic development and energy consumption has significant effect to carbon emission level. To check the order of integration used two famous first generation unit root tests which are (Levin et al., 2002; Pesaran et al., 2001). The estimates indicate that the consumption of energy and CO2 emission have $I(1)$ order of integration, while economic growth has$I(0)$. Therefore, we use ARDL instead of OLS because it can provide better and more effective results and has a long-term coefficient. This study's used macroeconomic indicators which are carbon dioxide emissions, square of GDP, GDP, and energy consumption. The theory of EKC defines that initially carbon emission increase with increase in economic development and later carbon emission level is diminishing with economic development. The results of this study are consistent with (De Bruyn et al., 1998) and (Acaravci & Ozturk, 2010) in the UK and EKC (Esteve & Tamarit, 2012b; Roca et al., 2001) of Spain.

Furthermore, results confirm that increase in the level energy and economic development inevitably leads to a comparative upsurge in Co2 emissions. Moreover, economic development boosts the carbon emission level which postures towards a danger for developing countries. Further square of economic development reduces the carbon emission. That means greater emphasis must be placed on the economic sector's growth to motivate to invest in technology and income to generate low carbon emissions. However, the outcomes show that if no measures are taken, economic growth and energy use will continue, leading to carbon emissions in emerging economies. Economic activities also contribute significantly to developing countries' carbon emissions, because according to the EKC assumptions, most economic activities have not yet reached the significant capacity level of renewable energy use.

According to the results, facts and figures the policymakers of the ASEAN region must encourage new economic policies for adoption of renewable energy and encouraging fiscal policy incentives and regulations. Because the use renewable energy emits low level of carbon emission level. So, more emphasis must be placed on the sustainable energy level (renewable energy sources) instead of unstable energy level (non-renewable energy sources). Hydropower, wind, atomic and solar energy must be developed in developing countries. Therefore, the supply of renewable energy must be expanded and strengthened in certain countries and worldwide, and governments must improve energy efficiency. Investment in green technologies must be increased to reduce carbon emissions level. To this end, appropriate incentives must be considered, such as increased foreign direct investment by the government to strengthen the industrial sector related to investment in renewable energy production. If this policy becomes an obligation, it can go into effect and make the public aware of the positive impact on the environment and new green technologies.

Government and regulatory authorizes are responsible for addressing the result of environment pollution before the global deaths increase. In these situations, knowledge management strategies must be introduced to raise awareness of climate alteration threats

in all sectors. The information must be composed and then shared amongst citizens over various means of communication.

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