



## **Environmental Kuznets Curve (EKC): Empirically Examined Long Run Association Between Globalization, Financial Development and CO2 Emission for ASEAN Countries**

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### **ABSTRACT**

This study mainly inspects the effect of globalization and financial expansion on CO2 emissions in the existence of the EKC (Environmental Kuznets Curve) framework for ASEAN economies, firstly the study employs the cross-sectional dependence econometric test. Results of CADF, CIPS unit root test, LM test, panel Kao Cointegration, Johansen Fisher test and Panel ARDL investigation revealed that (i) the hypothesis of EKC supports in ASEAN economies (ii) financial expansion and consumption of energy subsidize to the Co2 productions while urbanization has positive and globalization negative affiliation with carbon dioxide emissions (iii) the data is heterogeneous and cross-sectional dependence test confirms that there exit cross sections dependency (iv) Co-integration test confirms that variables are co-integrated, urbanization has an order of integration is I(0) and a square of GDP, economic development, globalization, financial expansion, use of energy and CO2 emission have an order of integration is I(1). Moreover, it is recommended that the authorities of ASEAN economies give some special consideration to the globalization level. Since better institutional reforms, institutional quality is vital to upsurge financial development and globalization improved financial growth.



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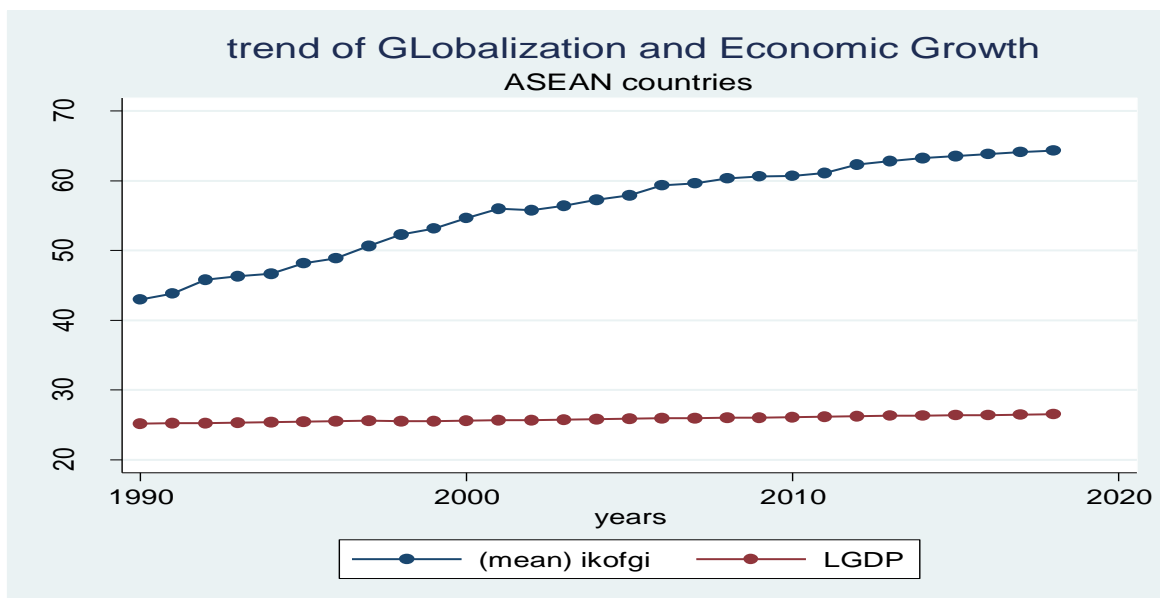
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## **1. Introduction**

All over the world, globalization is a phenomenon that influences human beings politically, socially and economically. It stimulates to form interactions amongst different economies by increasing the services, trade in goods, and investment flow that leads to development (Shahbaz, Mallick, Mahalik, & Loganathan, 2015). Rendering to Shahbaz, Mahalik, Shah, and Sato (2016), the process of globalization is growing among different economies of the world, which is encouraging struggle between developed and developing countries. Now the economies are involved both in competition and globalization; thus, they are strictly related politically, economically and socially with each other. The emerging economies wish to expand the growth of the economic sector by rising economic actions and at the same time, their priority is to eliminate poverty. Those nations although want to improve the global technological level to boost the production level at a low-cost price. By the urbanization and industrial capability to eliminate the poverty level in those economies. Due to that kind of global modification, it reduces the burden from the government to lead economic and sustainable development in the country.

Both locally as well as globally, excluding these stages, poverty reduction is a difficult process. Therefore, to increase the growth of the economic sector, nations should upsurge industrialization, production level, domestic and foreign investment, trading, and economic activities. The energy of any economy is the dynamic pre-essential for the actions because it is the main effort for households as well as businesses. In any economy, higher energy consumption leads to more emissions of carbon.

The environmental quality is severally affected by the globalization of markets like natural resources, a decrease in minerals and global warming, etc. (Shahbaz, Khan, Ali, & Bhattacharya, 2017). Developed nations in the globalized economic environment can simply meet the expense to hire a cheap labour force from other developing economies toward enhancing the level of production. From developed economies, emerging economies can also obtain environmental welfare due to globalization by easy contact with progressive energy-saving technology. The procedure of globalization might disturb the environment in 3 ways, such as composition effect, technique effect and income effect. Through the production of impulse and trade of goods, globalization inspires economic movement which harms the environment thus encouraging carbon dioxide emissions globally. This occurrence has recognized the effect of income. By accessing international markets, nations use energy-efficient technologies through globalization. By the use of these improved technologies boosts the production level, while using the minimum energy sources that improve environmental quality and decreases the level of carbon dioxide emission that is called the technique effect. While in the presence of globalization, changes the structure of the production level and also change the labor-capital ratio in the nation, that effect is called the composition effect. It has a direct proportion to the emission of carbon and economic development due to the boosts in the pollution level by pollution created by the industry, service and agricultural sectors. Hence, the economy interchanges from the agriculture to the industrial subdivision it boots the production level of carbon in the economy and then to control the level of environment it continues to move from industrial to service sector because it has less production of carbon Shahbaz, Shahzad, and Mahalik (2018) that confirms that due to globalization there increase in the economic development. This study takes data from WDI and draws the graph of ASEAN countries and that also verifies that on average in the ASEAN region with the increase in the level of globalization, boosts the level of development which is also shown in figure 1.



**Figure 1: ASEAN countries trend of Globalization and Economic growth**

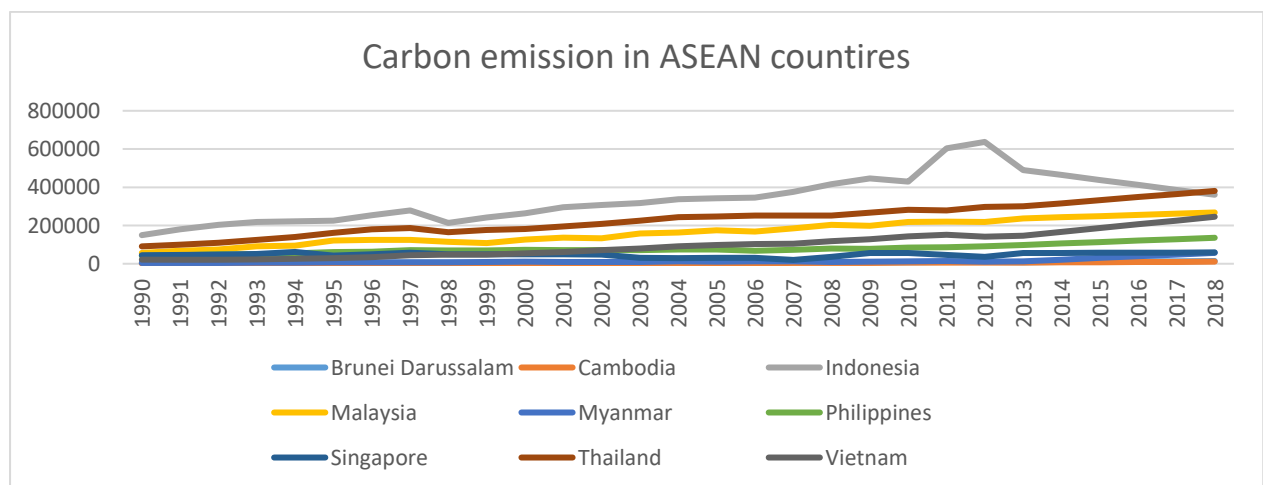
Through institutional reforms, globalization is a very imperative and vital aspect of financial development and economic growth if an economy wishes to heighten the investment by allowing financial markets the government from the development of the financial sector to receive foreign capital, which effects of rising the investment and reduction in cost.

In both developed and developing economies, the financial sector shows a leading role in the development of the economic sector. The effective administration of financial systems, even with scarce financial resources, permits nations to use financial assets productively. This generates socio-economic environs which are additional promising for stimulating economic development and innovation growth (Furuoka, 2015). A managed financial system and well-developed invite investors to advance the effectiveness of economic activities and boosts the stock market. In every economy, financial expansion is a significant part, which encourages the banking activities and the stock market in the financial sector of the economy invites foreign direct investment that turns to FDI in the financial structure of the economy by expanding the productivity of the economy sector. Confirmed that the strong correlation between the economic sector and financial sectors (Sadorsky, 2011). Due to the expansion of financial development funding networks and depresses the financing cost which allows nations to purchase a massive quantity of new machinery and industrial products at inferior prices. This might affect the usage of energy and the emissions of carbon dioxide. Therefore, financial development and globalization might have a substantial influence on the degradation of environment (carbon dioxide emissions).

ASEAN economies comprise a set of 11 developing nations, i.e., Vietnam, Singapore, Malaysia, Indonesia Cambodia, Burma (Myanmar), Brunei, Timor-Leste, Laos, the Philippines, and Thailand, which has been increasingly general in both academia and public media for having a sole outline amongst emerging economies, due to technological innovations, low-cost labour and an abundance of abundant minerals (Radulescu, Panait, & Voica, 2014). Table 1 and figure 2 shows that there is an increasing affiliation amongst carbon emission and time trend which means that carbon production grows with the increase in time. In ASEAN countries, Indonesia has the highest carbon emission all over the time from 1990 to 2018 and after that Thailand is in the second position and after that Malaysia maintains its third position in all ASEAN countries.

**Table 1**  
**Selected ASEAN countries' Carbon Emission with over time.**

year	Brunei Darussalam	Cambodia	Indonesia	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
1990	6193.56	1261.44	149565.9	56592.81	4275.722	41763.47	44495.38	90805.92	21407.95
1995	4789.10	1551.14	224941.1	121132	6959.966	60710.85	42174.17	161153.7	29090.31
2000	4712.09	1976.51	263418.9	125734.1	10087.92	73307	49005.79	181270.8	53644.54
2005	5005.45	2775.91	341991.8	174486.9	11598.72	74832.47	30359.09	247467.5	98143.59
2010	8203.07	5012.78	428760.3	218476.2	12515.47	84869.05	55643.06	281926.3	142738
2015	10414.2	7766.70	438125.8	249132.3	30403.1	113178.3	57069.52	332336.6	186591.6
2016	11719.73	8848.47	412075.4	255443.2	39174.56	120703	57766.24	348460.4	206272.4
2017	13025.19	9930.23	386025.1	261754.1	47946.02	128227.6	58462.97	364584.2	225953.2
2018	14330.64	11012	359974.7	268065	56717.49	135752.3	59159.7	380708	245634



**Figure 2: Carbon emission in selected ASEAN countries**

Specified this background, this observed study examines the active association amongst carbon dioxide emissions, economic growth, energy consumption, globalization,

and financial development in ASEAN nations in the occurrence of the EKC postulate. Since the last decades, numerous studies have found and revealed the associations amongst carbon emissions, financial development, and energy consumption by using diverse econometric techniques in diverse nations. For example, Bekhet, Matar, and Yasmin (2017), in GCC nations; (Riti, Shu, Song, & Kamah, 2017), 90 economies studied considered by income; (Salahuddin, Alam, Ozturk, & Sohag, 2018), in Kuwait; (Shahbaz, Solarin, Mahmood, & Arouri, 2013), in Malaysia; (Shahbaz, Tiwari, & Nasir, 2013), in South Africa; (Shahbaz, Shahzad, Ahmad, & Alam, 2016; Shahzad, Kumar, Zakaria, & Hurr, 2017), in India; (Jalil & Feridun, 2011), in Pakistan; (Boutabba, 2014) in China; (Tamazian, Chousa, & Vadlamannati, 2009), in BRIC (Farhani & Ozturk, 2015), in Tunisia and for Malaysia (Bakhtyar, Kacemi, & Nawaz, 2017).

As described above studies, there are numerous insufficiencies. Firstly, the outcomes from these studies are unconvincing; secondly mostly studies to extent long-run causality and cointegration employ conventional approaches results that cannot explain for cross-sectional dependence and heterogeneity; third, in these studies probable variable such as globalization is overlooked which affects the quality of environment due to the carbon emissions. This observed study subsidizes the literature in three ways. Firstly, this is the first effect of our knowledge in the presence of the EKC theory, to investigate the dynamic affiliation amongst carbon dioxide discharges, urbanization, consumption of energy, globalization, financial development and economic development in the study of ASEAN economies. We used ASEAN nations and also added urbanization and globalization.

The study has two parts as it used several econometric techniques and secondly is observed the affiliation by country. For policymakers, this study offers a more depth view of developing better comprehensive policies. Additionally, different from other studies, we used the second-generation unit-root test to reveal the cross-sectional dependence and heterogeneity for co-integration. We use Johansen Fisher and Kao panel cointegration methods to analyze the co-integration amongst variables. We employ panel ARDL to investigate long-run estimates, which explanation for cross-sectional dependence and heterogeneity. To notice causation amongst variables, the lasting portion of the paper is as follows: the literature review is explained in section 2. In the third section variable description and data source. The fourth segment defines the econometric methodology—the fifth section presents outcomes and discussion whereas the last one is based on the conclusion of the study.

## **2. Literature Review**

The significant economic growth experienced the world economy due to the excess use of energy. The demand for economic development and energy growing demand has higher environmental significances (Shahbaz, Nasreen, Ahmed, & Hammoudeh, 2017). The first researcher Kraft and Kraft (1978) was who found the affiliation amongst economic growth, carbon discharges, and energy usage. That study clarified the substantial use of energy with economic growth that makes carbon emissions. Stern (2010) claimed that deprived of global productions and substantial environment variation, and it is very tough to attain consistent economic expansion. Consequently, several studies have widely debated the association between economic progress and climate quality in the existence of the EKC (environmental Kuznets curve) framework. This theory suggests that carbon emissions rise as the economy experience economic growth in the early phases, but later on as country develops and attain the inception of income per capita, more rise in the growing of economic sector twitches to lessen carbon emissions and therefore, association arises between CO<sub>2</sub> emissions and economic growth with an inverted U-shaped curve (Dinda, 2004; Grossman & Krueger, 1995) for ASEAN countries (Muhammad Atif Nawaz, Azam, & Bhatti, 2019).

Grossman and Krueger (1991), among one of the earliest economists, presented or discussed the reversed U-shaped affiliation among environmental quality and economic expansion. After this, numerous examiners employ the EKC framework in their researches via including various variables in various economies. Such variables are Co<sub>2</sub> emanations, usage of energy & economic development. For example, Muhammad A Nawaz and Hassan (2016); Shahbaz, Khraief, Uddin, and Ozturk (2014) inspected the effect of economic development and consumption of energy on carbon dioxide discharges by using VECM

Granger causality tests and ARDL bound testing technique over the time period 1971 to 2010 in the existence of EKC framework in Tunisia. They establish that inverted U-shaped with use of energy mains to higher carbon discharges and association occurs among carbon emissions and economic expansion.

Pao and Tsai (2010) considered the link amongst economic expansion, Co<sub>2</sub> emissions, and consumption of energy between 1971–2005 in BRIC nations. They established that economic development and use of energy are the central factors of CO<sub>2</sub> emissions. In contrast, carbon releases become reduced after the edge of economic development, which confirms the occurrence of EKC affiliation.

Tamazian et al. (2009) inspected the affiliation among carbon emissions and economic expansion by including the growth of the financial sector over the time period from 1992 to 2004 in BRIC countries and determined that growth in the financial sector and economic development are the core factors of (CO<sub>2</sub>) emissions levels. They establish that the productions level of carbon dioxide decreased due to financial development and explored that by calming the carbon emissions and economic development reduces, which confirms EKC. Pao and Tsai (2011) establish the same outcomes for the time period 1980–2007 in BRIC by using various econometric methods such as LLC, Fisher and Kao, Pedroni panel unit root and cointegration tests.

Dogan and Turkekul (2016) create related outcomes over 1960–2010 in the USA by using similar techniques excluding the growth in the financial sector, which has not influenced the quality of the environment. According to the literature of energy, it is observed that widespread empirical researches on the relationship amid CO<sub>2</sub> emanations, financial growth, use of energy and economic expansion. Conversely, the studies on determining the association among carbon dioxide production, financial expansion, globalization, economic development, and energy use are imperfect. For example, (Shahbaz, Shahzad, & Mahalik, 2018) inspected the effect of globalization on CO<sub>2</sub> (carbon dioxide) emissions by including economic growth and consumption of energy for the time period of 1970–2014 in Japan by applying the ARDL model and investigating that economic growth, globalization and energy consumption rises the emission level. Shahbaz, Ozturk, Afza, and Ali (2013) considered the influence of globalization on emissions of CO<sub>2</sub> by comprising economic growth and energy intensity in the existence of the EKC framework over the time period from 1970 to 2010 by using VECM and ARDL method in case of Turkey. They determined that energy intensity and economic growth raise carbon dioxide emissions, whereas globalization lessens carbon releases.

Furthermore, in this empirical study, EKC is valid. Similar outcomes are established (Shahbaz, Khan, et al., 2017) for the time period from 1970 to 2012 in the case of China and explored that the index of globalization and globalization sub-indices reduces emissions of carbon in the existence of EKC. Shahbaz, Solarin, and Ozturk (2016) examined the effect of globalization and energy intensity on carbon emissions over 1971–2012 in 19 African nations by using the ARDL method and found varied outcomes. They also established an indication of EKC in various economies such as Tunisia, Cameroon, Morocco, Congo Republic, Zambia, and Algeria.

Lately, Shahbaz, Shahzad, Mahalik, and Hammoudeh (2018) studied the casualty relationship amongst globalization and carbon emissions in 25 developed nations with North America, Western Europe, Oceania, and Asia for the time span of 1970 to 2014 by using annual-time series and panel data methods. The institute that globalization raises carbon emissions. Shahbaz et al. (2015) maintenance EKC with economic expansion, financial growth, and consumption of energy consumption to examine the outcome of globalization on the ecological quality for the Indian economy, over time-spam 1970 to 2012, using VECM approach with Bayer and Hanck cointegration approach. In that study, they also established financial growth, globalization and energy consumption raises the emissions level. Earlier studies explored the association amongst financial expansion, economic development, the consumption level of energy and CO<sub>2</sub> releases in the situation of the panel and individual nations. In the present study, few studies cited that additionally, numerous studies have discoursed the connection between carbon dioxide releases and globalization in various nations.

### 3. Data & Methodology

The present study wishes to reveal the connection among environmental degradation, financial growth, globalization, economic development, and the square of economic development in the existence of the EKC hypothesis in ASEAN countries and urbanization used as a control variable. After analyzing the objectives of the study, using the theoretical approach, we have developed a model.

$$CO_2 = f(GDP, GDP^2, FINDEV, GLOB, URBAN) \quad (1)$$

Where  $CO_2$  is the emission level of carbon dioxide in (kt), GDP is economic growth (constant 2010 US\$), Economic growth square, FINDEV to the private to domestic credit (% of GDP), URBAN is measured by urban-population (% of the total population).

All variables have become to natural logarithm to overlook the dynamic properties (Shahbaz, Mahalik, et al., 2016). The form of the equation is linear logarithmic econometric. (1) is as follows;

$$\log CO_{2it} = \delta_0 + \delta_1 \log GDP_{it} + \delta_2 \log GDP_{it}^2 + \delta_3 \log FINDEV_{it} + \delta_4 \log GLOB_{it} + \delta_5 \log URBAN_{it} + \varepsilon_{it} \quad (2)$$

Where  $t$  denotes the time trend,  $i$  denote the cross-section, and  $\delta$  denotes the coefficients of intercept, urbanization, globalization, economic growth, a square of economic and financial expansion.

To analyze the appearances of the error term in the globalization, financial expansion, square GDP, economic development, energy consumption, and  $CO_2$  emission data of these sample nations (Breusch & Pagan, 1980; Pesaran, Ullah, & Yamagata, 2008). For cross-section interdependence, the LM test was applied because it is more consistent and reliable and as compared to the time dimension when the cross-section of  $t$  is small.

#### 3.1. Unit root test

The unit root test for the panel was used for the confirmation of stationarity properties economic expansion, use of energy, globalization, urbanization and financial expansion. Pesaran (2004) offered a new method known "the CIPS" to account for cross-section dependence for a robust heterogeneity and yields more consistent and steady findings related to conventional unit root tests (Harris & Tzavalis, 1999; Im, Pesaran, & Shin, 2003; Levin, Lin, & Chu, 2002) the equation is discussed as follows

$$\Delta X_{it} = \beta_i + \gamma_i X_{it-1} + \delta_i T + \sum_{j=1}^n \varphi_{ij} \Delta X_{it-j} + \mu_{it} \quad (3)$$

$X_{it}$  where symbolizes examined variables,  $\Delta$  for the difference,  $\mu_{it}$  for error term,  $T$  for time trends and  $\beta_i$  is individual intercepts.

#### 3.2. Panel Cointegration-test

In demand to establish the link between the estimators, the current healing of the Johansen Fisher panel cointegration test, and the Kao cointegration test applied. This technique is more consistent with solving a problem of diversity and with evading wrong estimates. After confirmation of cointegration and the outcomes of the panel unit root test, indicates that we applied PMG and MG which is known as panel ARDL econometrics model to see the long and short-run results with cointegration terms.

#### 3.3. Mean Group

To evaluate the coefficients of short- and long-term coefficients from the panel data, we use estimates of the grouped mean group and signify a group that follows the ARDL autoregressive distribution lag technique. The mean group (MG) model is derived from (Pesaran, Shin, & Smith, 1999) by default. The problem of heterogeneity in the dynamic problem is solved by estimating MG, and another advantage is that the estimator MG provides a long-term coefficient for the panel. Estimate the long-term parameters by

averaging the long-term parameters estimated through the ARDL models for the individual countries. The ARDL model follows these guidelines:

$$Y_{it} = \beta_{it} + \delta_i Y_{i,t-1} + \vartheta_i X_{it} + \varepsilon_{it} \quad (4)$$

According to equation 4;  $i$  stand for the numeral of cross-sections which is many nations and  $t$  attitudes towards the number of observations which is  $t = 1,2,3, \dots, N$ .

### 3.4. Pooled Mean Group

For panel analysis, the most appropriate technique used dynamically is ARDL ( $p, q$ ) with an error correction mechanism. Therefore the estimate of the average group (MG) which is represented by (Pesaran & Smith, 1995) and The Pooled Mean Group (PMG), is established by (Pesaran et al., 1999), its form of representation is shown below.

$$Y_{it} = \sum_{j=1}^{p-1} \gamma_j (Y_i)_{t-j} + \sum_{j=0}^{q-1} \sigma_j (X_i)_{t-j} + \phi_i (Y_i)_{t-1} + \mu_i + \varepsilon_{it} \quad (5)$$

In equation 5  $X_{i,t-j}$  represents the rank of the matrix is ( $k \times 1$ ) the number of cross-sections is a set of groups  $i$  explanatory indicators and  $\mu_i$  is the fixed effect of the estimate of the panel data. If the panel data is not balanced, ARDL ( $p, q$ ) may vary depending on the countries/cross-sections. Under the conditions of homogeneity and the long run association among the explanatory and explanatory indicators, the PMG replaces the MG estimates with best and consistent estimates (Pesaran et al., 1999). So according to PMG, our desired model will become like this:

$$CO2=f (GDP, GDP^2, FINDEV, GLOB, URBAN) \quad (6)$$

$$\begin{aligned} CO2_{it} = & \gamma_0 + \sum_{i=1}^p \gamma_1 \Delta CO2_{i,t-1} + \sum_{i=0}^p \gamma_2 \Delta GDP_{i,t-1} + \sum_{i=0}^p \gamma_3 GDP_{it}^2 + \sum_{i=0}^p \gamma_4 \Delta FINDEV_{i,t-1} + \\ & \sum_{i=0}^p \gamma_5 \Delta GLOB_{i,t-1} + \sum_{i=0}^p \gamma_6 \Delta URBAN_{i,t-1} + \gamma_7 CO2_{i,t-1} + \gamma_8 GDP_{i,t-1} + \gamma_9 GDP_{it}^2 + \gamma_9 FINDEV_{i,t-1} + \\ & \gamma_{10} GLOB_{i,t-1} + \gamma_{11} URBAN_{i,t-1} + \varepsilon_{it} \end{aligned} \quad (7)$$

### 3.5. Data Source

Annual panel data of 9 ASEAN<sup>1</sup> economies for the time span from 2000 to 2018 has been taken from the World Development Indicators (World Bank, 2020).

## 4. Results and Discussion

Summary statistics are given in table 2, Rendering to table 2, ASEAN country's economic growth means the value is 6.97 with a 1.16% standard deviation and while Brunei Darussalam has the highest economic growth 8.90 with a standard deviation of 0.1966% and Myanmar has the lowest which is 5.72 with 0.2140 SD. ASEAN countries' CO2 emission is 10.68, Indonesia has the highest average carbon dioxide emission 12.67 with 0.3585% SD which is higher than the mean value of ASEAN countries and Cambodia has the lowest emission with 8.01 with 0.6742% SD. Globalization's mean value is 3.97 with 0.3309 in ASEAN countries and Singapore has the highest in ASEAN counties rank while Malaysia is placed at the lowest in globalization. Moreover, financial development in ASEAN countries is 3.715, with 1.12% SD. Malaysia has the highest financial development with 4.74 with 0.18 standard deviation which is also quite low and Cambodia has minimum financial development with 2.37 with a higher standard deviation which is 1.45%.

<sup>1</sup> Selected ASEAN countries are Indonesia, Myanmar, Cambodia, Brunei Darussalam, Vietnam, Malaysia, Philippines, Thailand and Singapore.

**Table 2**  
**Summary Statistics**

Variables	GDP		CO2		URBAN		GLOB		FINDEV	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Overall	6.9786	1.1689	10.6863	1.6180	3.7589	0.5142	3.9752	0.3309	3.7175	1.1214
Brunei										
Darussalam	8.9860	0.1966	8.7799	0.3762	3.5954	0.5458	3.9823	0.1183	3.9986	0.5101
Cambodia	5.7459	0.2278	8.0108	0.6742	3.6942	0.5619	4.0387	0.1058	2.3729	1.4529
Indonesia	6.6265	0.1596	12.6747	0.3585	3.6739	0.5282	3.6941	0.3300	3.5372	0.3555
Malaysia	7.7192	0.2589	11.9349	0.4293	3.6825	0.5325	3.4155	0.2188	4.7460	0.1810
Myanmar	5.7203	0.2140	9.3243	0.6614	3.7823	0.5045	4.2975	0.0800	2.0697	0.5926
Philippines	6.1544	0.0722	11.2231	0.2989	3.8114	0.4936	4.0688	0.1179	3.5372	0.3122
Singapore	8.5509	0.1364	10.7238	0.2731	3.8617	0.4960	4.3750	0.0379	4.5988	0.1529
Thailand	7.2140	0.3022	12.2762	0.3895	3.8388	0.4736	4.1087	0.1261	4.7679	0.2049
Vietnam	6.0906	0.3486	11.2289	0.7846	3.8901	0.4751	3.7962	0.2297	3.8289	0.8624

Before going to the unit root test of the panel we tested the dependence of cross-section and effects are shown in table 3,

**Table 3**  
**Cross-Section Dependence Test**

Test	Breusch-Pagan	Pesaran-LM	Bias-corrected scaled	Pesaran-CD
GDP	0.00	0.00	0.00	0.00
CO2	0.00	0.00	0.00	0.00
URBAN	0.00	0.05	0.07	0.00
GLOB	0.00	0.00	0.00	0.00
FINDEV	0.00	0.00	0.00	0.00

We applied several cross-section dependence tests, which are Breush pagan, Psearan scaled, Pesaran CD test, and bias-corrected scaled. Results of all tests specify that there occurs a cross-section-dependence in all the variables which are GDP, CO2, URBAN, GLOB, and FINDEV. So we applied the second generation CIPS and PESCADF unit root test and the results are shown in table 4,

**Table 4**  
**Unit root test**

variables	CIPS				PESCADF			
	Level		first		Level		first	
GDP	-1.075	-2.51	-4.346	-2.51	-1.311	-2.57	-3.109	-2.57
CO2	-1.83	-2.51	-4.523	-2.51	-1.697	-2.57	-3.157	-2.57
URBAN	-3.974	-2.51			-3.596	-2.57		
GLOB	-1.408	-2.51	-4.549	-2.44	-1.213	-2.57	-3.375	-2.57
FINDEV	-1.549	-2.51	-4.625	-2.51	-1.887	-2.57	-3.812	-2.57

According to table 4, CIPS and PESCADF results indicate that carbon dioxide emission (CO2), economic development (GDP), Globalization (GLOB), and financial expansion (FINDEV) are stationary at the first difference and urbanization (URBAN) has stationary at level. So, we move to the panel cointegration test which is shown in 5,

According to the Kao cointegration test, the null hypothesis is there does not exist cointegration in the model and according to problem value, which indicates that we accept the alternative hypothesis and discard the null hypothesis which is their exits the cointegration in the model. Furthermore, according to the Johansen cointegration test, we reject the first three hypotheses and accept the 3 and 4 hypotheses which indicate there exits the cointegration minimum 3 and 4 equations. Hence concludes that there exists cointegration in the model. And render to the panel unit root test there exist the mix order of integration so PMG and MG results are more appropriate in this case and results of PMG are presented in table 6.

According to table 5, the term of error correction specifies that there exits the cointegration in the model and the speed of adjustment is almost 25% annually, which means due to external shock if the model will move dis-equilibrium stage then the model will move to equilibrium stage with the speed of 25% annually. So, this defined that GDP



and its square, globalization, urbanization, carbon productions, financial expansion, economic development and energy use and are defined, ensuring long run relationships.

**Table 5**  
**Cointegration test**

Kao Cointegration Test		Johansen Fisher Panel Cointegration Test				
t-Statistic	Prob.	No. of CE(s)	trace test	Prob.	max-eigen test	Prob.
-3.25513	0.0006	None	160.20	0.00	99.75	0.00
		At most 1	78.71	0.00	53.46	0.00
		At most 2	39.16	0.00	29.01	0.05
		At most 3	24.51	0.14	22.88	0.20
		At most 4	22.13	0.23	22.13	0.23

**Table 6**  
**ARDL Results**

Long Run Equation				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP	3.683**	1.396	2.638	0.009
LGDP <sup>2</sup>	-0.314**	0.112	-2.815	0.006
LFINDEV	0.102**	0.044	2.326	0.022
LKOFGI	-3.303***	0.297	-11.114	0.000
LURBAN	0.116**	0.035	3.305	0.001
Short Run Equation				
C	-3.590**	1.359	-2.642	0.009
COINTEQ01	-0.250**	0.087	-2.893	0.004
D(LCO2(-1))	0.031	0.095	0.331	0.741
D(LFINDEV)	0.030	0.030	1.007	0.316
D(LFINDEV(-1))	0.236	0.187	1.265	0.208
D(LGDP)	3.041	17.744	0.171	0.864
D(LGDP(-1))	-4.580	10.222	-0.448	0.655
D(LGDP <sup>2</sup> )	-0.017	1.420	-0.012	0.990
D(LGDP(-1) <sup>2</sup> )	0.450	0.801	0.562	0.575
D(LKOFGI)	-0.705	1.059	-0.666	0.507
D(LKOFGI(-1))	-1.654**	0.667	-2.479	0.014
D(LURBAN)	-0.016	0.013	-1.197	0.234
D(LURBAN(-1))	0.001	0.032	0.035	0.972

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

Economic development increases the level of CO<sub>2</sub> emission while Economic growths square decrease the CO<sub>2</sub> emission in ASEAN countries which also confirms the EKC hypothesis. The results show that the economic growth value coefficient and GDP square is 3.68 and 0.314 respectively, resulting in increased environmental degradation from the rise in the level of economic development. The inverse coefficient of GDP square suggests that emission reduces carbon dioxide when it passes through the threshold of GDP, by increasing economic expansion, reflecting the strength of the Environment Kuznets curve (EKC). This is in accordance in Pakistan (Ali, Waqas, & Ahmad, 2015), (Shahbaz et al., 2015) for India, (Jalil & Feridun, 2011; Shahbaz, Khan, et al., 2017) verifies the existence of EKC in case of China (Shahbaz, Tiwari, et al., 2013) in South Africa, (Ozturk & Acaravci, 2013; Shahbaz, Ozturk, et al., 2013) for Turkey, (Saboori & Sulaiman, 2013) in ASEAN nations, (Pao & Tsai, 2011; Tamazian et al., 2009) followed in the region of BRICS nations, (Solarin, Al-Mulali, Musah, & Ozturk, 2017) for Ghana, (Shahbaz, Solarin, et al., 2016) valid also in African Nations and (Kasman & Duman, 2015) in new EU members.

Carbon emissions and financial development have a long run increasing affiliation, suggesting that the rise in the development of the financial sector for the ASEAN nations increases carbon emissions. These outcomes are in line with studies (Xiong, Tu, & Ju, 2017) for the least industrialized nations in China, (Solarin et al., 2017) in the case of Ghana, (Farhani & Ozturk, 2015) and into Tunisia, (Javid & Sharif, 2016) in Pakistan and (Shahbaz et al., 2015) in case of India. These outcomes revealed the negative influence on carbon emissions due to financial development. Stock markets care reducing the financial cost, publicly traded companies, increasing investments in new projects, increasing the financial means, reducing the risk, important to the use of energy and then carbon dioxide productions. Additionally, financial institutions can deliver diverse lending prospects to

consumers to purchase their products that release extra carbon emissions (Javid & Sharif, 2016).

The globalization value of the coefficient is -3.303, suggesting that it has a negative affiliation with the emission level of Co<sub>2</sub> for the panel of the ASEAN region. The association of these variables is the unsustainable state and social environmental sustainability of these nations such as (Shahbaz, Khan, et al., 2017) claimed that environmental and social sustainability are basics for the globalization procedure. The industry can be another reason, as the industry has a greater impact on globalization and on the demand for energy, which stimulates more carbon releases. It can lead to political and social which does not have regulator over carbon emissions, which eliminates the straight affiliation between globalization and the quality of the atmosphere (Shahbaz et al., 2015). At times, when the policymakers develop macro policies the motive for small globalization is the open market that generates problems, that is, trade, capital control and international investment. Moreover, the globalization benefits will be limited due to high operating costs. So, for the improvement of the economic conditions, the governments should have a role to attain the welfares of globalization. Though, these nations must partake in the market integration procedure along with business partners that remove barriers on trade.

## **5. Conclusion**

The main attention of this study is to inspect the affiliation among urbanization, globalization, financial growth, GDP with its square and economic growth on CO<sub>2</sub> releases with the existence of EKC framework into the ASEAN nations. In responsibility, several econometric approaches were used such as, to explore cross-dependency Breusch-Pagan LM Pesaran, scaled LM, Bias-corrected scaled LM and Pesaran CD tests were used and for diversity in the sample economies, CADF and CIPS were applied to verify the unit's root, panel Johansen and Kao Fisher used to verify the order of cointegration. To examine the long run affiliation among considered variables cointegration technique, and for long run estimates for the panel data, the PMG was used.

Empirical results suggest some important results, the results suggest that economic growth has positive while GDP square shows negative effects respectively, suggesting that EKC is valid in these panel economies. Urbanization and development of the financial sector have an optimistic affiliation with long-term carbon dioxide releases. Interestingly, globalization has a negative affiliation with the release of CO<sub>2</sub> in ASEAN economies. The results of the study addressed several important political suggestions for ASEAN nations. The government needs to plan policies that will allow industries and companies to use more efficient and effective technology. The ASEAN countries should take actions to implement technological and structural alterations, which could recover effectiveness in the energy sector by consuming well developed and new raw materials. The efficiency of energy could be attained through the implementation of the projects of saving energy, by subcontracting energy conservation policies and energy infrastructures in these sample economies to reduce carbon dioxide emissions.

The financial sector in the protection of the environment can play a vital role by promoting environmentally friendly and efficient projects of energy. An efficient and strong financial division would be beneficial in easing the procedure of speculation by promoting business loans to restrict carbon dioxide releases. Moreover, it is recommended that the administration of given economies pay consideration to globalization. Since better institutional reforms, institutional quality is vital to upsurge financial development and globalization deal improved financial development. Moreover, prudential regulation, the superiority of financial evidence, corruption, regulation of the banking structure, property rights and legal systems could benefit these economies rise financial development and globalization.

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