

# THE ROLE OF ECONOMIC GROWTH, FINANCIAL DEVELOPMENT, AND FINANCIAL LIBERALIZATION ON THE ENVIRONMENTAL QUALITY: AN EMPIRICAL ANALYSIS FROM ASEAN COUNTRIES

Nartraphee Tancho<sup>1</sup>, Kittisak Jermsittiparsert<sup>2</sup>, Krisada Chienwattanasook<sup>3\*</sup>

<sup>1</sup>Faculty of Business Administration, Rajamangala University of Technology Thanyaburi, Thailand

<sup>2</sup>MBA School, Henan University of Economics and Law, China

<sup>3</sup> Faculty of Business Administration, Rajamangala University of Technology Thanyaburi, Thailand

Corresponding author: E-mail: krisada\_c@rmutt.ac.th

## ABSTRACT:

The basic aim of the present study is to examine the role of economic growth (EG), financial development (FD) and financial liberalization (FL) on the environmental quality of ASEAN countries. The data were extracted from the World Development Indicator (WDI) and ASEAN States Data Portal for the year 2001 to 2018. Generalized Methods of Moment (GMM) estimator was used to test the hypotheses of the study. The results highlighted that EG and financial development have positive link with the environmental quality of the ASEAN countries. The findings also exposed that financial liberalization has negative link with the environmental quality of the ASEAN countries. The current study also recommended to the policymakers that they should emphasize on the improvement of the EG and FD that are necessary for the high-quality environment of the ASEAN countries. This study also suggested to the legislators that they should control the FL that has adverse effect on the environmental quality of the ASEAN countries.

## Keywords:

Environmental Quality, Economic Growth, Financial Development, Financial Liberalization, ASEAN countries

Article Received: 18 October 2020, Revised: 3 November 2020, Accepted: 24 December 2020

## INTRODUCTION

The immense attention has been received by the debate on economic growth, financial liberalization, FD, and carbon dioxide emissions (CO<sub>2</sub>) (environmental quality) in the literature of economic energy worldwide (Tang & Tan, 2015; Haseeb, Wattanapongphasuk, & Jermsittiparsert, 2019). However, FD and financial liberalization play an essential role in EG and environmental quality. The environmental quality depends on the efficient use of available financial resources that also enhance the EG of the country. Nowadays, the variable of FD is taking in the literature as an additional variable and also consider as an essential tool for decisive economic and environmental growth. The environmental function can be influenced by both factors like financial development as well as economic growth to control energy consumption and trade and, most importantly weaken GHG emissions (Salahuddin, Gow, & Ozturk, 2015).

Most of the latest literature indicated that FD, financial liberalization, and trade openness could affect the carbon emission level in different areas, states, and countries of the world (Hussain, Mosa, & Omran, 2018). Thus, there are two separate thoughts of researchers examined in the previous studies regarding the effects of FD on the quality of the environment. As far as first view is concern, financial development eliminates the constraints of credit and increases the investments in the projects of high energy consumption that boost up energy consumption, EG, and CO<sub>2</sub> emissions. On the other hand, the thoughts of other researchers are the difference that FD increases the investments in energy-efficient technology that reduces the consumption of energy and enhance the quality of the environment.

Similarly, there are two different thoughts of researchers examined in the previous studies regarding the effects of financial liberalization on the quality of the environment. As far as first view

is concern, financial liberalization eliminates the constraints of credit and increase the investments in the projects of high energy consumption that boost up the energy consumption, EG, and CO<sub>2</sub> emissions. On the other hand, the thoughts of other researchers are the difference that financial liberalization increases the investments in energy-efficient technology that reduces the consumption of energy and enhance the quality of the environment (Hussain, Musa, & Omran, 2019). In addition, EG is also one of the essential elements of CO<sub>2</sub> emissions that decrease the quality of the environment. Previous studies have three different opinions about the link between EG and environmental quality (Hussain, Musa, & Omran, 2018). The first opinion is that the acceleration in the growth of economy becomes a significant cause of CO<sub>2</sub> emissions, but later on they change their opinion and argue that the acceleration in the growth of economy could reduce the CO<sub>2</sub> emissions and also support the “Environmental Kuznets Curve” (EKC) hypothesis. The second opinion is that high energy consumption causes high carbon emissions. The third opinion is that there is causal link among the growth of the economy and degradation of environment that shows the growth of the economy is one of the foremost elements of carbon emissions (Hussain et al., 2012). Therefore, economic growth is necessary element for the economy because it helps boost the advance technology, business opportunities, and invest efficiency (Hussain, Mosa, & Omran, 2017).

One of the ASEAN countries called the “Asian Infrastructure Development Bank” (AIDB) for the construction of Maritime Silk Road a few months later. After few months, it is approved by the State Council, and in 2016, Chinese government converted it into one belt one road initiative. According to the Chinese report, about 65 countries such as 26 Asian countries (11 Central Asia, 2 Southeast Asia, 5 South Asian and 8 East Asian), 24 Europe countries, and 15 North African and Middle East countries participate in this mega project. This project includes 4.4 billion people

that is around 62.3 percent of the total population and also covers about 30 percent of total GDP of the world. This initiative shows financial liberalization and also enhances the economic and financial development with the help of reliable and effective policy management and even though the personnel and cultural exchange between the countries who are participating in this mega project. It is considered as one of the mega projects that have substantial financial estimation ranging approximately, from USD 1.4 trillion to USD 6 trillion. However, around 48 countries also express their willingness to join as an active participant in this mega project along with all these 65 countries (Wang, Fang, Wang, Huang, & Ma, 2015).

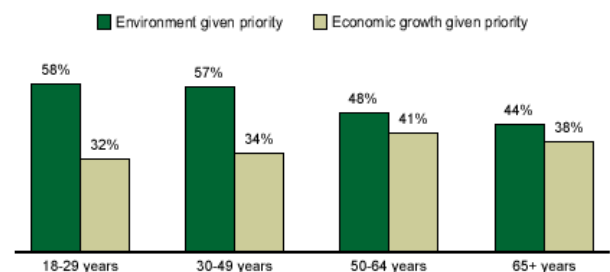
Resultantly, according to the State Information Centre, the number of active participants countries increases and reached 71 active participant countries in 2017 with approximately USD 6 trillion total investment that represents approximately 34 percent of the total GDP of the world. Furthermore, this project carries an extensive range of economic objectives and also other objectives such as efficient resource utilization, connectivity of facilities, development, economic openness, infrastructure, unimpeded and financial integration. This road plan consists of the three major routes, such as (I) “China to Central Asia to West Asia to Persian Gulf to Mediterranean Sea, (II) China to Central Asia to Russia to Europe, and (III) China to Southeast Asia to South Asia to Indian Ocean”. This project will bring economic and FD in the participant countries of the world. This project was initially launched by the government of China with USD 10 billion initial capital and total USD 40 billion at the end of the project. However, after 2016, it includes 15 further projects such as construction, financial assistance, industrial corporations, infrastructure, and exploration of resources with approximately USD 6 billion worth of investment. This project provided productive results in five different areas like policy regarding corporation, people to people communication and exchange,

infrastructure, finance, and trade. This project provided a unique platform for globalization in wide-range and collaboration between the partner countries. Thus, this project promoted trade and also enhanced economic collaboration across Europe, Africa, and Asia. In addition, these activities of huge investment increased the economic and financial development and growth and also promoted financial liberalization among the participating countries, and these activities also have a noticeable impact on the quality of the environment of participant countries (Lajunen & Lipman, 2016).

Currently, the quality of the environment is the primary concern among all the countries around the world, and the common perception of most of the researchers is that environmental degradation is the outcome of economic growth. Moreover, enormous literature regarding the economic and environment has highlighted the growing significance of the link between FD, EG, and environmental degradation. Thus, there is need for adequate policies about the enhancement of quality of the environment (Ertugrul, Cetin, Seker, & Dogan, 2016). This interest of the countries regarding the quality environment is growing, and in recent years, the importance of the people is increasing regarding the study on the relationship among economic growth, financial liberalization, and other factors that affect the quality of the environment. In addition, adverse effects have been observed about environmental degradation that increases its instantaneous and also has a direct impact on the health and life of human and future generations. This is the reason that there is need for serious consideration on it along with appropriate control. The carbon emissions are the basic cause of environmental degradation and global warming as compare to any other GHGs such as sulfur dioxide and nitrogen oxides that usually the outcomes of power plant, energy-intensive industry, and transportation. Nevertheless, several environmental policies for the protection of the environment are already developed by the different countries around the

world but not up to the mark due to which environmental degradation increases with the increase in economic growth that consumes high energy. However, the well-organized energy resources increase EG and also provided easy and smooth access to resources of the energy. While external laws, rules, and regulations become the primary cause to reduce employment, competitiveness and economic growth. Thus, the nexus among the economic growth and quality of the environment is still puzzling.

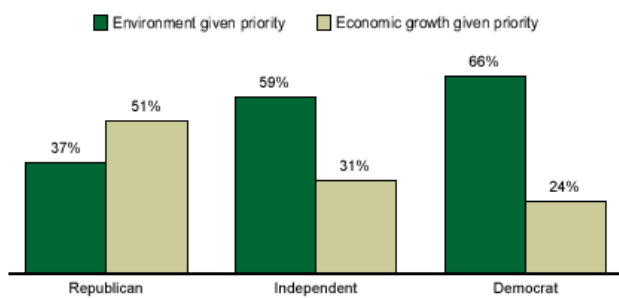
The focus on the environment quality is greater than the focus on the economic growth in ASEAN countries. As shown in figure 1, the priority at the age 18 to 29 years on environmental quality is 58 percent, but the priority on economic growth is only 32 percent. In addition, the priority at the age 30 to 49 years on environmental quality is 57 percent, but the priority on economic growth is only 34 percent. Moreover, the priority at the age 50 to 64 years on environmental quality is 48 percent, but the priority on economic growth is only 41 percent. Furthermore, the priority at the age 65 and more years on environmental quality is 44 percent, but the priority on economic growth is only 38 percent. These figures highlighted that the priority of environmental quality is higher than the priority of economic growth at every stage of the life of humans in ASEAN countries. Figure 1 regarding the percentage of EG and environmental quality of ASEAN countries is given below:



**Figure 1:** Percentage of Economic Growth and Environmental Quality of ASEAN Countries

The focus on the environment quality is greater than the focus on the economic growth in ASEAN countries. As shown in figure 2, the priority of Republicans on environmental quality is 37 percent, but the priority on economic growth is

only 51 percent. In addition, the priority of independent on environmental quality is 59 percent, but the priority on economic growth is only 31 percent. Moreover, the priority of democrat on environmental quality is 66 percent, but the priority on economic growth is only 24 percent. These figures highlighted that the priority of environmental quality is greater than the priority of economic growth at every stage of the life of humans in ASEAN countries. Figure 2 regarding the percentage of EG and environmental quality of ASEAN countries of different individuals is given below:



**Figure 2:** *Economic Growth and Environmental Quality of ASEAN Countries*

On the other hand, the environment of the quality decrease in the ASEAN countries due to different economic issues in the ASEAN countries. The environmental quality decreases due to sulfur oxides by 66.7 percent in the ASEAN countries from 2000 to 2015. In addition, environmental quality also reduces due to nitrogen oxides by 37.9 percent. Moreover, the environmental quality also reduces due to ozone by 30.9 percent in the ASEAN countries from 2000 to 2015. Furthermore, environmental quality also decreases due to carbon monoxide by 66.4 percent. Similarly, environmental quality decreases due to particulates by 25.5 percent. Likewise, the environmental quality also decreases due to lead by 17.3 percent in the ASEAN countries from 2000 to 2015. Table 1 regarding the percent increase in pollution of ASEAN countries from 2000 to 2015 is given below:

**Table 1:** *Percentage Increase in Pollution of ASEAN Countries from 2000-2015*

Pollution	Percentage Increase
Sulfur Oxides	66.7%
Nitrogen Oxides	37.9%
Ozone	30.9%
Carbon Monoxide	66.4%
Particulates	25.5%
Lead	17.3%

Thus, the basic aim of the present study is to examine the role of EG, financial development and financial liberalization on the environmental quality of ASEAN countries from 2001 to 2018.

**LITERATURE REVIEW**

The previous studies regarding the variable, their operational definitions, and links among the variables are given in this section.

**1.1 Environmental Quality**

The characteristics of the atmosphere that have noteworthy effects on the life of the human and that explain the natural things is said as quality environment. Moreover, the competition among the all services of the environment but not included the services of waste receptor (Hu, Zhang, Huang, & Teng, 2017). In addition, the situation of the atmosphere that have some characteristics that suitable for the man kind in this world (Cushing, Morello-Frosch, Wander, & Pastor, 2015). Moreover, environmental quality means the properties of ongoing environment in which people spend their life that may be good and harmful for human beings. Furthermore, “quality of environment is a set of properties and characteristics of the environment, either generalized or local, as they impinge on human beings and other organisms. It is a measure of the condition of an environment relative to the requirements of one or more species, any human need or purpose. Environmental quality includes the natural environment as well as the built environment, such as air, water purity or pollution, noise, and the potential effects which such characteristics may have on physical and mental health” (p-213)(Draskiewicz, Challies, & Newig, 2015). Similarly, the environment that is beneficial for the life of human bodies, and is free of all types of pollution such as air, noise, and

water pollution. Likewise the atmosphere condition that express in the form of suitable or not suitable for the man kind of the world is known as environmental quality (Júnior, Juen, & Hamada, 2015). Similarly, there are two different thoughts of researchers examined in the previous studies regarding the effects of financial liberalization on the quality of the environment. As far as first view is concern, financial liberalization eliminates the constraints of credit and increase the investments in the projects of high energy consumption that boost up the energy consumption, EG, and CO<sub>2</sub> emissions. Additionally, quality of environment refers to the pure environment that is preferred by every person in life due to its purity and benefits of human life (Martins et al., 2015). Thus, the quality environment is essential for human beings, and the high-quality requirement of current society and the present study takes this area as main area of the study.

### **1.2 Economic Growth**

It refers to the growth of the financial condition of the society by increasing their output or production level by implementing the latest technology. In addition, the growth on the economy means the enhancement of the level of outcome in the country that is measure in term of GDP. (Zhu, Duan, Guo, & Yu, 2016). Furthermore, it also means the growth in the production level that can be measured with the comparison of previous and current year GNP of the country (Bende-Nabende, 2018; Shittu, Hassan, & Nawaz, 2018). Additionally, “economic growth is an increase in the production of goods and services over a specific period. To be most accurate, the measurement must remove the effects of inflation (Liu, Zhang, & Bae, 2017). Economic growth creates more profit for businesses. As a result, stock prices rise. That gives company’s capital to invest and hire more employees” (p-216) (Tan & Tang, 2016). Similarly, the growth in the economy refers to the development of the economy by enhancing the production level of the society. Likewise,

“economic growth is the increase in the inflation-adjusted market value of the goods and services produced by an economy over time. It is conventionally measured as the percent rate of increase in real gross domestic product, or real GDP” (p-42) (Thanh, 2015). Thus, the growth in the economy is essential for human beings, and the high-quality requirement of current society and present study takes this area as predictor of the study.

### **1.3 Financial Development**

It refers to the development in the financial sector by increasing their economy through improving the production level of the country. Moreover, the enhancement in the governance of corporations, trading, funds pooling, firms monitoring, risk management, diversification and mobilization is said as development of financial sector in the country. (Abidin, Haseeb, Azam, & Islam, 2015). In addition, the development of financial sector is also referred to as the enhancement of financial services such as pooling of funds, risk management and trading (Al-Mulali, Ozturk, & Lean, 2015). Furthermore, the financial sector of the country consist upon the financial institutions such as banks, investment companies and insurance companies and also consist upon the products that are introduce by these financial institutions and the development of the institutions and their instruments are called financial development in the country (Dogan & Seker, 2016). Similarly, financial development is also defined as the enhancement in the services of financial intermediates that improve the financial condition of the country. (Ziaei, 2015). Likewise, “financial development means the production and of exchange, the conditions under which feudal society produced and exchanged, the feudal organization of agriculture and manufacturing industry, in one word, the feudal relations of property became no longer compatible with the already developed productive forces; they became so many fetters” (p-43) (Phong, 2019). Thus, the development in the financial sector is essential for human beings, and the high-quality requirement of

current society and present study takes this area as predictor of the study.

#### **1.4 Financial Liberalization**

Financial liberalization is defined as the relief given by the government to its institutions regarding the rule and regulation impose on those institutions. In addition, the removal of the governmental restrictions on the trade of any security that is ban previously or the removal of limits on the particular transaction that are not allowed by the regulators or the removal of ban of trading the foreign countries is said as financial liberalization in the country(Syadullah, 2018). Moreover,

“financial Liberalization means lessening restrictions on various types of lending institutions and instruments. As a removing restriction on types of instruments that can be traded. Examples of institutions are banks, a countries treasury (or whoever issues bonds), money market funds, hedge funds, investment banks” (p-26)(Selvarajan, Ab-Rahim, & Awg-Marikan, 2018). Additionally, it also refers to the relief given by the regulatory authorities to the under supervision institutions about the restriction imposed by the regulators. However, the removal of all restrictions on the financial activities of the firm within or outside the firm or the country imposed by the government or any other regulators in the country is refer as the financial liberalization Similarly, the liberalization of economy means the releasing of all types of bans imposed by the regulatory authorities or the government of the firm to trade with any other firm or country. In addition, sometime to promote the particular products in the market, the company take off all the restrictions of the trade on that commodity that needs to promote in the society this relaxation of the rules and regulations is said as economic liberalization (Selvarajan & Ab-Rahim, 2017). Likewise, it means the elimination of regulations applied by the controllers on the institutions to avoid them to go towards uncertain events may happen in the institutions (Jaeger, Li, Scharl, & Praktijnjo, 2017). Furthermore,

“trade liberalization is the removal or reduction of restrictions or barriers on the free exchange of goods between nations. This includes the removal or reduction of tariff obstacles, such as duties and surcharges, and, nontariff obstacles, such as licensing rules, quotas and other requirements”(p-17)(Mahrinasari, Haseeb, & Ammar, 2019). Thus, the control on financial liberalization is essential for the human beings and high quality requirement of current society and present study takes this area as predictor of the study.

#### **1.5 Economic Growth and Environmental Quality**

Some of the studies indicated that EG is one of the factors of the environmental quality of the country in this modern era of the world. In addition, positive association has been observed between the EG and environmental quality in which the sources of energy effectively utilize(Mazur, Phutkaradze, & Phutkaradze, 2015). Moreover, quality of the environment depends upon the EG that is the outcome of efficient use of energy resources. Furthermore, results of previous studies indicated positive link among the environmental quality and EG of the country. Additionally, environmental quality is the outcome of effective use of resources that result in economic growth. Similarly, economic growth is one of the significant factors that affect environmental quality positively. Likewise, quality of the environment improves with increase in economic growth and vice versa. However, some of the studies indicated that EG is one of the factors of CO2 emission of the country in this modern era of the world(das Neves Almeida, Cruz, Barata, & García-Sánchez, 2017). In addition, negative association has been observed between the EG and environmental quality in which the sources of energy do not effectively utilize. Moreover, CO2 emissions depend upon the economic growth that is the outcome of inefficient use of energy resources. Furthermore, results of previous studies indicated negative link among the environmental quality and EG of the country(Zambrano-Monserrate, Valverde-Bajana, Aguilar-

Bohorquez, & Mendoza-Jimenez, 2016). Additionally, CO<sub>2</sub> emissions are the outcome of ineffective use of resources that result in economic growth. Similarly, economic growth is one of the significant factors that affect environmental quality negatively. Likewise, quality of the environment decreases with increase in economic growth and vice versa (Alam, Murad, Noman, & Ozturk, 2016). In addition, negative association has been observed between the EG and environmental quality in which the sources of energy do not effectively utilize. Moreover, CO<sub>2</sub> emissions depend upon the economic growth that is the outcome of inefficient use of energy resources. Furthermore, results of previous studies indicated negative link among the environmental quality and EG of the country. Thus, previously two schools of thoughts one view is positive link between economic growth and environmental quality and other is negative nexus between EG and environmental quality and this study develop the following hypothesis:

**H1:** There is positive nexus between economic growth and environmental quality in ASEAN countries.

### ***1.6 Financial Development and Environmental Quality***

Some of the studies indicated that financial development is one of the factors of the environmental quality of the country in this modern era of the world. In addition, positive association has been observed between the FD and environmental quality in which the sources of energy effectively utilize (Charfeddine & Kahia, 2019). Moreover, quality of the environment depends upon the FD that is the outcome of efficient use of energy resources. Furthermore, results of previous studies indicated positive link among the environmental quality and financial development of the country (Dar & Asif, 2018). Additionally, environmental quality is the outcome of effective use of resources that result in financial development. Similarly, financial development is one of the significant factors that affect environmental quality positively. Likewise,

quality of the environment improves with increase in FD and vice versa. However, some of the studies indicated that FD is one of the factors of CO<sub>2</sub> emission of the country in this modern era of the world. In addition, negative association has been observed between the financial development and environmental quality in which the sources of energy do not effectively utilize (Saud, Chen, & Haseeb, 2019). Moreover, CO<sub>2</sub> emissions depend upon the financial development that is the outcome of inefficient use of energy resources. Furthermore, results of previous studies indicated negative link among the environmental quality and financial development of the country (Amri, 2018). Additionally, CO<sub>2</sub> emissions are the outcome of ineffective use of resources that result in financial development. Similarly, financial development is one of the significant factors that affect environmental quality negatively. Likewise, quality of the environment decreases with increase in FD and vice versa (Cetin, Ecevit, & Yucel, 2018). Thus, previously two schools of thoughts one view is positive nexus between FD and environmental quality and other is negative link between FD and environmental quality and this study develop the following hypothesis:

**H2:** There is a positive nexus between financial development and environmental quality in ASEAN countries.

### ***1.7 Financial Liberalization and Environmental Quality***

Some of the studies indicated that FL is one of the factors of the environmental quality of the country in this modern era of the world (Hakimi & Hamdi, 2016). In addition, positive association has been observed between the FL and environmental quality in which the sources of energy effectively utilize. Moreover, quality of the environment depends upon the financial liberalization that is the outcome of efficient use of energy resources. Furthermore, results of previous studies indicated positive link among the environmental quality and financial liberalization of the country. Additionally, environmental quality is the outcome of effective use of resources that result in

financial liberalization (Omri, Daly, Rault, & Chaibi, 2015). Similarly, financial liberalization is one of the significant factors that affect environmental quality positively. Likewise, quality of the environment improves with increase in financial liberalization and vice versa. However, some of the studies indicated that FL is one of the factors of CO<sub>2</sub> emission of the country in this modern era of the world (Hua & Boateng, 2015). In addition, negative association has been observed between the financial liberalization and environmental quality in which the sources of energy do not effectively utilize. Moreover, CO<sub>2</sub> emissions depend upon the financial liberalization that is the outcome of inefficient use of energy resources (Ali, Waqas, & Ahmad, 2015). Furthermore, results of previous studies indicated negative link among the environmental quality and financial liberalization of the country. Additionally, CO<sub>2</sub> emissions are the outcome of ineffective use of resources that result in financial liberalization (Abid, 2017). Similarly, financial liberalization is one of the significant factors that affect environmental quality negatively. Likewise, quality of the environment decreases with increase in financial liberalization and vice versa (Nasreen & Anwar, 2015). Thus, previously two schools of thoughts one view is positive link between financial liberalization and environmental quality and other is negative link between financial liberalization and environmental quality and this study develop the following hypothesis:

**H3:** There is a negative nexus between financial liberalization and environment quality in ASEAN countries.

## RESEARCH METHODS

The basic aim of the present study is to examine the role of EG, financial development and financial liberalization on the environmental quality of ASEAN countries. The data were retrieved from the World Development Indicator (WDI) and ASEAN States Data Portal for the year 2001 to 2018. Generalized Methods of Moment (GMM) estimator was used to test the hypotheses of the study. There are four assumptions of panel

regression that need to be fulfilled before the analysis. The first assumption is multicollinearity that means the predictors are not highly correlated. The second assumption is normality that means data should be normally distributed. The third assumption is heteroscedasticity that means the variance in error term should be constant, and the final assumption is serial correlation that indicates the current year value of the variable should not be highly correlated with its previous value. If all of above assumptions are full-filled, then the regression can be run on the data. This study examines the link among economic growth, financial liberalization, financial development, and environmental quality and develops the following equation:

$$CO_{2it} = \alpha_0 + \beta_1 EG_{it} + \beta_2 FD_{it} + \beta_3 FL_{it} + \beta_4 EC_{it} + e_{it} \quad (1)$$

Where

$i$  = Country

$t$  = time period

CO<sub>2</sub> = Environmental Quality

EG = Economic Growth

FD = Financial Development

FL = Financial Liberalization

EC = Electricity Consumption

## 1.8 Data

This study examines the link among EG, financial liberalization, FD, and environmental quality while EG is measured by the GDP per capita; on the other hand financial liberalization is measured by the trade openness by eliminating the restrictions. In addition, FD is measured by the domestic credit given to the private sector, financial sector percentage of GDP while “environmental quality is measured by the CO<sub>2</sub> emissions in metric ton per capita. Moreover, the electricity consumption is measured by electric power consumption (kWh) per capita”.

## RESULTS

The findings of the study showed the descriptive statistics, multicollinearity, normality, heteroscedasticity, autocorrelation, correlation matrix, and GMM estimators. Firstly, results showed the descriptive statistics that highlighted



the mean, standard deviation, minimum and maximum values of the data. Table 2 showed the descriptive statistics given below:

**Table 2: Descriptive Statistics**

Variable	Obs	Mean	Std. Dev.	Min	Max
FD	180	-.467	.520	-1.687	.587
FL	180	.612	.385	-.234	1.619
CO2	180	1.657	.582	-.179	3.437
EG	180	1.169	.182	.645	1.756
EC	180	.897	1.926	-9.180	4.060

The multicollinearity means the high correlation in the predictors that can affect the results, and this study investigated it by VIF. It can be evaluated by following equation:

$$R^2_{EG} EG_{it} = \alpha_0 + \beta_2 FD_{it} + \beta_3 FL_{it} + \beta_3 EC_{it} + e_{it} \tag{2}$$

$$R^2_{FD} FD_{it} = \alpha_0 + \beta_2 EG_{it} + \beta_3 FL_{it} + \beta_3 EC_{it} + e_{it} \tag{3}$$

$$R^2_{FL} FL_{it} = \alpha_0 + \beta_2 FD_{it} + \beta_3 EG_{it} + \beta_3 EC_{it} + e_{it} \tag{4}$$

$$R^2_{EC} EC_{it} = \alpha_0 + \beta_2 FD_{it} + \beta_3 FL_{it} + \beta_3 EG_{it} + e_{it} \tag{5}$$

$$j = R^2_{EG}, R^2_{FD}, R^2_{FL}, R^2_{EC}, \tag{6}$$

$$Tolerance = 1 - R_j^2 VIF = \frac{1}{Tolerance} \tag{7}$$

The results of VIF mentioned that there is no issue with the multicollinearity assumption of OLS because the values of tolerance are greater than 0.10, and the values of VIF less than 5.0. The values of tolerance and VIF are given below in Table 3.

**Table 3: Variance Inflation Factor**

	VIF	1/VIF
FL	2.059	.486
FD	1.794	.557
EC	1.243	.805
EG	1.057	.946
Mean VIF	1.538	

The multicollinearity can also be examined through correlation matrix, and the results showed no problem with multicollinearity because values are less than 0.80, which shows no high correlation among the predictors. A correlation matrix is given below in Table 4.

**Table 4: Correlation Matrix**

Variables	FL	FD	CO2	EG	EC
FL	1.000				
FD	0.635	1.000			
CO2	-0.741	-0.646	1.000		
EG	0.031	-0.158	0.291	1.000	
EC	-0.429	-0.189	0.483	-0.041	1.000

This study used Skewness and kurtosis to check the normality of the data and the results shows no issue with normality of CO2, FL, and FD because values are greater than 0.50, but FG and EC are not normal because their values are less than 0.05, but this cannot be affected the because when data are more than 100 then it consider as large and normality cannot be affected results of large data. Table 5 highlighted the test of Skewness and kurtosis given below:

**Table 5: Skewness and Kurtosis Test**

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj_chi2(2)	Prob>chi2
CO2	180	0.172	0.046	5.720	0.057
FL	180	0.586	0.493	0.780	0.679
FD	180	0.203	0.272	2.870	0.238
EG	180	0.000	0.000	33.490	0.000
EC	180	0.000	0.000		0.000

The third assumption is about homoscedasticity, that refers to the variation in error terms is constant. The results highlighted that heteroscedasticity problem exists in the data because the probability values are less than 0.05. The fourth assumption is about autocorrelation that refers to the current value of variable is affected by its lag values. The results highlighted that serial correlation problem exists in the data because the probability values are less than 0.05. Tables 6 and 7 show the results of fixed and random effect models in which one of them is selected based on Hausman test. The finding highlighted that if 1 percent change in financial liberalization, the CO2 emission will also change 100.5 percent but in opposite direction. In addition, if 1 percent change in financial development, the CO2 emission will also change 1.8 percent in same direction. Moreover, if 1

percent change in economic growth, the CO2 emission will also change 105.8 percent in same direction. Similarly, if 1 percent change in electricity consumption, the CO2 emission will also change 3.4 percent in same direction.

**Table 6: Fixed Effect Model**

CO2	Coef.	St.Err.	t-value	p-value	L.L	U.L	Sig
FL	-1.005	.007	-154.03	.000	-1.018	-.993	***
FD	.018	.008	2.24	.000	.013	.017	***
EG	1.058	.016	66.48	.000	1.026	1.089	***
EC	.034	.002	20.90	.000	.031	.037	***
Constant	-.081	.021	-3.94	.000	-.121	-.040	***
R-squared		0.997	Prob > F		0.000		

\*\*\* p<.01, \*\* p<.05, \* p<.1

The finding highlighted that if 1 percent change in financial liberalization, the CO2 emission will also change 100.7 percent but in the opposite direction. In addition, if 1 percent change in financial development, the CO2 emission will also change 1.9 percent in same direction. Moreover, if 1 percent change in economic growth, the CO2 emission will also change 105.0 percent in same direction. Similarly, if 1 percent change in electricity consumption, the CO2 emission will also change 3.4 percent in same direction.

**Table 7: Random Effect Model**

CO2	Coef.	St.Err.	t-value	p-value	L.L	U.L	Sig
FL	-1.007	.006	-160.42	.000	-1.020	-.995	***
FD	.019	.008	2.23	.000	.013	.017	***
EG	1.05	.014	72.85	.000	1.022	1.079	***
EC	.034	.001	22.84	.000	.031	.037	***
Constant	-.073	.02	-3.73	0	-.111	-.035	***
R-squared within		0.997	R-squared between		0.997		

\*\*\* p<.01, \*\* p<.05, \* p<.1

The results of the Hausman test showed that the random effect model is appropriate because the probability value is greater than 0.50. The results of Hausman test are given below in Table 8.

**Table 8: Hausman Test**

	Coef.
Chi-square test value	2.778
P-value	.596

The results of GMM estimators highlighted that FD, EG, and EC have positive link with CO2 while FL has negative link with CO2 because probability values are less than 0.05, and t values are greater than 1.64. The finding highlighted that if 1 percent change in financial liberalization, the CO2 emission will also change 98.5 percent but in opposite direction. In addition, if 1 percent change in financial development, the CO2 emission will also change 2.8 percent in same direction. Moreover, if 1 percent change in economic growth, the CO2 emission will also change 112.7 percent in same direction. Similarly, if 1 percent change in electricity consumption, the CO2 emission will also change 3.9 percent in same direction. The results of GMM estimators are given below in Table 9.

**Table 9: GMM Estimator**

CO2	Coef.	St.Err.	t-value	p-value	L.L	U.L	Sig
L.CO2	.029	.011	2.59	.010	.007	.052	***
FL	-.985	.009	-106.08	.000	-1.003	-.967	***
FD	.028	.012	2.33	.000	.011	.052	***
EG	1.127	.046	24.36	.000	1.037	1.218	***
EC	.039	.005	8.28	.000	.029	.048	***
Constant	-.219	.046	-4.74	.000	-.309	-.128	***
Mean dependent var		1.607	SD dependent var		0.550		
Number of obs		150.000	Chi-square		67271.072		

\*\*\* p<.01, \*\* p<.05, \* p<.1

## DISCUSSIONS AND CONCLUSION

The basic aim of the present study is to examine the role of EG, FD and financial liberalization on the environmental quality of ASEAN countries. The finding revealed that FD, EG, and electricity consumption have positive link with environmental quality because the development and EG increase the consumption level of electricity but inefficient ways in ASEAN countries that is why instead of decreasing the quality of environment increases with increase in FD, EG and EC. In addition, the finding also revealed that financial liberalization has negative link with environmental quality because the relaxation in the regulation increases the inefficient consumption level of ASEAN countries; that is why instead of improving the quality of environment decreases with increase in financial liberalization.

Thus, the current study concluded that when the FD and EG are at peak level the efficient use on energy level has been increased that is not harmful to the environment. But in case the government gives relief to the institutions, then they are going towards the inefficient use of energy resources that increase the CO2 emissions and affect the environment severely. So, current study recommended to the regulators that they should develop strong policies for the efficient use of energy resources that decrease the CO2 emissions in the country.

The present study also suggested to the regulators that restricted the organization from inefficient use of energy resources. The current studies also have limitation that is the gaps for future researchers. This study takes ASEAN countries under examination, and coming researcher can

add more countries for the examination. In addition, the present study takes three predictors to predict the CO<sub>2</sub> emissions and further studies can add more predictors in their studies. Furthermore, current study investigated for only eighteen years from 2001 to 2018 and further researchers may add more years under investigation. Finally, the present study takes only CO<sub>2</sub> emissions to measure the quality of the environment and further literature may add other measures under examination.

## REFERENCES

- [1] Abid, M. (2017). Does economic, financial and institutional developments matter for environmental quality? A comparative analysis of EU and MEA countries. *Journal of environmental management*, 188, 183-194. <https://doi.org/10.1016/j.jenvman.2016.12.007>
- [2] Abidin, I. S. Z., Haseeb, M., Azam, M., & Islam, R. (2015). Foreign direct investment, financial Development, international trade and energy consumption: Panel data evidence from selected ASEAN Countries. *International Journal of Energy Economics and Policy*, 5(3), 841-850.
- [3] Al-Mulali, U., Ozturk, I., & Lean, H. H. (2015). The influence of economic growth, urbanization, trade openness, financial development, and renewable energy on pollution in Europe. *Natural Hazards*, 79(1), 621-644.
- [4] Alam, M. M., Murad, M. W., Noman, A. H. M., & Ozturk, I. (2016). Relationships among carbon emissions, economic growth, energy consumption and population growth: Testing Environmental Kuznets Curve hypothesis for Brazil, China, India and Indonesia. *Ecological Indicators*, 70, 466-479. <https://doi.org/10.1016/j.ecolind.2016.06.043>
- [5] Ali, S., Waqas, H., & Ahmad, N. (2015). Analyzing the dynamics of energy consumption, liberalization, financial development, poverty and carbon emissions in Pakistan. *J Appl Environ Biol Sci*, 5(4), 166-183.
- [6] Amri, F. (2018). Carbon dioxide emissions, total factor productivity, ICT, trade, financial development, and energy consumption: testing environmental Kuznets curve hypothesis for Tunisia. *Environmental Science and Pollution Research*, 25(33), 33691-33701.
- [7] Bende-Nabende, A. (2018). FDI, regionalism, government policy and endogenous growth: a comparative study of the ASEAN-5 economies, with development policy implications for the least developed countries: Routledge.
- [8] Cetin, M., Ecevit, E., & Yucel, A. G. (2018). The impact of economic growth, energy consumption, trade openness, and financial development on carbon emissions: empirical evidence from Turkey. *Environmental Science and Pollution Research*, 25(36), 36589-36603.
- [9] Charfeddine, L., & Kahia, M. (2019). Impact of renewable energy consumption and financial development on CO<sub>2</sub> emissions and economic growth in the MENA region: A panel vector autoregressive (PVAR) analysis. *Renewable energy*, 139, 198-213. <https://doi.org/10.1016/j.renene.2019.01.010>
- [10] Cushing, L., Morello-Frosch, R., Wander, M., & Pastor, M. (2015). The haves, the have-nots, and the health of everyone: the relationship between social inequality and environmental quality. *Annual Review of Public Health*, 36, 193-209.
- [11] Dar, J. A., & Asif, M. (2018). Does financial development improve environmental quality in Turkey? An application of endogenous structural

- breaks based cointegration approach. *Management of Environmental Quality: An International Journal*, 29(2), 368-384. <https://doi.org/10.1108/MEQ-02-2017-0021>
- [12] das Neves Almeida, T. A., Cruz, L., Barata, E., & García-Sánchez, I.-M. (2017). Economic growth and environmental impacts: An analysis based on a composite index of environmental damage. *Ecological Indicators*, 76, 119-130. <https://doi.org/10.1016/j.ecolind.2016.12.028>
- [13] Dogan, E., & Seker, F. (2016). The influence of real output, renewable and non-renewable energy, trade and financial development on carbon emissions in the top renewable energy countries. *Renewable and Sustainable Energy Reviews*, 60, 1074-1085. <https://doi.org/10.1016/j.rser.2016.02.006>
- [14] Drazkiewicz, A., Challies, E., & Newig, J. (2015). Public participation and local environmental planning: Testing factors influencing decision quality and implementation in four case studies from Germany. *Land use policy*, 46, 211-222. <https://doi.org/10.1016/j.landusepol.2015.02.010>
- [15] Ertugrul, H. M., Cetin, M., Seker, F., & Dogan, E. (2016). The impact of trade openness on global carbon dioxide emissions: Evidence from the top ten emitters among developing countries. *Ecological Indicators*, 67, 543-555. <https://doi.org/10.1016/j.ecolind.2016.03.027>
- [16] Hakimi, A., & Hamdi, H. (2016). Trade liberalization, FDI inflows, environmental quality and economic growth: a comparative analysis between Tunisia and Morocco. *Renewable and Sustainable Energy Reviews*, 58, 1445-1456. <https://doi.org/10.1016/j.rser.2015.12.280>
- [17] Haseeb, M., Wattanapongphasuk, S., & Jermittiparsert, K. (2019). Financial Development, Market Freedom, Political Stability, Economic Growth and CO2 Emissions: An Unexplored Nexus in ASEAN Countries. *Contemporary Economics*, 13(3), 363-374. DOI: 10.5709/ce.1897-9254.319.
- [18] Hu, W., Zhang, Y., Huang, B., & Teng, Y. (2017). Soil environmental quality in greenhouse vegetable production systems in eastern China: current status and management strategies. *Chemosphere*, 170, 183-195. <https://doi.org/10.1016/j.chemosphere.2016.12.047>
- [19] Hua, X., & Boateng, A. (2015). Trade openness, financial liberalization, economic growth, and environment effects in the north-south: New static and dynamic panel data evidence Beyond the UN Global Compact: Institutions and Regulations (pp. 253-289): Emerald Group Publishing Limited. <https://doi.org/10.1108/S2051-503020150000017020>
- [20] Hussain, M. S., Mosa, M. M., & Omran, A. (2017). The Mediating Impact Of Profitability On Capital Requirement And Risk Taking By Pakistani Banks. *Journal of Academic Research in Economics*, 9(3), 435-443.
- [21] Hussain, M. S., Mosa, M. M., & Omran, A. (2018). The impact of owners behaviour towards risk taking by Pakistani Banks: Mediating role of profitability *Journal of Academic Research in Economics*, 10(3), 455-465.
- [22] Hussain, M. S., Musa, M. M., & Omran, A. (2019). The Impact of Regulatory Capital on Risk Taking By Pakistani Banks. *SEISENSE Journal of Management*, 2(2), 94-103. <https://doi.org/10.33215/sjom.v2i2.124>

- [23] Hussain, M. S., Musa, M. M. B., & Omran, A. A. (2018). The Impact of Private Ownership Structure on Risk Taking by Pakistani Banks: An Empirical Study. *Pakistan Journal of Humanities and Social Sciences*, 6(3), 325-337.
- [24] Hussain, M. S., Ramzan, M., Ghauri, M. S. K., Akhtar, W., Naeem, W., & Ahmad, K. (2012). Challenges and failure of Implementation of Basel Accord II and reasons to adopt Basel III both in Islamic and conventional banks. *International Journal of Business and Social Research*, 2(4), 149-174.
- [25] Jaeger, K., Li, Y., Scharl, S., & Praktiknjo, A. (2017). Evaluation of Market Liberalization in Developing Countries in the Case of the ASEAN and the Philippines in Particular. Paper presented at the Meeting the Energy Demands of Emerging Economies, 40th IAEE International Conference, June 18-21, 2017.
- [26] Júnior, C. d. S. M., Juen, L., & Hamada, N. (2015). Analysis of urban impacts on aquatic habitats in the central Amazon basin: adult odonates as bioindicators of environmental quality. *Ecological Indicators*, 48, 303-311. <https://doi.org/10.1016/j.ecolind.2014.08.021>
- [27] Lajunen, A., & Lipman, T. (2016). Lifecycle cost assessment and carbon dioxide emissions of diesel, natural gas, hybrid electric, fuel cell hybrid and electric transit buses. *Energy*, 106, 329-342. <https://doi.org/10.1016/j.energy.2016.03.075>
- [28] Liu, X., Zhang, S., & Bae, J. (2017). The impact of renewable energy and agriculture on carbon dioxide emissions: investigating the environmental Kuznets curve in four selected ASEAN countries. *Journal of cleaner production*, 164, 1239-1247. <https://doi.org/10.1016/j.jclepro.2017.07.086>
- [29] Mahrinasari, M., Haseeb, M., & Ammar, J. (2019). Is trade liberalization a hazard to sustainable environment?: fresh insight from ASEAN countries. *Polish Journal of Management Studies*, 19, 15-24.
- [30] Martins, M. V. A., Zaaboub, N., Aleya, L., Frontalini, F., Pereira, E., Miranda, P., . . . El Bour, M. (2015). Environmental quality assessment of Bizerte Lagoon (Tunisia) using living foraminifera assemblages and a multiproxy approach. *PloS one*, 10(9), e0137250. <https://doi.org/10.1371/journal.pone.0137250>
- [31] Mazur, A., Phutkaradze, Z., & Phutkaradze, J. (2015). Economic growth and environmental quality in the European Union countries—is there evidence for the environmental Kuznets curve? *International Journal of Management and Economics*, 45(1), 108-126. <https://doi.org/10.1515/ijme-2015-0018>
- [32] Nasreen, S., & Anwar, S. (2015). The impact of economic and financial development on environmental degradation: An empirical assessment of EKC hypothesis. *Studies in Economics and Finance*, 32(4), 485-502. <https://doi.org/10.1108/SEF-07-2013-0105>
- [33] Omri, A., Daly, S., Rault, C., & Chaibi, A. (2015). Financial development, environmental quality, trade and economic growth: What causes what in MENA countries. *Energy Economics*, 48, 242-252. <https://doi.org/10.1016/j.eneco.2015.01.008>
- [34] Phong, L. H. (2019). Globalization, Financial Development, and Environmental Degradation in the Presence of Environmental Kuznets Curve: Evidence from ASEAN-5 Countries. *International Journal of Energy Economics and Policy*, 9(2), 40-50.

- [35] Salahuddin, M., Gow, J., & Ozturk, I. (2015). Is the long-run relationship between economic growth, electricity consumption, carbon dioxide emissions and financial development in Gulf Cooperation Council Countries robust? *Renewable and Sustainable Energy Reviews*, 51, 317-326. <https://doi.org/10.1016/j.rser.2015.06.005>
- [36] Saud, S., Chen, S., & Haseeb, A. (2019). Impact of financial development and economic growth on environmental quality: an empirical analysis from Belt and Road Initiative (BRI) countries. *Environmental Science and Pollution Research*, 26(3), 2253-2269.
- [37] Selvarajan, S. K., & Ab-Rahim, R. (2017). Economic Liberalization And Its Link To Convergence: Empirical Evidence From Rcep And Tppa Countries. *International Journal of Business & Society*, 18(3), 15-31.
- [38] Selvarajan, S. K., Ab-Rahim, R., & Awg-Marikan, D.-A. (2018). Does financial liberalization foster economic growth? Empirical evidence from ASEAN-6 countries. *development*, 23, 24-35.
- [39] Shittu, W.O., Hassan, S., & Nawaz, M.A. (2018). The nexus between external debt, corruption and economic growth: Evidence from five SSA countries. *African Journal of Economic and Management Sciences*, 9(3), 319-334. <https://doi.org/10.1108/AJEMS-07-2017-0171>
- [40] Syadullah, M. (2018). ASEAN banking efficiency review facing financial services liberalization: The Indonesian perspective. *Asian Development Policy Review*, 6(2), 88-99.
- [41] Tan, B. W., & Tang, C. F. (2016). Examining the causal linkages among domestic investment, FDI, trade, interest rate and economic growth in ASEAN-5 countries. *International Journal of Economics and Financial Issues*, 6(1), 214-220.
- [42] Tang, C. F., & Tan, B. W. (2015). The impact of energy consumption, income and foreign direct investment on carbon dioxide emissions in Vietnam. *Energy*, 79, 447-454. <https://doi.org/10.1016/j.energy.2014.11.033>
- [43] Thanh, S. D. (2015). Threshold effects of inflation on growth in the ASEAN-5 countries: A Panel Smooth Transition Regression approach. *Journal of Economics, Finance and Administrative Science*, 20(38), 41-48. <https://doi.org/10.1016/j.jefas.2015.01.003>
- [44] Wang, S., Fang, C., Wang, Y., Huang, Y., & Ma, H. (2015). Quantifying the relationship between urban development intensity and carbon dioxide emissions using a panel data analysis. *Ecological Indicators*, 49, 121-131. <https://doi.org/10.1016/j.ecolind.2014.10.004>
- [45] Zambrano-Monserrate, M. A., Valverde-Bajana, I., Aguilar-Bohorquez, J., & Mendoza-Jimenez, M. J. (2016). Relationship between economic growth and environmental degradation: Is there evidence of an environmental Kuznets curve for Brazil? *International Journal of Energy Economics and Policy*, 6(2), 208-216.
- [46] Zhu, H., Duan, L., Guo, Y., & Yu, K. (2016). The effects of FDI, economic growth and energy consumption on carbon emissions in ASEAN-5: evidence from panel quantile regression. *Economic Modelling*, 58, 237-248. <https://doi.org/10.1016/j.econmod.2016.05.003>
- [47] Ziaei, S. M. (2015). Effects of financial development indicators on energy consumption and CO2 emission of European, East Asian and Oceania

countries. Renewable and Sustainable  
Energy Reviews, 42, 752-759.  
<https://doi.org/10.1016/j.rser.2014.10.085>