

Primary submission: 01.11.2018 | Final acceptance: 10.05.2019

# Financial Development, Market Freedom, Political Stability, Economic Growth and CO<sub>2</sub> Emissions: An Unexplored Nexus in ASEAN Countries

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## ABSTRACT

The prime objective of the current study is to explore the nexus among financial development, market freedom, political stability, economic growth and CO<sub>2</sub> emissions in ASEAN countries. The present study has attempted to examine the asymmetric association among financial development, CO<sub>2</sub> emissions, and economic growth. The data for the variables are obtained from the World Bank. The CO<sub>2</sub> emission is measured in kilotons. The Johansen cointegration technique has been used for analyzing the long-term association. The results of the political freedom model indicate that in countries where there will be political stability, their CO<sub>2</sub> emission will be low. A number of research papers have investigated the relationship between the environment and political freedom. A positive relationship has been found by most of the studies; however, these studies have not taken CO<sub>2</sub> emissions into account. The probability of making agreements at international conferences is directly linked with the political freedom to lower the level of global pollutants. This study proves that the implementation of such agreements has started recently and a significant impact of political freedom on emissions cannot yet be finalized with the limited data available. Financial development appears to have a significant relationship with carbon emission. This study will be helpful for policymakers and researchers in understanding the issues related to financial development, market freedom, political stability, and economic growth and CO<sub>2</sub> emissions in ASEAN countries.

## KEY WORDS:

Financial development, Market freedom, Political stability, CO<sub>2</sub> emission, ASEAN countries

**JEL Classification:** E44, F43, Q50

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## 1. Introduction

In recent times, global leaders have needed to consider the environment in order to achieve progress. Currently, global warming has gained enough attention among environmental protectionists and society to be a major societal concern. Global warming has caused

serious challenges for most of the countries around the globe. This study has analyzed the association among development indicators, industrialization effects, and environmental emissions under the political institution of the state.

The environmental Kuznets curve (EKC) hypothesis states that as the economy progresses it generates higher levels of involvement in activities that cause less emissions and reduce the pollutants that are responsible for environmental degradation. The

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**Table 1.** CO<sub>2</sub> emission (metric tons per capita) in ASEAN countries

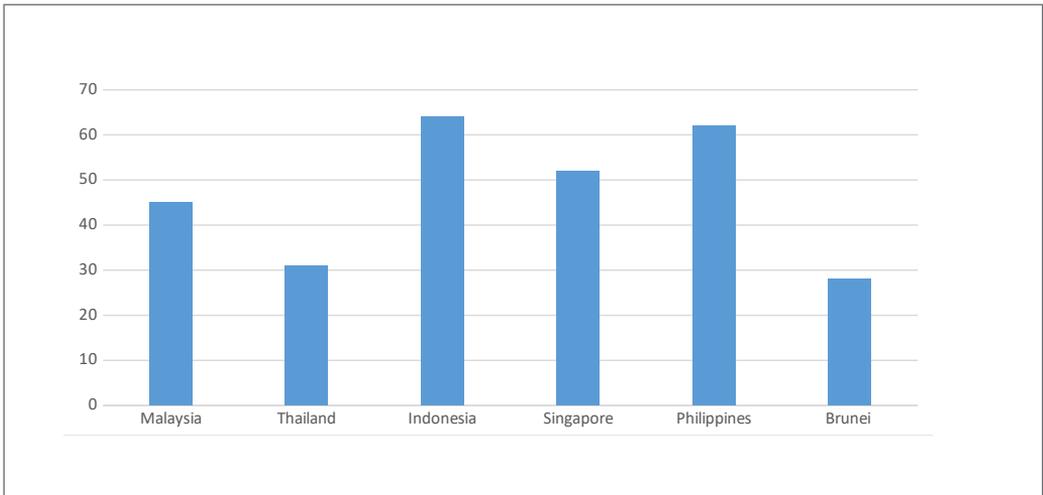
Years	Vietnam	Thailand	Brunei	Malaysia	Indonesia
2004	1.084	3.741	13.902	6.508	1.51
2005	1.164	3.782	13.707	6.8	1.508
2006	1.207	3.829	13.132	6.415	1.501
2007	1.221	3.814	22.450	6.941	1.612
2008	1.361	3.794	24.047	7.526	1.764
2009	1.469	4.001	20.486	7.204	1.865
2010	1.613	4.195	21.106	7.772	1.768
2011	1.701	4.121	24.607	7.498	2.457
2012	1.572	4.372	24.181	7.962	2.56
2013	1.609	4.622	19.233	8.033	1.945
2014	1.803	5.02	22.124	8.096	8.096

Source: Adapted from "Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States" by The World Bank Group (2014). Retrieved from [https://data.worldbank.org/indicator/en.atm.co2e.pc?end=2018&most\\_recent\\_value\\_desc=false&start=1960](https://data.worldbank.org/indicator/en.atm.co2e.pc?end=2018&most_recent_value_desc=false&start=1960)

panel data of income emissions forms an inverted U-shaped curve (Panayotou, 2000). To develop the EKC hypothesis, various factors were analyzed, such as national income composition during periods of economic development, i.e., countries transitioning towards industrialization and services sectors (Dryzek, 2013). As the economy reaches a certain level of development, it starts reducing the emissions level of the country. The technological advancements in the recent era have been increasingly supportive of a "green" Earth. As the incomes of people improve, demand for environmental quality also increases. While taking into consideration internal and national goals, the political institution is also considered. Empirical testing has been done in this research study to investigate the relationship among democracy, urbanization, environmental degradation, and economic development. Table 1 presents the CO<sub>2</sub> emissions of the ASEAN economies.

Government policies affect the relationship between environmental quality and income. Political institutions shape the strategic policies or instruments for improving environmental quality (Howes, 2017). The effect on

environmental quality caused by political institutions has been largely observed by policy makers and researchers. However, mixed findings were found when testing the EKC hypothesis, since different variables, techniques, samples and control variables were being employed in different studies. Among other pollutants that contribute to environmental degradation, CO<sub>2</sub> is found to be the principal greenhouse gas. However, a natural amount of CO<sub>2</sub> circulates in the environment, which is important for plants, animals and soil. The existence of CO<sub>2</sub> emissions naturally occurs in the environment, which is part of the CO<sub>2</sub> cycle of Earth. The natural CO<sub>2</sub> emissions cycle is disturbed by human activities, which result in the emission of gas. Different human activities such as the use of energy resources (fossil fuel combustion including oil, coal and natural gas) result in the emission of CO<sub>2</sub> emissions dioxide. This consumption of nonrenewable energy sources is necessary for transportation and industrial activities. The political freedom in the ASEAN region is comparably lower than that in other regions, as is evident from the figure that no country is considered to be politically free; rather, four countries are partially free and two are not free (see Figure 1).



**Figure 1.** Political freedom score of ASEAN countries

Source: Adapted from "Table of country score, freedom in world 2018" by Freedom House (2019). Retrieved from <https://freedomhouse.org/report/freedom-world-2018-table-country-scores>

The relationships among democracy, income, and CO<sub>2</sub> emissions are somehow difficult to comprehend. The effect of political institutions on the income-environment transmission channel is multifaceted. Political rights and freedom of information together have created public awareness and have given rise to the development of environmental policy. Under democracy, more public awareness can be spread by strategic environmental groups (Adams & Klobodu, 2017). By contrast, in the absence of democracy, the decision-making process turns into a one-sided process that obstructs the information flow. Therefore, governments need to be more vigilant and responsive under a democratic economy. Furthermore, in a democratic economy, the representative governing body also guarantees the involvement of social groups for the development of public policy.

Market economies are preferred by democratic governments and economic freedom is thus sustained. Such governments obey the rule of law and fulfill the agreements to improve the quality of the environment.

## 2. Literature Review

In the 67<sup>th</sup> American economic association meeting, Simon Kuznets put forward the linkage between per capita income and income distribution (Stern, 2004). The Kuznets curve hypothesis states that high-income

groups are susceptible to receiving higher income distributions during the income increase. However, the income inequality and skewness of the curve decreases when the income per capita increases. Various researchers have attempted to check the feasibility of the EKC hypothesis in the context of environmental economics. This can be done by replacing environmental degradation with income distribution, making it the EKC hypothesis. (Panayotou, 2000) has made recognized contributions in this area of research.

In a seminal paper, the relationship between income and environmental degradation was proposed by the researchers. (Wu, Li, & Li, 2018) declared that, initially, the environmental quality of a country deteriorates with the process of development. However, after a certain point of increase in income per capita, the environmental quality starts to enhance. The turning point differs for different economies. For most countries, this point is achieved when the economy reaches the level of \$8000 income per capita. At this level, countries begin to consider the quality of air and water, in addition to other aspects of environmental quality. For studying this phenomenon, panel data is chosen to estimate the model (Howes, 2017). Similarly, the environmental Kuznets curve with an inverted curve is defined. Furthermore, the EKC hypothesis is

analyzed by reviewing the literature. The present study emphasizes the theoretical and empirical findings of the EKC hypothesis. Further research was also considered to observe the contribution of democracy to the environment-emission nexus.

A meta-analysis was conducted by (Belbasis, Dosis, & Evangelou, 2018), which was based on 69 studies. The research involved almost 547 regressions and the variations in the EKC hypothesis results were investigated by incorporating deforestation to be the indicator of environmental degradation. It was found that the probability of a declining EKC was greater with more research. It was concluded that there is a significant impact of control variables (selection) on the occurrence of the EKC relationship. The chance of the EKC result regarding deforestation was negatively influenced by the use of trade as a control variable.

It was argued that the because of variables such as trade, the transmission channel of environmental degradation and macro variables is changed. This finding provides direction to the researchers by indicating future research implications for the EKC hypothesis. Several researchers have explored the theoretical aspect of the EKC hypothesis. Among several researchers, the theoretical aspect of the EKC model was studied by (Özokcu & Özdemir, 2017). The researchers made use of changing and static classification aspects among various classifications related to the theoretical discussion of the EKC.

It was found that several researchers have not agreed with the hypothesis. There is doubt regarding the use of the research method and data for the EKC. Some alternatives were proposed by (Wang, Wei, & Guo, 2018) after the analysis of basic econometric issues related to the traditional estimation method of the environmental Kuznets curve. The adoption of a between estimator was proposed to resolve the issue of time effect problems and cross-sectional dependency. The variations in technology cannot be resolved through time dummies, as indicated by Stern, and this may lead to the contemporary association among residual errors, country effects and repressors. The important econometric issues were analyzed by (Chow & Li, 2014), which existed in the testing of the EKC hypothesis. For the analysis, data from approximately 132 countries over the 1992-1994 period was used. CO<sub>2</sub> emissions from the combustion of fuel were used. For each year,

a cross-sectional regression with panel data was done. A t-test was used to test the EKC hypothesis.

The EKC for the economy has been observed in terms of ecological footprints caused by human activities (Al-Mulali, Saboori, & Ozturk, 2015). For the time period of 1980-2008, 93 economies were selected to explore these relationships. In addition to GDP and financial development, trade openness, energy consumption, and urbanization were also incorporated as explanatory variables. For this purpose, cross-sectional data was employed with the categories of upper-income, upper-middle-income, lower-middle-income, and low-income group countries. The study found that the EKC is only applicable to upper-middle-income economies and upper-income economies. Therefore, it is inapplicable for low-income economies and lower-middle-income economies. The fixed effect model and the Generalized Method of Moments were employed to obtain the results for the study.

A few researchers were unsure regarding the methodology employed for the EKC hypothesis testing. Instead of utilizing a tipping point, these researchers suggested a tipping band as a policy instrument. (Bernard, Gavin, Khalaf, & Voia, 2015) also observed the EKC hypothesis and stated that in the case of the EKC, using a tipping band provides more ease for the environmental policy makers. They analyzed the EKC through a set of control variables, namely, GDP, energy consumption from fossil fuels, and CO<sub>2</sub> emissions in kgs by an economy. For the purpose of research, the data from 114 economies were gathered for the years 1960-2007. The chosen countries were producing CO<sub>2</sub> emissions and SO<sub>2</sub> emissions. The study concluded that identifying a tipping point is somehow difficult, which is economically reasonable (Bernard et al., 2015). In addition, analyzing it through nonparametric and parametric alternatives is also uncertain.

### 2.1 Political Freedom and CO<sub>2</sub> Emissions

For a country's environmental quality, the public demand plays a crucial role in its political and civil system. (Hart, Baldock, & Tucker, 2018) have observed and discussed the positive association among CO<sub>2</sub> emissions and environmental quality. This positive association exists because of the inability of non-democratic economies to provide public goods such as environmental quality.

The political elites receive a large share of income, which is associated with higher costs of environmental regulation. In addition, this group receives proportionate benefits in case of pollution control. (Spilker, Koubi, & Bernauer, 2017), following the model by Deacon, also presented a model. They presented similar arguments and also included a planning perspective by the nondemocratic government. However, the model failed to confirm a direct association between political freedom and environmental quality. Social groups with environmental interests were promoted by a system having a representative legislature. Through the provision of subsidies for industries, CO<sub>2</sub> emissions can increase with more political freedom, in case the effect is biased because of unfriendly environmental solutions. When there exists the environmental issue of CO<sub>2</sub> emissions across the globe, the impact of political freedom on the environment can be insignificant as any country has the option to free ride. There can be an association between the emission of global pollutants and other environmental problems. Political freedom can thus be influential in this way (Fankhauser, Genaioli, & Collins, 2015). Due to the risks of instability across the globe, a country's preferences for global quality of the environment can become high. For instance, an indication of this preference can be the increase in the number of climate conferences.

There is mixed literature available on the influence of democracy on the EKC. It has been argued by some researchers that environmental quality is enhanced through democracy while another group of analysts has said that environmental quality deteriorates with the involvement of political institutions. A third group of researchers claims that there is no direct influence of democracy on environmental quality. This debate was taken into account by (Beeson, 2018), and the relationship between the two factors was explored. The use of empirical evidence with key concern for the impact of the political regime and social activities on the destruction of environmental quality were taken into account. The researchers employed five environmental degradations, which were the result of human activities such as deforestation, CO<sub>2</sub> emissions, water pollution, degradation of land and emissions of nitrogen oxide. Almost 105 countries were studied, including 143 variables. The control variables involved were population density, trade openness, per capita GDP and per capita GDP squared. The

dichotomous variable was democracy, which was also used as a continuous variable. It was found that environmental degradation is reduced by democracy and there are variations in its effects. By restricting human activities through government policies, environmental degradation can be controlled in some ways.

It is interesting to know about the changes in results due to examining different variables. The Polity IV index is not the only indicator for democracy. Other indicators that can be used for democracy can be Civil Liberties, Freedom House Political Rights Index and Polity measure. The EKC hypothesis was restudied by (Al-Mulali et al., 2015) to analyze the influence of trade openness and democracy on environmental quality. The method of quantile regression was used. Cross-section data over the time period of 1985-2005 were used in the study. The demographic structure of different countries is likely to impact their pollution levels. Population size, trade openness and industrial share in GDP of the country were the variables used to study different demographic structures in this research.

The ratio of total imports per year plus total exports per year to GDP is called Trade openness. The total population of a country is the size of its population. The influence of democracy on CO<sub>2</sub> emissions varied over quantiles. Emissions were found to be lower for the economies where there was a high level of democracy. Emissions were not reduced through greater financial openness. Environmental pollution was found to be affected by political institutions in different ways taking into consideration the current pollution level of each country.

During its early stages, economic development does not ensure income equality distribution. However, the EKC hypothesis is affected by the continuous process of income inequality. (Policardo, 2015) analyzed the nature of association among political powers, economic development, income inequality, and environmental degradation. This study also took into consideration the consumers that are involved in buying environmental goods. The study categorized these individuals into two groups based on different pollution exposure levels. The most exposed group was expected to be decisive voters. The study concluded that democratization positively influences the environment if the income difference among both decisive actors turns out to be quite high.

It has been argued by various researchers that this inequality negatively affects environmental quality, which overcomes the impact of democracy on environmental quality. (You, Zhu, Yu, & Peng, 2015) examined the way a democratic institution potentially affects environmental quality. The data were collected for 122 economies for the time period 1960-2008. The study incorporated two environmental quality indicators. However, the study found that a democratic institution generated an opposite impact on environmental quality. These findings were found due to the negative impact on indirect investment and income inequality and positive impact on environmental quality. The study employed one-step and two-step GMM techniques for model estimation.

The effects of democracy are discussed as follows. An individual democracy factor can influence the analysis outcome. The study examined the impact of a few control variables and democracy effects on environmental pollution through reviewing the literature. (Sugiawan & Managi, 2016) were suspicious about the traditional association between economic growth and environmental quality. For this purpose, they employed data for the years 1986-1999 and included governance control, population density, per capita income, vulnerability, and pollution to create economic activities as the control variables. The governance and geographic vulnerability in the cities of developing economies were found to have some influence on the levels of air pollution.

It has been argued by (Fredriksson & Neumayer, 2013) that the environmental quality in a country is affected by its political history. The capital stock of democracy influences environmental quality more than the current democratic political institutions. The stock comprises the historical accumulation of social and civic rights. Institutions, Climate Laws and Measures Index (CLIMI) have been used as the dependent variables. According to (Mukherjee & Chakraborty, 2013), a crucial role is played by economic growth in the relationship between democracy and the environment. An important role is played by voter preferences, political will and relative strength in the development of the EKC. The EKC hypothesis has been explained from different perspectives by previous research studies. Environmental quality is influenced by the stock of democratic capital, individual democracy and the different elements of democracy.

## 2.2 Market Freedom and CO<sub>2</sub> Emissions

Economic freedom is an essential component to achieving optimal or effective resource utilization. A number of economic freedom variables play an important role in achieving economic growth and, as a result, affect the level of CO<sub>2</sub> emissions. To study the potential effects of CO<sub>2</sub> emissions, three hypotheses were proposed. The first proposed hypothesis considers the efficiency effect, assuming that economic freedom results in efficient and competitive markets. However, a negative association may also exist between economic freedom and CO<sub>2</sub> emissions (Mironiuc & Hui-an, 2017). Optimal resource utilization is achieved as a result of liberalization. However, economic policies in the form of taxation for negative externalities can influence the price of resources. Under an efficient market, the consumer demand and political regulations can be handled easily. Firms present innovative products for their survival under competitive markets. Such influence is important when consumers demand environmental regulations or cleaner manufacturing. (You et al., 2015) have argued that the nature of CO<sub>2</sub> emissions prevents them from occurring as a result of resource efficiency CO<sub>2</sub>. However, emissions can be reduced as a result of the direct association between energy consumption and cost minimization.

The second hypothesis is related to the Trade Regulation Effect. Economic freedom is reduced because of the restriction on trade or high taxes. Because of the pressure associated with international competition, the effective allocation of resources could be the result of trade liberalization. A so-called effect of 'Pollution Haven' can exist (Dalby, 2015). Economies driven by production, which is capital intensive and involves a limited environmental regulation structure, are expected to specialize in industries with dirty activities that generate more emissions. Increased specialization is the result of trade. Some countries work to reduce their emissions while some strive to increase. However, global pollution remains constant. Trade liberalization results in two effects: the pollution haven effect and the efficiency effect. The long-term impact of these is not clear. It is expected that CO<sub>2</sub> emissions will decrease with the increase in efficiency. The structure of a country demonstrates whether the pollution haven effect is negatively or positively related to emissions.

The third hypothesis is related to the stability effect. Better decisions related to consumption and investment can be made when price stability is high. Long investment horizons are supported through a stable macroeconomic environment. Several investments related to the environment are made with the certainty that the economy will remain stable unless profits are retained. The level of emissions can be reduced when the macroeconomic environment is stable. The structure of property rights is a crucial factor in the stability effect. In the literature, there has been a great emphasis on the importance of the viability of contracts and security of property rights (Andersson, 2018). Long-term investments to improve efficiency can be made when there are secure property rights. Increased levels of consumption and investment can be the result of secure property rights. It is less likely that investments will be related to the decrease in CO<sub>2</sub> emissions because of public good character. Investment changes related to energy consumption can affect emissions.

### 2.3 Financial development and CO<sub>2</sub> emissions

The relationship between CO<sub>2</sub> emissions and financial development has been subject to new empirical studies for different economies. The influence of income, trade and financial development was studied by a researcher with reference to the economy of India. A positive relationship between CO<sub>2</sub> emissions and financial development was revealed through empirical findings. The Granger causality test validates the one-way association between financial development and relentless growth (Liu et al., 2018). The long-term relationships among economic growth, financial openness, energy consumption and trade openness were examined by another research study that focused on Turkey. In this case, CO<sub>2</sub> emissions are reduced when per capital threshold level was attained.

There is no association between emissions of CO<sub>2</sub> dioxide and financial development in the long term. Through the use of the cointegration method, Granger causality test, ARDL and panel data, it was found that the relationship between emissions of CO<sub>2</sub> and financial development was contradictory (Saboori, Sulaiman, & Mohd, 2016). This reflects the trends captured by a current literature review on the relationship between CO<sub>2</sub> emissions and financial development. The influence of financial development on CO<sub>2</sub> emissions and consumption of energy was examined by empirical studies from the aspect of a developing country, i.e., ASEAN.

The influence of financial development on the consumption of energy was examined by a study for almost 22 emerging economies. The level of energy in the emerging countries was increased by the financial sector growth. Another study exploring the emissions of CO<sub>2</sub> and financial development for ASEAN, Russia, Brazil and South Africa found that environmental quality was affected by the important factor of financial development. Domestic credit awarded to the private sector and FDI were used as proxy variables for advanced financial development, as had also been done in previous research studies. The traditional theory related to financial development is not based on the concept of Foreign Direct Investment. The influence of financial development on environmental quality has been examined through several studies. The results are mixed. The effectiveness of energy and the level of productivity are improved through FDI; this results in the reduction of CO<sub>2</sub> emissions (Omri, Daly, Rault, & Chaibi, 2015).

The relationships among CO<sub>2</sub> emissions, economic growth and health expenditures were examined for the years 1995-2013. The results of the study revealed that a bidirectional association exists among economic growth, health expenditures and emissions of CO<sub>2</sub>. This relationship was found to exist for all countries other than the group of low-income countries. It was concluded by the research article that when the EKC exists and impacts buyer demand, the income level threshold is not attained. The relationship with the consumption of electricity is positively associated with CO<sub>2</sub> emissions, while imports and exports are negatively associated with CO<sub>2</sub> emissions. The relationship between the use of energy and CO<sub>2</sub> emissions was examined by (Wang & Feng, 2017) along with the impact factors related to the emissions of CO<sub>2</sub> related to energy use for the years of 1995–2011. It was indicated by the outcomes of this research study that economic level, urbanization and industry proportion were the key drivers behind the emissions of CO<sub>2</sub>. The interregional differences in ASEAN countries were evaluated by (Abula & Adebayo, 2016), based on the emissions of CO<sub>2</sub> from coal, which influenced economic growth. The findings of this research demonstrated that interregional economies and emissions vary because of government policy. The influence of population growth, energy consumption and income were analyzed on emissions of CO<sub>2</sub>. The results reflected that the use of energy and income are linked with in-

creases in CO<sub>2</sub> emissions for four selected countries. A significant relationship was found to exist between population growth and CO<sub>2</sub> emissions for Brazil and India. The relationship was found to be insignificant for Indonesia and ASEAN countries.

### 3. Measurements

The data for the study were taken from the World Development Indicators. The data for the CO<sub>2</sub> emissions were obtained from the Environmental Sciences Division, Carbon Dioxide Information Analysis, and Oak Ridge National Laboratory. The CO<sub>2</sub> dioxide emissions are usually measured in metric tons per capita. CO<sub>2</sub> dioxide emissions occur due to cement manufacturing and fossil fuel consumption. CO<sub>2</sub> emissions can also emit in the form of CO<sub>2</sub> emissions from the liquid fuels, solid and gas fuels, and flaring of gas. Using purchasing power parity, the data for the GDP is converted to the international price of the dollar.

The data for economic freedom were obtained from "Economic Freedom of the World: Annual Report." The main constituents of the economic freedom index are property protection, personal choice, and freedom of exchange. The economic freedom index has been categorized into seven classes. Every index is estimated on the scale of 0-10, where 0 indicates the lowest and 10 indicates the highest level. Section 2 involves the categories and the proposed hypothesis. Furthermore, the economic structure and market use categories comprise the efficiency effect. This category estimates the production and allocation share of the government. Trade regulation is represented by the category of international exchange including the freedom to trade among foreigners. The legal structure, monetary policy, and price stability explain the stability effect. Where the category of price stability and monetary policy determines the money protection in the form of stored value. Property rights and legal structure together with the contract viability determines the property right security. Since 1970, after a period of years, the data for economic freedom has been announced. However, this report does not include data for all countries.

Political freedom measures depend on the indices of political and civil freedom (Fiedlschuster, 2018 & Haseeb, Hussein, Kot, Androniceanu, & Jermstittiparsert, 2019). The political freedom index determines whether the government will come through a democratic or nondemocratic regime. Furthermore, the political freedom index also includes the analysis regarding op-

position existence and free and fair elections. The civil freedom index involves individual rights for establishing organizations, freedom of expression and press or media freedom restrictions. This index also includes political parties and pressure groups. The average value is used to denote political freedom due to the high association among the two indices. These range from 1-7, where 1 denotes the lowest and 7 denotes the highest.

### 4. Methodology

The Johansen cointegration technique has been used for analyzing the long-term association. (Johansen & Juselius, 1990) developed this method and revolutionized the short-term and long-term relationship estimations for the multivariate equation. It is better than (Engle & Granger, 1987) method, as it calculates the cointegrating vectors as well as all the cointegrating vectors for the variables in order to check for cointegration. This approach also takes all the involved variables as latent endogenous variables, thus avoiding the problem of exogeneity. Moreover, this approach is capable of determining the causal relationships among a set of involved variables. Last, the Johansen and Juselius approach employs the highest eigenvalue, tracking down statistics to determine the cointegrating associations with the coefficients' expected sign. However, the Engle and Granger method performs the stationary test of the error term to check for the cointegration.

The Johansen cointegration approach has the ability to expand a single equation for an error correction model to a multivariate equation. Suppose that the CO<sub>2</sub> emission is represented by  $Z_t$ , political freedom by  $W_t$ , economic freedom by  $X_t$ , and GDP growth by  $Y_t$ , which takes the form of

$$Z_t = [Y_t, X_t, W_t] \quad (1)$$

The AR model of equation can be

$$Z_t = A_1 Z_{t-1} + A_2 Z_{t-2} \dots A_k Z_{t-k} + \varepsilon_t \quad (2)$$

Equation (2) may be altered to VECM as given in equation (3)

$$\Delta Z_t = \alpha_1 \Delta Z_{t-1} + \alpha_2 \Delta Z_{t-2} \dots \alpha_{k-1} \Delta Z_{t-k-1} + \sigma Z_{t-k} + \varepsilon_t$$

$$(3) \text{ where } \alpha = [I - A_1 - A_2 - \dots - A_k], i=1,2,3,\dots,k-1 \text{ and } \sigma = -(I - A_1 - A_2 - \dots - A_k)$$

**Table 2.** Correlation

		1	2	3	4	5	6	7
CO <sub>2</sub>	1	1						
TRDO	2	-0.1830	1					
MRKO	3	-0.5257	0.6483	1				
PRST	4	-0.7810	0.6188	0.8929	1			
GDPG	5	0.6456	-0.4363	0.8129	0.7579	1		
POLT	6	0.7308	-0.7847	-0.7828	-0.7674	0.6882	1	
FDVL	7	0.5408	0.5823	0.5322	0.5671	0.4325	0.4381	1

Therefore,  $\Pi$  is a 3 by 3 matrix because of three assumed variables. This can be broken up into  $\Pi = \alpha\beta$  where  $\alpha$  contains the speed of adjustment towards equilibrium. In this case,  $\beta$  is the long-term coefficient and  $\beta Z_{t-1}$  is an error correction term. For a simplistic example, the k=2 equation (3) can be written as

$$\begin{bmatrix} \Delta Y_t \\ \Delta X_t \\ \Delta W_t \end{bmatrix} = \Gamma_t \begin{bmatrix} \Delta Y_{t-1} \\ \Delta X_{t-1} \\ \Delta W_{t-1} \end{bmatrix} + \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \\ \alpha_{31} & \alpha_{32} \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} \\ \beta_{21} & \beta_{22} & \beta_{23} \\ \beta_{31} & \beta_{32} & \beta_{33} \end{bmatrix} \begin{bmatrix} \Delta Y_{t-1} \\ \Delta X_{t-1} \\ \Delta W_{t-1} \end{bmatrix} + \varepsilon_t \quad (4)$$

THE ECT equation (2) can be written as

$$\Pi_t Z_t = [\alpha_{11}\beta_{11} + \alpha_{21}\beta_{21}] [\alpha_{21}\beta_{12} + \alpha_{22}\beta_{22}] [\alpha_{31}\beta_{13} + \alpha_{32}\beta_{23}] \begin{bmatrix} Y_{t-1} \\ X_{t-1} \\ W_{t-1} \end{bmatrix} \quad (5)$$

The equation can be transformed into the following yield equation:

$$\Pi_t Z_{t-1} = \alpha_{11}(\beta_{11}Y_{t-1} + \beta_{21}X_{t-1} + \beta_{31}W_{t-1}) + \alpha_{12}(\beta_{12}Y_{t-1} + \beta_{22}X_{t-1} + \beta_{32}W_{t-1}) \quad (6)$$

According to (Enders, 2004),  $\alpha_{11}$  and  $\alpha_{12}$  are speeds of adjustment terms.

### 5. Results

The correlational analysis of the variables is shown in Table 2. The correlation value indicates that all the variables used in the current study are highly correlated. The correlations among trade openness (TRDO), market openness (MRKO), price stability (PRST), HDP growth (GDPG) and political stability (POLT) are shown in Table 2.

The Johansen cointegration test demands first and foremost that optimal lag length must be determined. The optimal lag length should be such that it is sufficiently matched with white noise. The optimal lag length for obtaining the Johansen cointegration is based on the Vector Autoregressive Model (Tvaronavičienė, 2018). Then, lag order is obtained according to the information criteria (Enders, 2004). As shown in Table 3, different information criteria suggested different optimal lags for cointegration. The Akaike Information Criterion (AIC) chose two lags while the Schwartz Information Criterion (SIC) suggested one lag. The two lags as suggested by the AIC were used. The aim is to have the best and most parsimonious results.

Cointegration is all about a long-term relationship among at least two variables that are nonstationary. The test for cointegration requires that the variables be integrated in the same order. The Johansen test uses a trace test and maximum eigenvalue test to determine the number of cointegrating equations. Table 4 presents the cointegration results.

The regression results of the models 1, 2, and 3, which explain the impact of political instability on the saving of the ASEAN countries, are explained in Table 1. The findings of the study were consistent with prior findings.

**Table 3.** Lag Length Selection Criterion

Lag	LogL	LR	FPE	AIC	SC
0	-730.929	NA	4.05e+12	46.058	46.332
1	-624.659	166.047*	5.24e+10*	41.667	43.590*
2	-585.566	46.418	5.58e+10	41.473*	45.046

**Table 4.** Johansen cointegration test

Dependent Variable: CO <sub>2</sub>	Model 1	Model 2	Model 3	Model 4
TRDO <sub>t-1</sub>	0.0217*** (0.002)		0.0089** (0.244)**	0.0213*** (0.010)
MRKO <sub>t-1</sub>	0.0198** (0.022)		0.0170 (0.149)	0.0328** (0.020)
PRST <sub>t-1</sub>	0.0254** (0.004)		0.0243** (0.071)	0.0924** (0.010)
GDPG <sub>t-1</sub>	0.0622** (0.076)	0.0313* (0.074)	0.0284* (0.075)	0.0522*** (0.006)
POLT <sub>t-1</sub>		-0.0488** (0.094)	-0.0633** (0.098)	0.0921*** (0.000)

The results of model 1 indicated that economic freedom variables have a significant impact on CO<sub>2</sub> emission.

The results of the political freedom model indicate that where there will be political stability, CO<sub>2</sub> emissions will be low. A number of research papers have investigated the relationship between the environment and political freedom. Most of the studies found a positive relationship between these variables; however, these studies did not take into account the CO<sub>2</sub> emissions. The probability of making agreements at international conferences is directly linked with the political freedom to lower the level of global pollutants. This study proves that the implementation of such agreements has only started recently and a significant impact of political freedom on

emissions cannot yet be concluded with the data that are currently available. Financial development appeared to have a significant relationship with CO<sub>2</sub> emission.

## 6. Conclusion

In an efficient market, consumer demands and political regulations can be handled appropriately. Firms present innovative products for their survival under competitive markets. Such influence is important when consumers demand environmental regulations or cleaner manufacturing. Because of the ability of countries and individuals' to free ride, the CO<sub>2</sub> emissions reductions do not necessarily happen as a result of resource efficiency but because of the nature of CO<sub>2</sub> emissions. Nevertheless,

emissions can be reduced as a result of CO<sub>2</sub> dioxide's direct association with energy consumption and cost minimization. The demand for a country's environmental quality plays a crucial role under political and civil systems. (Hart et al., 2018) have observed and discussed the positive association among CO<sub>2</sub> emissions and environmental quality.

According to the researchers, the reason for the positive association among these is the no provision of public goods, including environmental quality, in a nondemocratic country in contrast to democratic economies. The role of social groups that are interested in the environment is promoted by a system having representative legislature. Through the provision of subsidies for industries, CO<sub>2</sub> emissions can increase with political freedom, in case the effect is biased because of unfriendly environmental solutions. When there is an environmental issue of CO<sub>2</sub> emissions across the globe, the impact of political freedom on the environment can be insignificant, as any country have the option to free ride. There can be an association among the emission of global pollutants with other problems that are linked with the environment. Political freedom can thus influence environmental quality in this way (Fankhauser et al., 2015). Due to the risks of instability across the globe, a country's preferences for global quality of the environment can become high. For instance, an indication of these preferences can be the increase in the number of climate conferences. This study uses the Johansen cointegration test to prove that political freedom and economic freedom are key determinants of CO<sub>2</sub> emissions in ASEAN countries.

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