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THE EFFECT OF ECONOMIC GROWTH AND TRADE OPENNESS ON ENVIRONMENTAL QUALITY: EVIDENCE FROM 10 ASEAN MEMBER COUNTRIES

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Abstract
Global warming and climate change are forms of decreasing environmental quality. The main cause of global warming is the emission of carbon dioxide (CO2). Carbon dioxide emissions will increase along with increasing industrial growth. Increased industrial growth as a form of increasing economic growth. This is explained in Kuznets theory which states that there is a relationship between economic growth and environmental quality. Therefore, empirical studies are needed to analyze the effect of economic growth and openness on environmental quality.
This study uses a quantitative method with panel data regression estimates in 10 ASEAN member countries during the 2010-2020 period. The variables used are carbon dioxide emissions as the dependent variable and population, economic growth, economic openness as seen from the trade balance and foreign investment. Stages of panel data to choose the best model required several tests, namely the Chow test, Housman test and LM test.
This study uses GDP as a proxy for economic growth, the result is a significant negative effect and this is in accordance with the existing theory. Then, the proxy of trade openness in this study uses export, import and FDI variables. The results show that exports and FDI have a positive and significant effect on CO2 emissions, while imports have no effect. Furthermore, this study also uses population variables as a control variables and the results have no affect to environmental quality. The results of this study provide that the variables used contribute to CO2 emissions in 10 ASEAN member countries.

Keywords: CO2 emissions, Economic growth, Environmental Quality, Trade Openness
JEL Classification: (please fill the JEL Classification based on keywords that you have chosen)

Introduction

Global warming and climate change are forms of decreasing environmental quality. Changes in environmental quality have become a global issue in the last few decades. According to Ghosh (2010), the main cause of global warming is the result of carbon dioxide (CO2) emissions. This is resulted from rapid economic growth thereby increasing industrial growth which has an impact on air pollution and affects the decline in environmental quality (Candra, 2018).

CO2 gas contributes greatly to global warming, which is about 56%, while NH4 gas and N2O gas only contribute about 18% and 6%, respectively. The high CO2 gas in the atmosphere is the effect of greenhouse gases which then results in global warming. Greenhouse gases have a Global Warming Potential (GWP) whose measurement is relatively between CO2 gas and a value of 1. The large GWP value indicates that it is increasingly destructive (Sugiyono, 1997).

Based on the Intergovernmental Panel on Climate Change (IPCC) explained that Southeast Asia is expected to experience serious climate change because most of its economic growth still relies on natural resources and the agricultural sector. This is similar to what was stated by Kolstad and Krautkraemer (1993) that economic growth can cause negative impacts on the environment in the long term. This is further clarified by Kuznet's theory which explains that there is a positive

relationship between economic growth and environmental quality (Panayotou, 2003). Therefore, according to Todaro et al (2009) that the development process does not only focus on the development of the economic sector but also the need for the development of environmental quality.

In addition, rapid population growth will lead to increased demand for food, energy, water, and other resources, which in turn can lead to pressure and excessive exploitation of the environment. Bran et al (2009) explain that the relationship will become more complex given the dependence of the population on natural resources. This condition will of course have the potential to worsen environmental damage and even have the potential to cause natural disasters. At the beginning of the 20th century, the world population fluctuated by about 6 billion. 80% of them are population from developing countries and the majority are from ASEAN member countries. In the region of ASEAN member countries, Indonesia has the largest population (Nazeer and Furuoka, 2017).

The hypothesis built in this study is that there is a significant effect between economic growth, economic openness, population, and energy consumption on carbon dioxide (CO2) emissions in 10 ASEAN countries. There are very few studies related to economic activity and environmental quality. Whereas the relationship between economic growth is very closely related to environmental quality which is explained through Kuznets theory. In theory, Kuznets (1955) explains that the damaged environment occurs in developing countries, most of which are countries with low per capita income. This happens because industrialization growth is still in its early phase, which is still focused on economic development and employment. Meanwhile, environmental issues have not received special attention. Thus, there is a positive correlation on economic growth with changes in environmental quality in this phase. However, when the economic goals have been achieved in the sense that per capita income has increased, the level of awareness of environmental quality begins to develop. This is shown in the environmental curve of kuznets (see Figure 1), which becomes more sloping at a certain income level. In this phase, people are willing to sacrifice their consumption of goods for the sake of a protected environment (Spilker et al, 2017).

Ehrlich and Holdren (1972) in their theory of (Impacts of Population, Affluence and Technology (IPAT) explain that income and population are the main factors that can affect the environment. Then it will decrease along with the development of technology. In research conducted by George Halkos (2011) using panel data explains that there is an influence between economic development and the level of pollution (CO2 emissions). According to him, this problem can be overcome by a policy. Ikefuji and Horii (2014) explain that if in an expanded economy only the scale of production can be achieved. increasing pollution and bad environmental impacts. There are three negative impacts, namely local and global pollution and environmental degradation. In addition, those related to economic openness are found in Jugurnath and Emrith (2016) research which says that foreign direct investment (FDI), population, dummy crisis and technology positive and significant impact on environmental degradation. Meanwhile, FDI and trade have a significant negative effect on environmental degradation.

This research introduces the idea that high economic growth, international trade activities, population levels and energy consumption will result in an increase in the value of carbon dioxide emissions which have an impact on global warming and a decrease in environmental quality. Therefore, this study is relevant to be carried out whose purpose is to analyze how the influence of economic growth and openness on CO2 emissions.

Research Method

This study uses a quantitative method approach that aims to analyze the changes of environmental quality caused by economic growth and trade openness. The data used is secondary data in 2010-2020 in 10 ASEAN member countries (Indonesia, Thailand, Myanmar, Vietnam, Malaysia, Myanmar, Singapore, Cambodia, Laos, Philippines) obtained from World Bank data sources. The variables that will be used in this empirical study are:

Table 1
Variable Identity

Variable	Definition
CO2 emissions	CO2 emissions (metric tons per capita)
Economic growth	Total GDP per capita (constant) in millions of US dollars
Population	Total population in 10 ASEAN countries
Trade openness	Total exports and imports of goods and services in 10 ASEAN countries
Foreign direct investment	Net foreign investment rate

The data analysis method used is quantitative analysis using panel data regression. The use of panel data regression is to find out how the differences between individuals or in this case are in each ASEAN member country. Panel data can also be used to avoid the limited number of observations, because the large number of observations will increase the degree of freedom. In addition, this estimation can reduce the existence of collinearity between independent variables. The general equation for panel data is as follows:

$$Y_{it} = \beta_{it} + \beta_{it}X_{it} + \varepsilon_{it} \quad \text{..... (1)}$$

In this equation, *Y* is the dependent variable, β is the regression parameter, *X* is the independent variable and ε is the stochastic disturbance variable. While *i* and *t* show the observation and time.
In this study, the model used as an approach to analyze the relationship between economic growth and trade openness with CO2 emissions is as follows:

$$CO2_{it} = a_{it} + \beta_1 Growth_{it} + \beta_2 POP_{it} + \beta_3 NP_{it} + \beta_4 FDI_{it} + \varepsilon_{it} \quad \text{..... (2)}$$

Where CO2 is the CO2 emissions or carbon dioxide produced, Growth is economic growth, *Pop* is the total population, *NP* is the trade balance, *FDI* is foreign investment. The trade balance and FDI are indicators used as an indicator of the openness of the economy. Meanwhile, ε_{it} it is the coefficient of confounding.

The estimation of this research panel data uses several stages of testing, namely the selection of the best model and the classical assumption test. In selecting the best model, there are three stages of testing, namely conducting the *Chow test, Hausman test*, and *LM test.* The three models that will be regressed are the *common effect, fixed effect* and *random effect models*. Furthermore, in the classical assumption test, it is necessary to carry out three stages of testing namely heteroscedasticity test, autocorrelation test and multicollinearity test. The three tests must be met so that the data used can be tested for validity.

Result and Discussion

This study uses a quantitative method approach that aims to analyze the environmental kuznets curve hypothesis and analyze changes in environmental quality caused by economic growth and openness. The data used is secondary data in 2010-2019 in 10 ASEAN member countries (Indonesia, Thailand, Myanmar, Vietnam, Malaysia, Myanmar, Singapore, Cambodia, Laos, Philippines) obtained from World Bank data sources. The data used starting from 2010 aims to see the relationship between growth and economic openness to environmental quality in the last 10 years.

After collecting the data, then the data analysis was carried out using the panel data regression method. In panel data regression, the determination of the best model used in this study is the fixed effect model based on the best model selection test using the *Chow test* and *Hausman test*. Chow test is used to determine the best model between the *Common Effect Model* (CEM) and *Fixed Effect Model* (FEM). While the Hausman test is used to determine the best model between the *Fixed Effect Model* and the *Random Effect Model* (REM) by considering the probability of cross-section value (Susanti and Nidar, 2016).

In panel data, the classical assumption test is optional. Some researchers ignore classical assumptions. According to Gujarati (2012) that panel data has complexity regarding the behavior that is in the model so that panel data does not require classical assumption tests. Thus, the superiority of panel data regression implies that there is no need for classical assumption testing (Verbeek, 2000 and Gujarati, 2012). The following table 1 is the result of testing panel data consisting of the c*ommon effect mdel, fixed effect* and *random effect model*.

Table 1
Panel Data Model Estimation Results

Variable	Probabilitas		
	Common Effect	**Fixed Effect**	**Random Effect**
C	0.0156	-1.995007	-2.670087
LGDP	0.0000	-0.386154	-0.341169
LPOP	0.0020	0.113513	0.061382
LEXPORT	0.4886	0.371680	0.394691
LIMPORT	0.5079	0.050738	0.044890
FDI	0.0072	1.21E-12	2.61E-12
R-squared	0.300920	0.962263	0.138494
Adjusted R-squared	0.267310	0.956702	0.097076
F-statistic	8.953394	173.0319	3.343777
Prob(F-statistic)	0.000000	0.000000	0.007680

Source: Data processed with eviews, 2021

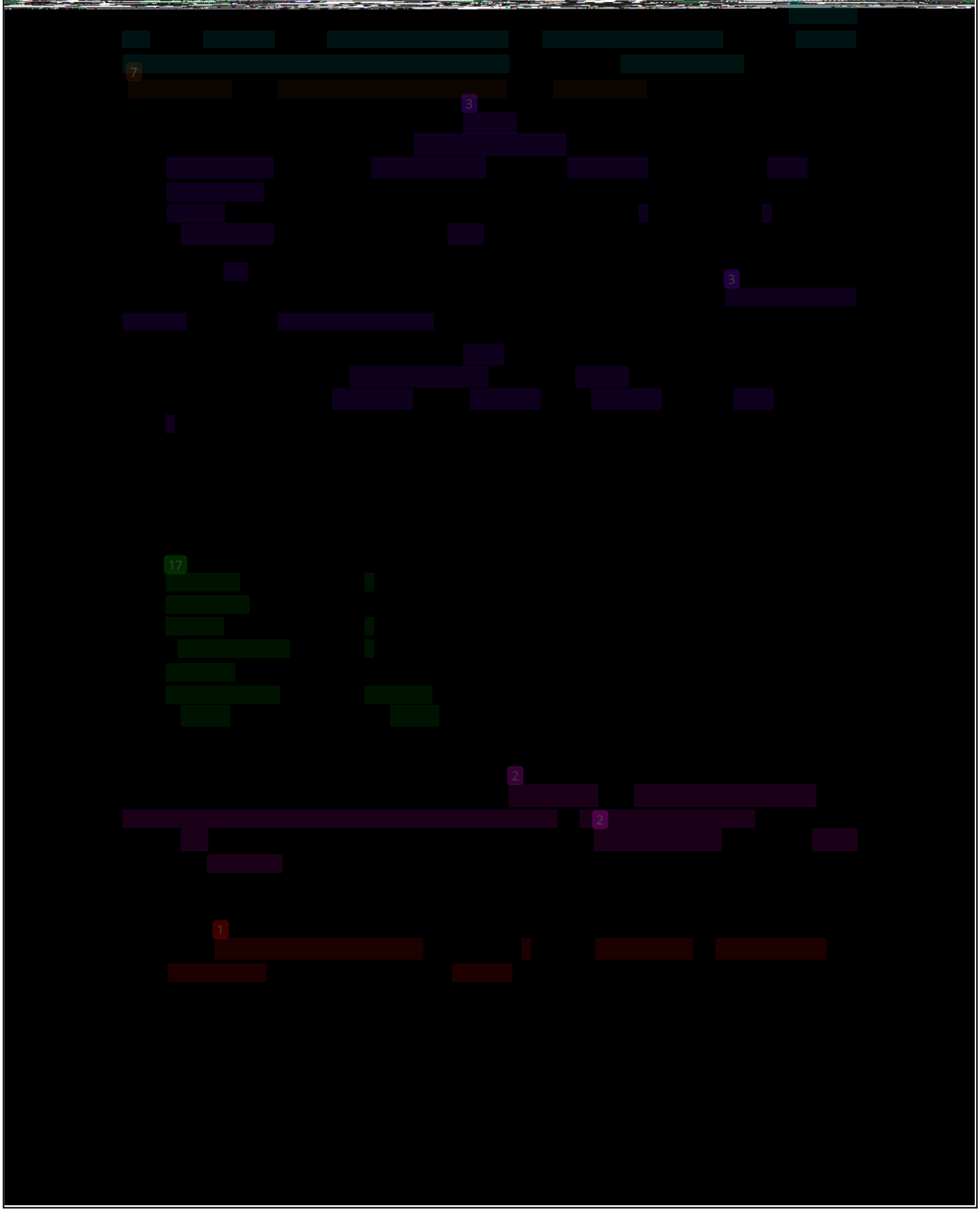
Based on the estimation results, then the best model is selected. The results of the chow test are as follows:

Table 2
Chow Test Result

Effects Test	Statistic	d.f.	Prob.
Cross-section F	169.659308	(9,95)	0.0000

Source: Data processed with eviews, 2021

Table 2 shows that the probability value of the cross section F < (0.05) which means that the Fixed Effect Model (FEM) is the best model compared to the Common Effect Model (CEM) in



environmental quality variable in 10 ASEAN member countries by 96.22%, then the remaining 3.78% can be explained by the variable others outside the research variables.
Based on the results of panel data regression using the *fixed effect model*, the following equation can be obtained:

$$CO2_{it} = -1.995007 - 0.386\ LGDP_{it} + 0.113\ LPOP_{it} + 0.371\ \text{LEXPORT}_{it} + 0.050\ \text{LIMPORT}_{it} + 1.210\ FDI_{it} + u_{it} \quad \text{.....(3)}$$

From the equation, it can be seen that the constant coefficient is -1.995007, meaning that there are other systematic variables that also affect the quality of the environment in 10 ASEAN member countries but are not included in the study. Furthermore, LGDP has a coefficient of -0.386 which indicates that if economic growth increases by 1 percent, it will reduce CO2 by 0.386 percent in the 10 ASEAN member countries. The results of the panel data output show that the probability value of LGDP is 0.0004, which means it is smaller than the alpha value of 0.05, so it can be concluded that LGDP has a negative and significant effect on CO2 emissions.

The next variable is LPOP where LPOP has a coefficient of 0.113 which indicates that if there is a 1 percent increase in the population, it will increase CO2 by 0.113 percent. However, the estimation result of LPOP has a probability value of 0.6192, which means it is greater than the alpha value of 0.05, so it is concluded that LPOP has a positive and insignificant effect on CO2 emissions in 10 ASEAN member countries. This also occurs in the LIMPORT variable which has a coefficient value of 0.050 with a probability value of 0.2170, which means that LIMPORT has a positive and insignificant effect on CO2.

Furthermore, the LEXPORT variable has a coefficient value of 0.371, which means that if there is an increase in exports of 1 percent, it will increase CO2 emissions by 0.371 percent. This is further supported by the probability value of 0.0000 (alpha value <0.05), which means that LEXPORT has a positive and significant effect on CO2 in 10 ASEAN member countries. Furthermore, the FDI variable has a coefficient value of 1,210 and a probability of 0.056 which indicates that FDI has a positive and significant effect on CO2 and if there is an increase in FDI of 1 percent, it will increase CO2 emissions by 1,210 percent.

Based on the estimation results of the fixed effect model, it can be seen together that the LGDP, LPOP, LEXPORT, LIMPORT and FDI variables have a significant effect on CO2 emissions in 10 ASEAN member countries. However, partially not all of the independent variables affect CO2 emissions in the 10 ASEAN member countries.

LGDP or in this case economic growth has a negative and significant impact on CO2 emissions in the 10 ASEAN member countries. This shows that when economic growth increases in a country, it will reduce the level of existing CO2 emissions. This means that when CO2 emissions decrease, the quality of the environment in that country increases. This is in accordance with the Environmental Kuznets Curve (EKC) theory which explains that the higher the economic growth of a country, the lower the level of environmental damage in the long term. An example is Indonesia, as one of the ASEAN member countries where Indonesia has a program as its determination to control greenhouse gases as stated in the NDC document in Law no. 16 of 2016. In its target, Indonesia has a target of reducing gas emissions by 29% on its own and then by 41% with international assistance. That means that the higher the level of economic growth of a country, the higher the level of awareness in each country of its concern for the environment, especially CO2 emissions. This study is in line with that conducted by Arouri et al. (2014), Ali et al. (2015), Ibrahim (2016) and Nikensari et al (2019).

Meanwhile, the population in this study had a positive and insignificant effect. That means that as the population increases, it will not affect CO2 emissions. Population growth causes energy

demand which will increase CO2 gas emissions (Li and Liu, 2014). According to Mahmood and Chaudhary (2012) that population density has a positive impact on CO2 emissions. However, in this study population growth had no significant effect. This shows that although the high population can increase the demand for fuel energy as a form of industrial generation, electric power, and transportation, the population is responsible for the environmental degradation that occurs. For example, in the industrial structure, along with the development of the times, the population switched to using heavy equipment towards service-based industries and the use of advanced technology that could lead to a reduction in CO2 emissions (Banerjee and Rahman, 2012). In addition, the population living in urban areas has a higher level of awareness of the importance of maintaining environmental quality. Therefore, currently there is control of energy consumption, especially in the transportation sector which can reduce the level of CO2 emissions (Chandran and Tang, 2013). This is different from research conducted by Zhao et al (2013) that population density has a negative effect on carbon dioxide gas. Similarly, research conducted by Ong and Sek (2013) that residents in low- and middle-income countries have a negative influence on CO2 emissions.

Furthermore, the export growth rate has a positive and significant impact on CO2 emissions in the 10 ASEAN member countries. This shows that the higher the level of international trade activity, the higher the CO2 emissions produced. The increasing demand for exports means an increase in the productivity of a country which of course requires more energy consumption. Not only energy, but the need for natural resources has also become more intensive so as to produce residues and waste that have an impact on environmental degradation (Hossain and Rao, 2014). According to Ong and Sek (2013) that human activities and industrialization will increase CO2 emissions that affect global warming. This is different from import activities where in this study it was found that imports had no effect on CO2 emissions. This is because import activities do not require high productivity which produces a lot of waste. Import activities are more prone to impact on environmental pollution caused by the sea transportation sector. Almost 95% of goods transportation for export and import purposes uses sea transportation (Bappenas, 2014). However, member countries of the International Maritime Organization (IMO) have agreed on a strategy to reduce greenhouse gases in shipping. This will tackle and reduce pollution in maritime waters.

There are various factors in this study which are estimated to cause an increase in CO2 emissions. Next is foreign direct investment (FDI) or foreign investment. The estimation results show that FDI has a positive and significant effect on CO2 emissions in 10 ASEAN member countries. That means, the increase in FDI will reduce the quality of the environment. These results are in accordance with the research conducted by Shahbaz et al. (2015) that high levels of FDI will cause more energy consumption to be used by a country, especially in the industrial sector where energy consumption can worsen environmental quality.

Conclusion

This study aims to analyze the effect of economic growth and trade openness on the quality of the environment in ASEAN member countries. This study uses GDP as a proxy for economic growth, the result is a significant negative effect and this is in accordance with the existing theory. Then, the proxy of trade openness in this study uses export, import and FDI variables. The results show that exports and FDI have a positive and significant effect on CO2 emissions, while imports have no effect. Furthermore, this study also uses population variables as a control variables and the results have no affect to environmental quality. The results of this study provide that the variables used contribute to CO2 emissions in 10 ASEAN member countries.

To improve the quality of the environment, the government in each country is advised to take advantage of its economic growth as an effort to improve environmental quality. For example,

by providing an allocation of funds to conduct research on technologies that can reduce CO2 emissions or improve environmental quality and provide special policies for the use of environmentally friendly products. The government is also advised to control export and import trade activities to provide solutions to the environmental quality problems faced. So that export activities can run optimally but still maintain environmental quality.

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