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DO FOREIGN INVESTMENTS AND RENEWABLE ENERGY CONSUMPTION AFFECT THE AIR QUALITY? CASE STUDY OF ASEAN COUNTRIES

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Abstract. Decent quality of air plays an important role to support all creature's life. This study examined the impact of foreign investment and the consumption of renewable energy supplies on the air quality in eight ASEAN countries over the period from 2005-2014. This research is a quantitative research that applies panel regression model. The selected random effect model shows, foreign investments affect the quality of air significantly as more investments will lead to more economic activities, thus increasing the consumptions of energy and the level of Carbon Dioxide (CO2) emissions. Further, the use of renewable energy will reduce CO2 emissions. The governments have to support the development of renewable energies and put smart policies to facilitate their development in the economy.

Keywords: air quality; foreign investment; renewable energy consumption

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1. Introduction

Decent air quality plays a vital role in the survival of many creatures and is the right of every citizen to be able to feel it. However, air pollution is among the world's most environmentally-related health risks of our time, killing about 6.5 million people worldwide each year (United Nations Environment, 2019). There have been many efforts aimed to socialize and reduce the impacts of air pollution, including The United Nations Environment Program which focuses on improving air quality to protect human health through many campaigns. The Global Initiative, led by the United Nations Environment Program, the World Health Organization and the Climate and Clean Air Coalition, aims to mobilize cities and individuals to protect our health and planet from the effects of air pollution. However, these efforts are not effective yet to reduce air contamination and improve air quality. It is evidenced by the increasing trend of Carbon Dioxide (CO2) Emission for the last 50 years, see figure 1.

During the process of economic development, the government has a huge need for funds to finance economic development projects. Depending on the state income originating from taxes, non-tax revenues, and grants will not be sufficient. While relying on the debt will have a long-term impact on the country, since the government is obliged to pay the loan interest and its principal at maturity. One of the alternatives is to attract foreign investment. Foreign investment is considered to develop new economic activities, create jobs, reduce unemployment and improve people's welfare. The inflow of foreign capital is considered as an opportunity for local industries

to grow and expand their business scope or improve product quality and quantity. Foreign investments help technological transfers from foreign companies, without exploiting and giving certain pressure on local companies (Madura, 2010). Ideal Foreign investment encourages more investment activities and ensures economic growth (Alfaro et al., 2004; Alguacil et al., 2011; Nor et al., 2015; Pengkas, 2015; Tvaronavičienė, 2019). However, more economic activities increase the needs of energy in addition to raw materials for production (Zamil et al., 2019; Lavrinenko et al., 2019; Vigliarolo, 2020; Chehabeddine, Tvaronavičienė, 2020). Concerning to the relationship of foreign investment of environment quality, there are several hypotheses that postulate the nexus of economic activities and environmental conditions including the Pollution Haven Hypothesis (PHH) and the Environmental Kuznets Curve (EKC). Both hypotheses argue that as higher economic activities will lead to higher pollution rate and degrade the environment conditions.

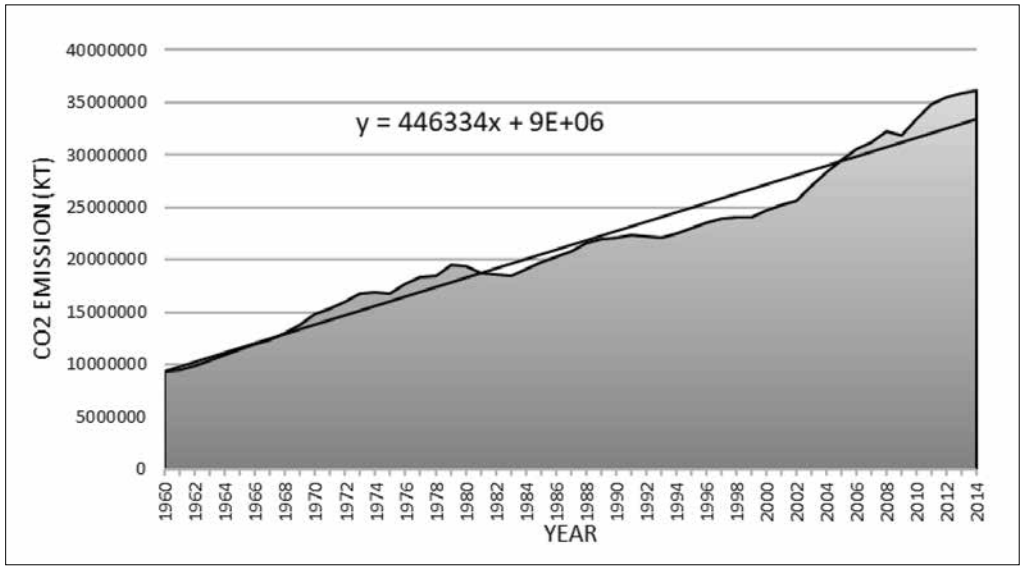

Figure 1. World Carbon Dioxide Emission (source: World Bank Database processed, 2019)

The Association of Southeast Asian Nations (ASEAN) is a regional intergovernmental organization comprising ten countries in Southeast Asia, which promotes intergovernmental cooperation and facilitates economic, political, security, military, educational, and sociocultural integration among its members and other countries in Asia. It is involved in numerous international affairs, and hosts diplomatic missions throughout the world. Alguacil et al. (2011) state that ASEAN region is one of the economic regions that have been enjoying for rapid economic developments for the last couple decades. These developments attract the inflow of foreign investments. In addition, the countries member of ASEAN are export-oriented countries that has a broad export destination. Pengkas (2015) argues, Industries in ASEAN countries are well-known as labour-intensive industries. Cheap labour and the abundant natural resources used as raw materials in this region were the motivations behind the inflow of many foreign direct investment. For multinational companies, cheap factors of production reduce the cost of production and become competitive advantages. The inflow of foreign investments ultimately triggered an increase in exports for many developing ASEAN countries.

This study aims to investigate the influence of foreign direct investment and the consumption of renewable energy on the CO2 emissions level. Governments and foreign investors are the parties who will take the most benefit of the study. Moreover, this study is projected to highlight the significant role of renewable energies supplies while providing guidance, insights or thoughts to assist in the establishment of policies concerning air pollution and degradation.

The remainder of this article is organized as follows. Part 2 provides a brief review of the related works of literature. Section 3 describes the data collected and the methodology. In section 4, results and analysis will be discussed while the last section brings research conclusions and provides recommendations for policy implications.

2. Literature Review

2.1. The impact of foreign investment on the CO2 emissions level

The relationship between foreign investment and its environmental impacts have been assessed in many empirical researches, especially for developing countries. The mainstream theory in this topic is what so-called The Pollution Haven Hypothesis (PHH). The theory stated that the impact of foreign investments inflow to the environment are worse in countries with looser environmental regulations and lower regulatory quality (Baek & Choi, 2015). Another mainstream theory concerning the flow of foreign investments and environmental degradation is the Environmental Kuznets Curve (EKC) Hypothesis that states the connection between economic growth and environmental degradation level. This hypothesis postulates that the environmental deprivation level rises as a country develops but fall when a certain level of income is reached. This hypothesis, which predicts that economic growth, is a solution to environmental problems in the future with no policy intervention (Abdouli & Hammammi, 2014).

The study of (Baek & Choi, 2015), using panel data of 17 Latin American countries found a negative relationship between the inflow of foreign investments and air quality. Using the full sample of income level that includes the high, middle and low level income, Foreign Direct Investment increases the level of CO2 emissions and confirmed the Pollution Haven Hypothesis. However, using a single sample of income level, the impact of FDI is shown only in the sample of countries with higher level of income. This study also confirmed the increase of CO2 emission in countries with a higher energy consumption.

A study conducted by (Neequaye & Oladi, 2015) examined the nexus between the inflow of FDI and environmental degradation and found the existence of an Environmental Kuznets Curve (EKC) for carbon dioxide and total greenhouse gas emissions derived from foreign investments in energy and industrial sectors. This result is supported by the researches of (Hitam & Borhan, 2012; Ren et al., 2014; Sbia et al., 2014) but not (Pazienza, 2015). Hitam & Borhan (2012) found the existence of an EKC and confirmed that foreign direct investment increases environmental degradation. In Addition, Ren et al. (2014) confirmed the larger inflows of foreign investments will further aggravate China's CO2 emissions level. Similarly, Sbia et al. (2014) confirmed the long run co-integration nexus between FDI and CO2 emissions level in the case of UAE as a sample country covering the period of 1975Q1–2011Q4. On the other hand, Pazienza (2015) studied how FDI inflowing the "agriculture and fishing" sector of 30 OECD countries exerts on CO2 emissions level over the period of 25 years. The findings confirmed the existence of the negative effects of FDI on CO2 emissions level. Further, using the VAR panel data model from 17 MENA countries over the period 1990–2012, Abdouli & Hammami (2017) confirmed the bidirectional causal relationship between CO2 emissions and economic growth, besides a bidirectional causality between foreign investments and CO2 emissions. As several studies found that contribute to the increased level of CO2 emission, we posit that:

Hypothesis 1: Higher foreign direct investments will provide the industry with fresh capital and new technology, thus increasing economic activity. The increased economic activities will require more energy and raw materials, thus, augmented the CO2 emissions and degrade the air quality.

2.2. The impact of renewable energies on the CO2 emissions level

The Study conducted by (Cheng et al., 2019) examined the effects of renewable energy, environmental patents, and economic growth and foreign investments on the CO2 emission per capita from 2000 to 2013 for the BRICS countries. The findings show that renewable energy supply reduces the level of CO2 emission per capita with the strongest effect while the variable of Foreign Investment effects are varied at different conditional distributions.

A study of Chen et al. (2019) examined the impact of economic growth and the consumption of renewable and non-renewable energy on the carbon dioxide emission level in China over the period of 1995 and 2012. The em-

pirical findings state that the non-renewable energy consumption was found to have a positive and significant effect on carbon dioxide emission level, although this result diverse through the three regions of China, with the greatest impact being in the central region. The more non-renewable energy used will increase CO2 emissions. Further, the study confirmed that renewable energy consumption had a negative impact on the CO2 emissions level in the eastern and western regions of China. The following result is supported by a study of Nathaniel & Iheonu (2019) that found the non-renewable energy significantly increases CO2 emissions level.

Using a Panel VAR approach of 24 MENA countries over 35 years, (Adedoyin et al., 2020) examined the impact of renewable energy consumption and financial development on carbon dioxide (CO2) emissions and economic growth. The finding shows, financial development and renewable energy consumption have a little contribution in explaining the variation on the level of CO2 emissions and economic growth.

Research by Chen et al. (2019) Found a long-run connection and co-integration among variables that include CO2 emissions, economic growth, renewable and non-renewable energy production and foreign trade in China. The study further confirmed the use of renewable energy as a solution to decrease the level of CO2 emissions since the increase of economic activity proxies by GDP and the use of non-renewable energy will increase the level of CO2 emissions, degrading the air quality in the country. The similar result is also found in (Kang et al., 2019) that confirmed the positive shock of GDP on the level of CO2 emissions.

A study of Waheed (2018) tested the long run and short run relationship between forest area, agricultural production, renewable energy, and CO2 emission. Applied ARDL model found the negative short run and the long run relationship between the forest area and the consumption of renewable energy on the CO2 emission level. The model show that forest planting act as a better solution to reduce air degradation, this comes due to the highest coefficient of variable forest area comparing to other variables under study. As several studies found that consumption of renewable energy supplies will reduce the level of CO2 emission, we posit that:

Hypothesis 2: higher consumption of renewable energy supplies will decrease the demand for non-renewable energies, thus decreasing the level of CO2 emissions and improve the air quality.

3. Research Methodology

This study is a quantitative research that applies Panel Data Regression Analysis with Random effect. The selection of Random Effect is based on the result of the Redundant Fixed Effect, Hausman, and Breusch-Pagan Random LM Tests. The application of this method is to examine the influence of determinant factors which include the foreign direct investments and the consumption of renewable energy on the CO2 Emission (kt). The study uses the sample of eight ASEAN countries comprising of Indonesia, Brunei Darussalam, Malaysia, Vietnam, Singapore, the Philippines Thailand, and Myanmar. This study uses secondary data in the form of a time series with annual frequency from 2005 to 2014. All data are derived from the World Bank. The selection of variables is based on previous literature studies. Based on the information above, the function of the model in this study is as follows where:

$$CO2\ Emissions = f\ (Foreign\ Direct\ Investment + Consumption\ of\ Renewable\ Energy + e) \quad (1)$$

4. Result and Discussion

The random effect regression model shows that, foreign direct investment has positive and significant influence on the level of CO2 Emissions. Further, the use of renewable energies play a significant role in reducing the level of CO2 Emission. The model of Panel Regression and its analysis will be discussed as follows, table 1 displays Panel Regression Result:

Table 1. Panel Regression Result (Random Effect)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_FDI	0.073707	0.028510	2.585310	0.0120
LN_RENEWABLE_ENERGY	-0.820292	0.328724	-2.495379	0.0152
C	11.74160	1.063608	11.03940	0.0000

The positive coefficient of FDI conveys the message that higher inflow of foreign direct investment in ASEAN countries will lead to increased level of CO2 emissions. In other word, empirically, this proves the first hypothesis that postulates higher foreign direct investments will provide the industry with fresh capital and new technology, thus increasing economic activity. The increased economic activities will require more energy and raw materials, thus, augmented the CO2 emissions and degrade the air quality. This result is in line with study using a full sample of different income class conducted by (Baek & Choi, 2014), that found FDI surges the level of CO2 emissions. The result is also in line with (Neequaye & Oladi, 2015) that found increased carbon dioxide and total greenhouse gas emissions levels derived from foreign investments in energy and industrial sectors. It also support the studies of Bin Hitam and Binti Borhan (2012) and Sbia et al. (2014) that confirmed the larger inflows of foreign investments will further aggravate CO2 emissions level. On the other hand, the positive and significant effect of FDI on the dependent variable opposed the research of Pazienza (2015) that found a negative nexus between the FDI and air degradation. This come due to the nature of investment that focused on "agriculture and fishing" economic sectors. Planting and agricultural production will provide the environment with more fresh oxygen and reduce the emission of CO2.

The negative coefficient of renewable energies conveys the message that higher consumption of renewable energies will lead to decreased level of CO2 emissions. In other word, empirically, this proves the second hypothesis that postulates higher consumption on renewable energy supplies will decrease the demand for non-renewable energies, thus decreasing the level CO2 emissions and improve the air quality. The model in this study give the variable of renewable energy consumption highest coefficient which gives a clue that policies to support renewable energies development is a solution to solve the degradation of air quality. This result is in line with study of Cheng et al. (2009) that confirmed the use of renewable energy supply reduce the level of CO2 emission per capita with the strongest effect among other variables under study. This is also in line with research conducted by Chen et al. (2019) that confirmed higher renewable energy consumption had a negative impact on CO2 emissions level in the eastern and western regions of China. The significant and negative effect is also found in study of Waheed et al. (2018) that found the negative short run and long run relationship between the forest area and the consumption of renewable energy on the CO2 emission level. However, in this study, planting in more forest areas is believed to be better solution than increasing the use of renewable energies. On the other hand, the significant and negative effects of renewable energy consumption to explain the variation in the dependent variable oppose the study of Charfeddine and Kahia (2019) that found renewable energy consumptions to have little contribution in explaining the variation on the level of CO2 emissions.

5. Conclusions

Foreign investment helps developed countries by providing funds and technology for economic development. However, there are higher costs that should have been put into consideration as foreign investments contribute to the degradation of the air quality. This study examined the impact of foreign investment and the consumption of renewable energy supplies on the level of air quality. The empirical results highlighted the importance of the use of renewables energies to reduce the level of CO2 emissions. In addition, the findings show that foreign investments contributed to the increased level of CO2 emissions. Therefore, to recommend, the government bodies especially the ministry of Environment and Forestry and other government bodies need to support the development of renewable energy. Reforestation and planting more trees could also be solutions to improve air quality. Further studies can focus on many other variables that could affect the level of CO2 emissions such as the number of vehicles, deforestation rate/forest area, economic activities, and numbers of industry in the economy.

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