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Towards a Quality Environment: Effect of Growth Economy, Foreign Direct Investment, Population, Goverment Effectiviness and Trade Opennes in ASEAN-7

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ABSTRACT: *Economic transformation has had a concrete impact on the environment, reflected in high carbon emissions. The consequence of increased economic activity is economic growth and increased pollution. As an ASEAN-7 developing country with an average economic growth of 4-5%, it is difficult for the country to get out of the middle income trap. According to the EKC hypothesis, environmental awareness will be achieved when income reaches a certain point, hence the demand for stricter regulations in the environmental sector. The aim of this research is to analyze economic growth, foreign direct investment, population, government effectiveness and economic openness in ASEAN-7. Empirically, this research uses annual secondary data from 7 countries in ASEAN from 2012 to 2021, and this research uses the PVECM (Panel Vector Error Correction Model) method. The results of the study found that there is a causal relationship between government effectiveness variables and economic openness variables on environmental quality. The GDP variable in the short and long term has a positive and significant influence on environmental quality, while the population, FDI, government effectiveness and economic openness variables in the long term negative effect, while in the short term it has a positive effect on environmental quality.*

KEYWORDS): *emisi carbon, growth economy, foreign direct investment, population, goverment effectiviness, trade openness, PVECM.*

HEADING

In recent decades, development has prioritized the use of natural resources and paid attention to environmental conservation by combining economic, environmental and social aspects into development aspects. This condition began to increase with the industrial revolution, technological developments and increasing investments state income (Kilinc-Ata, N, et al, 2022). The ongoing Industrial Revolution led to global warming and climate change as a result of society's extreme dependence on fossil fuels as a source of energy for the economy. This is consistent with energy consumption and increasing per capita income, which is related to economic growth, human well-being, financial development, industrialization and urbanization (Leal, P.H., et al., 2022).

Kuznet explained that severe environmental damage is likely in developing countries, which are predominantly low per capita income countries. This is because in the early stages of industrialization growth, there is a lot of focus on how fast the economy is growing and absorbing large numbers of workers, while environmental issues are not yet on the main agenda and the government has barely taken part in efforts to improve the system. In this phase, there is a positive relationship between changes in environmental quality due to many pollutants in the air and economic growth (Firdaus, 2017). Contrary to Malthus, he stated that if the environment is capable of supporting it, the environment will not be disturbed and the carrying capacity or carrying capacity of the environment will not be compromised. At the same time, the population must comply with environmental limits. So population growth must be directly proportional to natural resources, land and agricultural production, Santi et al. 2021.

Globalization is a phenomenon that can eliminate and reduce cross-border barriers and plays an important role in economic, social and political aspects. In particular, environmental quality can create financial development and promote economic trade and exchange of energy-saving technologies through foreign direct investment (Shabbaz, et al, 2018; Phong, 2019). The presence of globalization has led to increased trade liberalization, reflected in increased energy consumption and a large spread of pollution or environmental damage (Latief et al., 2018; Saud et al., 2018). Given the high degree of liberalization of trade and energy use, the government is obliged to provide opportunities for economic growth through spending

and institutional quality to improve environmental quality both directly and concretely (Le, H. P. & Ozturk I, 2020). Khan Z et al. (2020) and Wuz et al. (2021).

In addition to trade liberalization, the contribution of political institutions plays an important role in improving environmental quality and reducing carbon emissions resulting from financial development. And political institutions play an important role in determining the environmental impact of economic variables (Ali et al., 2019). Furthermore, Yasin et al. 2019; Ahmed F. et al. 2020; Khan H et al. 2022 the results of its research indicate that institutional quality is reflected in the strength of political institutions in setting crucial policies, one of which is related to environmental management and renewable energy innovation to reduce carbon emissions pollution caused by economic activities limit. Contrary to Phong Le (2020), based on research shows that the quality of governance increases carbon emission conditions. This is due to the economies of scale of government spending in developing countries, which is predominantly focused on economic activities to attract investment and trade rather than on environmental quality.

Several studies have shown that environmental damage is caused not only by increased economic growth through industrial value addition, but also by many other factors, especially in countries implementing economic openness, namely ASEAN-7 countries, including Indonesia, Malaysia, Thailand, the Philippines, Vietnam, Cambodia, Myanmar implementing openness. Business. Salvator, 1996: 424 states that trade openness is an engine of growth. This proves that in the era of globalization, economic integration is easier to achieve for different countries. In general, the development process carried out in any country is an attempt to increase the economic growth of that country.

It can be interpreted that the development of CO2 emissions in the ASEAN-7 countries fluctuates overall. Looking at the seven countries, Vietnam is the most prominent country in the last five years. This phenomenon occurs because Vietnam has an open economic policy and relies on foreign investment for exports. There is no denying that export efficiency has increased due to trade openness activities, but on the other hand, Vietnam ignores the impact on the environment. Measured by the global value chain, Vietnam is in the lowest position compared to six other countries in terms of controlling industrial development and the degree of localization of export products, the consequences of which are uncontrolled carbon emissions (Nguyen, P T, 2022).

Facts show that Vietnam's increasing economic growth is supported by the use of natural resources, which is reflected in increased energy consumption (Raihan A, 2023). Because the functional connection between natural resources and modern development cannot be avoided. As a developing country, Vietnam needs a balance between economic growth, energy security and environmental sustainability (Shahbaz M et al, 2019) The Philippines is one of the lowest CO2 emissions countries compared to other ASEAN-7 countries, where the Philippines is trying out an environmentally based innovative program, namely the Energy Transition Mechanism (MTE), as the largest program to reduce CO2 emissions. With the advent of MTE, there was an energy transition from coal-fired power plants to hydroelectric power plants (Belda J et al, 2022). So the actual result is that the percentage of carbon emissions is the lowest in the Philippines. Likewise, Indonesia and other ASEAN countries have their own ways to mitigate environmental problems.

Since the crisis, it has been under a subprime mortgage and is in a state of recovery. One way to support the economy is to implement relatively massive macroeconomic policies, maintaining financial vulnerabilities and shocks in economic channels, especially direct investment in the form of portfolios and foreign direct investment, as well as exports on the international trade side (Amanda, 2021). The continued inflow of foreign investment financing (foreign direct investment) as a form of government project approval is expected to increase. Since the impact of FDI varies greatly from country to country and from time to time, trade policies will regularly influence the role of FDI and economic growth (Kumari, R, et al., 2023).

Foreign investments made without providing environmentally friendly renewable technologies in return are tantamount to increasing environmental pollution, namely triggering environmental quality problems (Santi, R, et al, 2021). According to Demena, B. A. & Afesorgbor, S. K. (2020), a 1% increase in FDI will reduce

carbon emissions by 0.12% in developing countries, while in developed countries it will only attract FDI that contributes to the environment, i.e . h sophisticated and environmentally friendly technology.

CO2 levels go hand in hand with foreign direct investment. This reflects that high foreign direct investment is also accompanied by increasing CO2 emissions. This condition arose due to a shift in the economic structure from the agricultural sector to the industrial sector due to the promotion of foreign investment. According to Pratama. A (2022) Changes in the economic structure from agriculture to industry trigger potential environmental damage if the increase in carbon emissions (CO2) due to industrialization activities indicates an indirect relationship between economic growth and environmental quality. This increase in pollution goes hand in hand with the increase in income. An empirical study by Khan Z, et al. (2020) states that the need for policies that address the environment will significantly change the level of carbon (CO2) emissions.

LITERATUR RIVIEW

1.1.1 Neo-Maltusian Popullation Concept.

Neo-Malthusians argue that human populations tend to increase exponentially. This condition occurs when fertility is uncontrolled. If left unchecked, the natural resources will be exceeded, resulting in a catastrophe. This is one of the dominant paradigms in this field of population and environment (Sherbinin et al., 2007). Expressly, the population plays a dual role in the environment. The population explosion contributes to environmental degradation, on the other hand, the population has an impact on carbon emissions (CO2), which is reflected in the IPAC (Impact Population Influence Technology) model (Putri et al., 2022).
The point of view of Curnocopian, one of the neoclassical economists, is one of the same ideas as Neo-Malthus. The assumption is that human ingenuity can be seen from creativity and innovation in the creation of artificial resources to prevent a natural resource crisis in the future. This mindset leads to the use of technology to overcome environmental degradation. Regarding behavior when using natural resources. It can be concluded that damage to the environment and natural resources is caused by an increase in population as a result of urbanization, as well as the rate of economic growth (carrying capacity) (Simon, J, 1999)

1.1.2 Endogenous Growth Theory

Endogenous growth is a neoclassical theory by Paul M. Romer that discusses how, in the era of globalization or openness, science and technological development play an important role in promoting economic growth, assuming that technology is not only exogenous , but endogenous (Erikson, 1995). Economic openness can be carried out by developed and developing countries to increase the country's chances of economic growth (Prijambodo, 1995).Paul M. Romer modeled the development of technology (technological advancement) that is widely adopted according to the needs and decisions of individual companies. Investments in knowledge are made to increase individual research (thereby increasing private knowledge).

In general, the theory of endogenous growth analyzes endogenous growth that occurs within the economic system. This theory assumes that economic growth is determined by the production system and not from outside the system. Advanced technology is an endogenous variable and part of economic actors' investments in knowledge. Romer (1983, 1986) explains that the accumulation of knowledge determines long-term growth, although the increase in new knowledge reflects diminishing returns for an individual firm.

1.1.3 Environment Kuznet Kurve (EKC)

In 1990, Simon Kuznet put forward a hypothesis called the Environment Kuznet Curve (EKC). This hypothesis explains the inverted U-shaped relationship between economic growth and carbon pollution (Ponce and Alvarado, 2019). This hypothesis is considered the first theory to describe the connection between economic growth and environmental degradation. Kuznet believes that countries with low per capita pay primarily focus their attention on the manufacturing sector. This is because the investments obtained can stimulate their economy, indirectly reflecting the accumulation of state income, while ignoring nature and environmental sustainability. The effects of ignoring environmental problems cause pollution, especially CO2 emissions, and can reduce growth over time without realizing it (Istiyani et al., 2019).

Referring to the Kuznets hypothesis, environmental damage occurs in countries with low per capita growth because countries in the early stage of industrialization growth think about how the economy can develop quickly and absorb a lot of labor (Spilker et al., 2017). This phase results in very low environmental quality, reflected in high levels of CO2, which leads to an increase in the earth's temperature, affecting global warming. The following is the Kuznet curve, which describes the relationship between economic growth and environmental degradation, or the inverted U curve as follows:

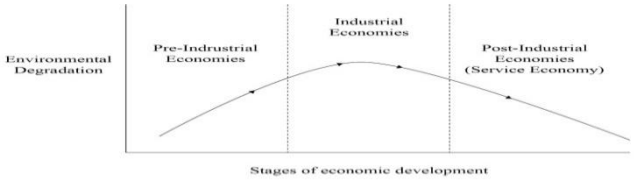


Figure 1: Environment Kuznet Curve (EKC)

Based on the table shown above, an overview of the Kuznet curve is given, which defines the time course of pollution, based on the income from economic development, which consists of three phases: The first phase is characterized by an intensive use of natural resources and characterized by a rapidly creeping carbon emissions, the second phase is characterized by the tipping point in earning higher income and the pollution resulting from earning income, the third phase is characterized by curbing environmental degradation (Leal, P, H et al, 2022).

In general, the Environmental Kuznet Curve (EKC) shows a U-shaped relationship between per capita income and income inequality. This U-shaped curve relationship distributes unequal income in the early stages of growth and income distribution, which equates to an increase in economic productivity in the early stages of growth. Further economic growth (Holtz-Eakin *et a*l, 1995).

1.1.4 Government Effectiveness

Governance plays a role that cannot be separated from the institutions, apart from being taken into account in the implementation of all sustainable decisions, as well as in the analysis of the implementation and the assessment of their effectiveness in environmental protection and management (Monteiro and Partidario, 2017 ; Maryono et al., 2021).). Government failure is a manifestation of dysfunctional or ineffective institutions, the root causes of which are government incompetence, corruption, collusion and nepotism (KKN).

According to the neo-Maltusian view, population pressure, market failure and government failure are the causes of environmental damage. This condition arises due to the slowness of policy implementation (Tietienberg T & Lewis L, 2015). The literature review by Ahmad M, et al. from 2021 highlights that institutional effectiveness plays an important role in ensuring the country's sustainability in environmental quality management. In the long term, institutional quality has important aspects in influencing ecological quality, both directly and indirectly (Ulucak, et al, 2020). Likewise, the role of institutions in environmental sustainability is very valuable as it is reflected in the reduction of recycling costs and energy conservation, which can reduce environmental degradation (Ahmed et al., 2020; Hassan et al., 2020).

The political dimension is directly related to democratic institutions that can directly or indirectly implement environmental policies. The success of implementing policy measures is reflected in the improvement of environmental quality. In addition to improving regulations in implementing sustainable environmental approaches and minimizing corruption in financing environmental improvements, carbon emissions can be reduced (Wang, et al., 2018; Ali, et al., 2020; Teng, et al., 2020)

RESEARCH METHODOLOGY

1.1.5 Data Types and Sources

The type of research used in this study is secondary data, namely time series data for the period 2012-2021, where the data source is from the World Bank and Development Indicators. Cross-sectional data have now been collected from seven countries in Southeast Asia, namely Indonesia, Malaysia, Thailand, the Philippines, Myanmar, Vietnam and Cambodia. The research object used included several countries in the Southeast Asia region. The reason for choosing the period 2012-2021 in this study is that it is related to economic and methodological questions. In 2012, it was related to problems following the economic recession in 2008, which began with the collapse of housing prices in America or the so-called subprime mortgage crisis. This was related to the ASEAN-7 economy and in 2020 to the Covid phenomenon. In 2019, there was a pandemic worldwide that affected economic activity and led to lockdowns or work-from-home policies. Therefore, 2012-2021 will be a very difficult process for the global economy, especially for ASEAN-7, with a 10-year period that is expected to provide answers to research problems.

1.1.6 Research Model Specifications

This research examines population, institutional governance and macroeconomic variables on environmental quality in ASEAN-7. This model specification was adopted and derived from the research of Kim, S, 2019, Rehman, et al, 2021, which relates environmental quality to carbon dioxide, which is shown in Equation 3.1

$$QE = aGDP^b P^c FDI^d TO^e EG^f \varepsilon \quad \text{.....3.1}$$

It is known that QE is a representation of environmental quality expressed by carbon dioxide, GDP is economic growth, P is total population, FDI is foreign direct investment, TO is economic openness expressed by export-import x (GDP). and EC is governance. Government as a proxy for government effectiveness is shown in Equation 3.2

$$\Delta KL = \Delta(GDP, P, FD, TO, EG) \quad \text{.....3.2}$$

So specifically, the above equation is formed in econometric model 3.3 and can be written as follows:

$$\Delta(\mathrm{KL}_{i,t}) = \Delta(a) + a\Delta\mathrm{GDP}_{I,t} + a\Delta\mathrm{P}_{i,t} + a\Delta\mathrm{FDI}_{i,t} + a\Delta\mathrm{TO}_{i,t} + a\Delta\mathrm{EG}_{i,t} + ECT_{i,t} + \varepsilon_{i,t} \quad \text{.....3.3}$$

1.1.7 Research Analysis Methods

The Vector Error Correction Method (VECM) is a VAR method that establishes a long-term relationship between the dependent variable and independent variables that are mutually cointegrated. In addition, VECM is a method that can determine the existence of short- and long-term relationships between variables and has dynamic and simultaneous properties, capable of detecting shocks caused by endogenous variables (Raehman et al, 2021).

In general, the VECM method for panel data uses the impulse response function (IRF) and variance decomposition (VD) and is implemented using a probability-based cointegration analysis framework in the vector error correction model (VECM) (Jan et al., 1999). So the PVECM equation can be formulated by modifying the equation using panel data as follows:

$$\mathrm{X_{it}} = \beta_{oi}(t) + \sum_{k}^{p} = 1\, \beta_{it} \mathrm{X_{it\text{-}k}} + \varepsilon_{it}$$

Where X_it is the K vector element of endogenous variables in each country, i = 1,..., N when t = 1,..., is a time period. In this research, X_it is a vector of.

Methode QE = GDP, FDI, Popullation, EP, TO

β_oi (t) reflects all deterministic components, namely constants, dummies, while X_(it-k) is the lag value of the endogenous variable and ε_it is K x 1 against uncorrelated disturbances. β_oi A=(t) and β_it as dependent cross section. The influence between variables can be seen from the PVECM analysis which is reduced to the following equation:

$$\Delta KL_{it} = \alpha_{a0} + \sum_{i=1}^{m} \alpha_{1i}\, \Delta KL_{it-1} + \sum_{i=1}^{m} \alpha_{2i}\, \Delta GDP_{it-1} + \sum_{i=1}^{m} \alpha_{3i}\, \Delta P_{it-1} + \sum_{i=t}^{m} \alpha_{4i}\, \Delta FDI_{it-1} + \sum_{i=t}^{m} \alpha_{5i}\, \Delta TO_{it-i} + \sum_{i=1}^{m} \alpha_{5i}\, \Delta EG_{it-i} + \alpha_4 ECT_{t-1} + \varepsilon_i$$

$$\Delta GDP_{it} = \alpha_{a0} + \sum_{i=1}^{m} \alpha_{1i}\, GDP_{it-i} + \sum_{i=1}^{m} \alpha_{2i}\, \Delta KL_{it-1} + \sum_{i=1}^{m} \alpha_{3i}\, 1 + \sum_{t=1}^{m} \alpha_{4i}\, \Delta FDI_{it-i} + \sum_{i=1}^{m} \alpha_{5i}\, \Delta TO_{it-1} + \sum_{t=1}^{m} \alpha_{6i}\, \Delta EG_{it-1} + \alpha_4\, ECT_{t-1} + \varepsilon_{it}$$

$$\Delta P_{it} = \alpha_{a0} + \sum_{i=1}^{m} \alpha_{1i}\, \Delta P_{it-i} + \sum_{i=1}^{m} \alpha_{2i}\, \Delta KL_{it-1} + \sum_{i=1}^{m} \alpha_{3i}\, \Delta GDP_{it-1} + \sum_{i=1}^{m} \alpha_{4i}\, \Delta FDI_{it-1} + \sum_{i=1}^{m} \alpha_{5i}\, \Delta TO_{it-1} + \sum_{i=1}^{m} \alpha_{5i}\, \Delta EG_{it-i} + \alpha_4 ECT_{t-1} + \varepsilon_{it}$$

$$\Delta FDI_{it} = \alpha_{a0} + \sum_{i=1}^{m} \alpha_{1i}\, \Delta FDI_{it-i} + \sum_{i=1}^{m} \alpha_{2i}\, \Delta KL_{it-1} + \sum_{i=1}^{m} \alpha_{3i}\, \Delta GDP_{it-1} + \sum_{i=1}^{m} \alpha_{4i}\, \Delta P_{it-1} + \sum_{i=1}^{m} \alpha_{5i}\, \Delta TO_{it-1} + \sum_{i=1}^{m} \alpha_{5i}\, \Delta EG_{it-i} + \alpha_4 ECT_{t-1} + \varepsilon_{it}$$

$$\Delta TO_{it} = \alpha_{a0} + \sum_{i=1}^{m} \alpha_{1i}\, \Delta TO_{it-i} + \sum_{i=1}^{m} \alpha_{2i}\, \Delta KL_{it-1} + \sum_{i=1}^{m} \alpha_{3i}\, \Delta GDP_{it-1} + \sum_{i=1}^{m} \alpha_{4i}\, \Delta FDI_{it-1} + \sum_{i=1}^{m} \alpha_{5i}\, \Delta P_{it-1} + \sum_{i=1}^{m} \alpha_{5i}\, \Delta EG_{it-i} + \alpha_4 ECT_{t-1} + \varepsilon_{it}$$

$$\Delta EG_{it} = \alpha_{a0} + \sum_{i=1}^{m} \alpha_{1i}\, \Delta EG_{it-1} + \sum_{i=1}^{m} \alpha_{2i}\, \Delta KL_{it-1} + \sum_{i=1}^{m} \alpha_{3i}\, \Delta GDP_{it-1} + \sum_{i=1}^{m} \alpha_{4i}\, \Delta FDI_{it-1} + \sum_{i=1}^{m} \alpha_{5i}\, \Delta P_{it-1} + \sum_{i=1}^{m} \alpha_{5i}\, \Delta TO_{it-i} + \alpha_4 ECT_{t-1} + \varepsilon_{it}$$

DISCUSSIONS

4.1 Develop General Descriptions

1.1.8 ment of Environmental Quality in ASEAN-7

Changes in environmental quality reflect the change in the economic structure and are also part of the effort to change the economic structure from the agricultural sector to the non-primary sector, namely industry and services, as a first step to promote development and economic growth (Susila J, 2019; Pratama A , 2022). The effects of changes in environmental quality are consistent with the concept of sustainable development, which combines three main elements: economic and social development through environmental monitoring; Redistribution of resource use taking into account environmental quality and the quality of life of current and future generations with long-term use of resources. Efforts must be made to design solutions to bridge these gaps that can continue to exist continuously and sustainably (sustainability) (Klarin, T 2018).

In general, the role of globalization is very real, especially in the economic sector, for example in investments, especially the influx of foreign direct investments capable of mobilizing economic development for the (host country) in the form of the construction of multinational factories rewards (country advantages) in the form of increasing government revenue, improving the quality of life of the community as well as opening up employment opportunities and technology transfer as an environmentally friendly innovation for waste processing. The close connection between population growth, the inflow of foreign funds and industrial activity is leading to environmental degradation that cannot be avoided unless a solution is found. Environmental problems arising from economic activity cannot be separated from the speed and growth of human activity, and environmental problems can only be solved through careful, comprehensive and multi-generational efforts with government support and the strengthening of sound principles in the acceptance of inbound foreign direct investment by the introduction of environmentally friendly technological innovations (Daniel A. M. & Michael E. K., 2009).

Another factor affecting environmental quality is trade opportunities, policies that allow easy access and reduce barriers to international market expansion, such as: B. accepting investments by host countries by considering the benefits of accelerating the economy and minimizing environmental damage through the development and exploration of existing resources. They are able to increase productivity while reducing energy consumption by creating transition effects through education and research reforms, thus producing technological innovations that can minimize environmental damage (Zafar, M, W et al., 2022). Below shows the state of environmental quality in ASEAN-7 over the period 2012-2021.

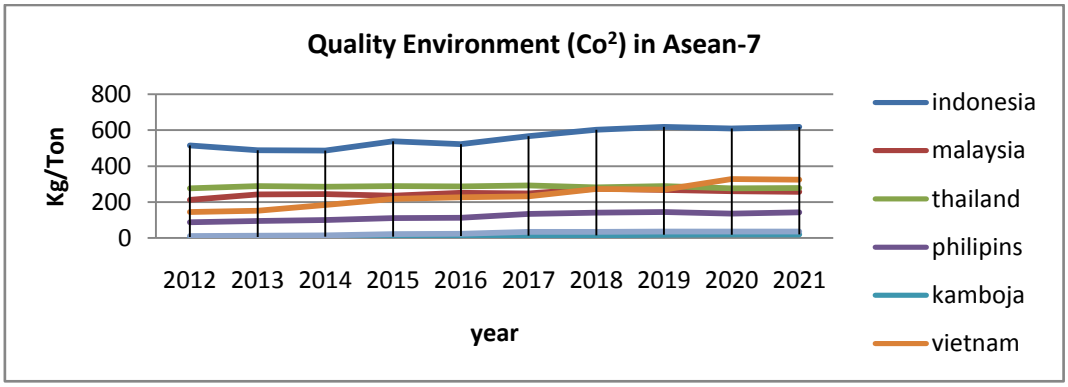


Figure 2: Development of Environmental Quality in ASEAN

In the graphic image, it reflects the development of environmental quality in ASEAN-7 countries, which has shown a fluctuating trend over the past 10 years (2012-2021). This phenomenon occurs because each country in ASEAN-7 has its own policies to manage its economy. Of the 7 countries that are part of ASEAN, Myanmar is a country with fairly low fluctuations in CO2 emissions. This is because Myanmar is among the countries with low levels of productivity, especially with still low access to electricity. Among the measures that can be taken to improve access to electricity, the Myanmar government is committed to exploiting the potential of renewable energy to exploit energies and reduce the production of fossil fuels. Obstacles in Myanmar are indicated from economic perspective, market technology and less supportive institutions as well as inadequate infrastructure (Oh, S. Kim, et al, 2023)

In contrast to Vietnam, CO2 emissions increased almost fourfold between 2010 and 2020 (World Bank, 2021). This situation occurred because rapid economic growth and increasing energy demand had led to an exponential increase in emissions. The government's policy plan is to offset high carbon emissions through decarbonization through a low-price mechanism to reduce greenhouse gas emissions, air pollution, climate change and human health, and reduce the pressure of environmental degradation. It is expected that the introduction of carbon pricing will help realize reductions while supporting Vietnam in the comprehensive use of renewable energy sources with the energy potential to transition to a low-carbon development model (Tun, M. M, et al, 2019).

Next is Cambodia. Historically, Cambodia is the lowest emitter, but has the fastest growth rate in Southeast Asia and one of the highest carbon intensity levels, which is a measure of how much carbon the country produces per unit of GDP - alongside other countries (World Bank, 2023) . Cambodia is a country with excessive use of fossil energy to increase production, which leads to an increase in carbon dioxide and causes global warming. Not far from other countries, Cambodia is also applying the same method by adopting a green economy or using renewable energy to overcome CO2 emissions (Liu B, et al, 2023),
Furthermore, the Philippines is a developing country that is highly sensitive to climate change and is also the Philippines with the fourth largest economy in ASEAN (World Bank, 2022). The rapid pace of the Philippine economy is directly proportional to the high economic growth, which also means that energy consumption as a driver of economic activity is increasing. One of the factors contributing to CO2 emissions in the Philippines is road congestion caused by the increasing use of private vehicles due to inadequate public transportation, causing air pollution (Tonisson, L, et al., 2020).

Malaysia is the third largest emitter of carbon emissions in ASEAN-7. This fact is due to over-reliance on fossil fuels, deforestation and land degradation. As a result, global average temperatures rose twice as much as expected. The sector that contributes the most to carbon emissions in Malaysia is power generation. Rising energy demand is putting pressure on the government to choose energy sources that are cheaper to produce but are not environmentally friendly due to the use of fossil fuels. The Malaysian government has adopted a fuel diversification policy to overcome the ongoing energy crisis and highlight the role of renewable energy sources in the energy mix (Abdul Latif, S.N. et al., 2020; Thaddeus J. et al., 2020).

Thailand is an ASEAN-7 country known for its tourism and experiencing economic and population growth. Thailand's economy relies on fossil fuels for around 80% of its energy needs (Word Bank, 2022). Thailand ranks 2nd in the contribution of CO2 emissions in the ASEAN-7 region. The very rapid CO2 rate is caused by an increase in energy consumption in the industrial and manufacturing sector, which is much larger than the growth rate of GDP. On the other hand, the Impacts of heavy tourism boost economies worldwide and are also related to increasing energy demands for transportation systems, food, housing, services and facilities that are highly vulnerable to environmental damage (Raihan et al., 2022h). ; Rihan, A, et al, 2023).

Indonesia ranks first when it comes to CO2 emissions in the ASEAN-7 region. Where the Indonesian economy is supported by the agricultural and manufacturing sectors (Word Bank, 2019). The growth of the industrial sector, especially manufacturing, promotes urbanization, which increases the intensity of energy consumption in Indonesia (Nguyen, 2018). Heavy urbanization in Indonesia is caused by economic growth, while industrialization promotes increased fuel consumption, leading to an increase in carbon emissions (Prastiyo et al., 2019). The policy implemented by the government to overcome the negative externalities of carbon emissions is to introduce a carbon tax and carbon reduction as a driver of the transition to renewable energy (Wortbank, 2022).

1.2 Model analysis and hypothesis testing

1.2.1 Results of the description analysis

Descriptive analysis is used explicitly in research to describe the behavior of each independent variable that may influence the dependent variable. Below is a description of the variables used in this research in ASEAN-7.

Table 1 : Result of the descriptions analysis

	CO2	**GDP**	**POPULATION**	**FDI**	**EP**	**TO**
Mean	0.786959	26664.04	7.813517	4.320896	-0.015821	2.006602
Median	0.687834	30135.00	7.969073	3.000000	0.090000	2.262467
Maksimum	2.297226	93188.00	8.437359	14.10000	1.160000	2.534675
Minimum	0.338288	1020.000	7.000000	-1.000000	-1.410000	0.942853
Standard Deviasi	0.479351	24857.99	0.381166	3.709143	0.637650	0.510167
Observation	67	67	67	67	67	67

1.2.2 Stationer Test

To test the stationarity of the data in this study, the unit root test is used. Data that is not stationary will cause the regression results to be incorrect or erroneous. This condition can be recognized by the high R2 value, but the t-statistic and F-statistic values are non-standard.Stationarity testing in this study used the Levin, Lin, Chu (LLC), Fisher-Augment Dickey Fuller (Fisher-ADF), and Fisher-Philip Perron (Fisher-PP) methods.

Table 2: Unit Root Test

Variabel		**LLC**		**ADF Fisher**		**PP Fisher**	
		level	**FD**	**level**	**FD**	**Level**	**FD**
CO2	Statistik	-1.84261	-4.56038	11.5382	26.8718	15.4388	53.4002
	(Prob)	0.00327	0.0000	0.6433	0.0200	0.3488	0.0000
GDP	Statistik	-50.0223	-5.27451	20.1133	26.4503	8.55408	52.5684
	(Prob)	0.0000	0.0000	0.1266	0.0093	0.8085	0.0000
Population	Statistik	-27.0767	-605.235	87.651	96.4053	89.6384	110.022
	(Prob)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FDI	Statistik	-2.22194	-1.67740	17.0547	18.2638	20.8134	38.6025
	(Prob)	0.0131	0.0467	0.2533	0.1950	0.1065	0.0004
EP	Statistik	-3.41447	-9.43451	17.8731	36.4956	15.0982	56.9950
	(Prob)	0.0003	0.0000	0.2955	0.0009	0.3715	0.0000
TO	Statistik	-1.37769	-2.42280	13.0007	24.7976	37.1290	39.0045
	(Prob)	0.0841	0.0077	0.5265	0.0366	0.3893	0.0004

Standard errors in parentheses

***stationary at 5% alpha

The above table reflects the estimated results of the LLC, ADF-Fisher and PP-Fisher unit root tests and shows that there are only 5 variables whose p-value is less than 5% and 1 other variable exceeds the α value or 5% Tests are required. on the first difference level. Next, the unit test results at the first level of difference show that all p-values for all variables are below the α value or 5%, so it can be concluded that the six variables at the first level of difference are stationary.

1.2.3 Optimum Lag Test

The optimal lag test shows the estimation results to determine the time period indicating the presence of variables that have an influence on other variables, which reflects optimal results.

Table 3: Optimum Lag Test

lag	LogL	LR	FPE	AIC	SC	HQ
0	-368.6275	NA	25.10205	20.25013	20.51136*	20.34223*
1	-329.1988	63.93831	21.43924	20.06480	21.89341	20.70947
2	-282.3112	60.82716*	13.96591*	19.47628	22.87227	20.67353
3	-245.6249	35.69478	21.31989	19.43919*	24.40255	21.18901

Standard errors in parentheses
***stationary at 5% alpha

The results of the optimal lag test in the table above, looking at the table in the Akaike Information Criterion (AIC) section, found that the optimum lag is at lag 3. This criterion is because the minimum value in the Akaike Information Criterion (AIC) is at lag 3.

1.2.4 Cointegration Test

The cointegration test is used to determine whether there is a long-term influence on the variables examined. This cointegration test uses the Johansen cointegration test method.

Table 4: Cointegration Test

Hypothesized No.of CE (s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None*	0.784920	151.7325	95.75366	0.0000
At most 1*	0.669831	94.87288	69.81889	0.0000
At most 2*	0.449680	53.87128	47.85613	0.0123
At most 3*	0.377991	31.77286	29.79707	0.0292
At most 4*	0.237102	17.20525	15.49471	0.0429
At most 5*	0.107113	4.191906	3.3841466	0.0406

Standard errors in parentheses
***stationary at 5% alpha

Based on the table above, it can be explained that at the 5% test level (0.05), there are five ranks of variables related to cointegration. This is proven by the trace statistical values 151.7325, 94.87288, 53. 87128, 31. 77286, 17.20525, 4.107113 which are greater than the Critical Value 0.05, namely 95.75366, 69. 81889, 47. 85613, 29. 7970 7, 15. 49471, 3.3841466 which means that H0 is rejected and H1 is accepted or in other words, all the variables are indicated to have a long-term relationship (cointegration) with each other. Explicitly estimating VECM was further carried out by VECM stability tests.

1.2.5 Causality Test

The causality test is one of the PVECM analyses, the purpose of which is to determine the interrelationship between variables, both one-sided and two-sided, by looking at the probability values.

Table 5: Causlity Test

Null Hypothesis	F-statistik	Prob.
GDP does not Granger Cause CO2	0.87731	0.4617
CO2 does not Grange Cause GDP	0.37092	0.7744
POPULASI does not Granger Cause CO2	0.63173	0.5987
CO2 does not Granger Cause POPULASI	0.01940	0.9963
FDI does not Granger Cause CO2	1.40221	0.2555
CO2 does not Granger Cause FDI	0.36151	0.7811
EP does not Granger Cause CO2	3.33101	0.0284
CO2 does not Granger Cause EP	1.26689	0.2980
TO does not Granger Cause CO2	5.70348	0.0023
CO2 does not Granger Cause TO	0.47338	0.7025
POPULASI does not Granger Cause GDP	1.33150	0.2789
GDP does not Granger Cause POPULASI	0.25780	0.8553
FDI does not Granger Cause GDP	1.34874	0.2735
GDP does not Granger Cause FDI	0.07058	0.9753
EP does not Granger Cause GDP	12.2004	1.E-05
GDP does not Granger Cause EP	1.75071	0.1736
TO does not Granger Cause GDP	1.40554	0.2565
GDP does not Granger Cause TO	1.45784	0.2418
FDI does not Grange Cause POPULASI	1.44952	0.2420
POPULASI does not Granger Cause FDI	0.68676	0.5652
EP does not Granger Cause POPULASI	1.07708	0.3692
POPULASI does not Granger Cause EP	0.59187	0.6238
TO does not Granger Cause POPULASI	1.79387	0.1630
POPULASI does not Granger Cause TO	2.35309	0.0858
EP does not Granger Cause FDI	0.77147	0.5165
FDI does not Granger Cause EP	0.17190	0.9148
TO does not Granger Cause FDI	1.81873	0.1584
FDI does not Granger Cause TO	0.13643	0.9377
TO does not Granger Cause EP	1.34114	0.2739
EP does not Granger Cause TO	0.63179	0.5986

Standard errors in parentheses

***stationary at 5% alpha

From the table above, the majority of test results fall within the independence causality criteria, or the absence of a causal relationship between variables, as reflected in the probability values in the table above. As can be seen in the table, there are two variables that have a reciprocal causality relationship between the variables and have a one-way relationship or are included in the unidirectional causality criteria from the results of the Parwise-Granger causality test, namely the first variable of the effectiveness of the government on carbon emissions with a probability value of 0.0284 and the economic openness to emissions variable. Carbon with a probability value of 0.0023, where for these two variables the probability value is less than the alpha value of 5%. Variables whose probability value is above an alpha value of 5%, on the other hand, have no causal relationship between the variables.

1.2.6 Panel Vector Error Correction Model (PVECM).

In the estimation results of this study using VECM because there is a cointegration relationship.

Tabel 6: PVECM Estimation Results

Variable	short-term estimated results	t-statistics
	Coefficient	
Cointegrating Eq	0.084311	2.40127
D(CO2(-1))	-0.639475	-3.46773
D(CO2(-2))	0.004331	0.02400
D(CO2(-3))	0.182515	1.13181
D(GDP(-1))	-3.36E-06	-2.01266

D(GDP(-2))	-1.06E-06	-0.79523
D(GDP(-3))	1.12E-06	0.96411
D(POPULATION(-1))	0.343708	1.94864
D(POPULATION(-2))	0.499737	2.66739
D(POPULATION(-3))	0.260632	1.64748
D(FDI(-1))	0.021290	0.77206
D(FDI(-2))	0.085782	3.21544
D(FDI(-3))	0.073495	4.29904
D(EP(-1))	0.001669	0.00892
D(EP(-2))	0.526067	3.07561
D(EP(-3))	0.366568	1.92228
D(TO(-1))	0.276092	0.33780
D(TO(-2))	-1.965838	-1.91589
D(TO(-3))	2.132381	2.65105
C	**-0.029729**	-1.22821
Variable	**Long-term estimated results**	**t-statistic**
	Coefficient	
CO2(-1)	1.000000	
GDP(-1)	3.30E-05	7.47711
POPULATION(-1)	-1.017805	-2.28036
FDI(-1)	-0.189321	-3.58474
EP(-1)	-0.522351	-1.96275
TO(-1)	-0.852387	-2.89282
C	8.827454	
R-Squared		
Adj. R-squared	0.545391	
F-statistic	3.273098	

Standard errors in parentheses

***stationary at 5% alpha

The estimation results show that the CO2 variable in the first lag has an insignificant negative effect of -0.63 percent in the short term. This means that with an increase of 1 percent in the previous year, there will be a CO2 reduction of -0.63 percent in the current year with a t-statistic value of -3.46773. then the 2nd lag and the 3rd lag of the CO2 variable have a t-statistic value that is smaller than the t-table (0.02 and 1.13 < t-table 1.99 respectively), which indicates indicates that CO2 has no effect. As reflected in Lag 1 and Lag 2, the t-statistic value is smaller than the t-table value, so the independent variable has no significant influence on the dependent variable, or the HO hypothesis is accepted and H1 is rejected.

Next, the GDP variable in short-term lag 1 has a significantly negative coefficient value for CO2, which is reflected in the coefficient value, namely -3.36, which means that if GDP increased by 1 percent in the previous year, CO2 emissions by -3.36 percent. For the 2nd and 3rd lags, the GDP variable has a t-statistic value smaller than the t-table, so it can be said that it has no significant impact on CO2. Unlike the short-run variable GDP, in the long run, it can be seen from the t statistic value > t table that 7.47711 > 1.99773, which means that in the long run, 1 percent GDP growth determines the long run value -Run- Growth characterized by technological development. and new ideas as a result of positive externalities on the production system will improve environmental quality. Therefore, the simultaneous hypothesis H1 is accepted and H0 is rejected.

In addition, the population variable in the short term in the 1st lag has a coefficient value of 0.34 and t-statistic < t-table, 1.94 < 1.99, so it can be concluded that in the 1st lag the population variable in the short term has a coefficient value of 0.34 has no significant impact on CO2. In the second lag, the significant positive effect is reflected in the coefficient value of 0.49, which means that if there was a 1 percent increase in the previous two years, CO2 emissions would now increase. Furthermore, the population variable has no significant influence on CO2 in the third lag. If the population variable has a negative and significant coefficient value for CO2 in the long run or the simultaneous hypothesis H1 is accepted and H0 is rejected, it

is proven that the independent variable has a significant influence on the dependent variable. This means that as the population increases, CO2 levels decrease by -1.01. It is noted that the population explosion plays a dual role, namely that population has an influence on CO2. Furthermore, population plays a role in realizing environmental degradation in the form of technological innovation and human creativity in exploiting technological advancements in line with Maltus' opinion on the concept of population.

Meanwhile, the FDI variable has no significant influence on CO2 in the short run in the first lag, as reflected in the t-statistic value <t-table, namely 0.772<1.999. The 2nd and 3rd lags have positive and significant coefficient values, which means that with an increase of 1 percent in the last two years and three years, CO2 emissions will increase in the current year. In the long run, however, the negative and significant coefficient value for CO2 is seen, namely -0.18, which means that a 1 percent increase in foreign direct investment will reduce CO2 emissions by -0.18 in the long run or accept the hypothesis H1 and H0 is rejected, then the rapid inflow of foreign direct investment into the country has substance. The country places great emphasis on sustainable development, which is not only capital intensive but also adopts renewable energy strategies and innovations to overcome the externalities of industrial progress.

The variable "government effectiveness" has no significant influence on CO2 in the short term in the 1st lag, as reflected in the t-statistic value < t-table 0.008 < 1.999. In contrast to the 2nd lag, it has a clearly positive effect on CO2. Meanwhile, this is reflected in the 3rd lag in the t-statistic value, which has no significant influence on CO2. It is noted that hypothesis H1 is rejected and H0 is accepted. It is proven that the independent variable is proven to have no significant influence on the dependent variable. Likewise, the variable government effectiveness has no significant influence on CO2 in the long term. This condition leads to volatility in the effectiveness of the government.

1.2.7 PVECM Model Stability Test

The stability test in this research model was carried out before estimating the PVECM model. In addition, the modulus value is used in the stability test to support the results of the impulse response function analysis and variance decomposition.

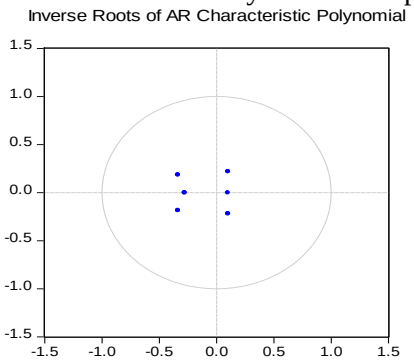
Tabel 7: Results of the model stability test

Root	Modulus
-0.159836-0.823200i	0.838574
-0.159836+0.823200i	0.838574
-0.529510-0.502535i	0.730015
-0.529510+0.502535i	0.730015
-0.138198-0.580075i	0.596310
-0.138198+0.580075i	0.596310
-0.464450-0.106900i	0.476594
-0.464450+0.106900i	0.476594
0.299547-0.269848i	0.403170
0.299547+0.269848i	0.403170
-0.043377-0.320384i	0.323307
-0.043377+0.320384i	0.323307

Standard errors in parentheses
***stationary at 5% alpha

The table reflects a fairly stable PVECM model. This is proven by the total modulus value being less than one, so it can be concluded that the PVECM model is valid.

Table 8: Model stability test landscape



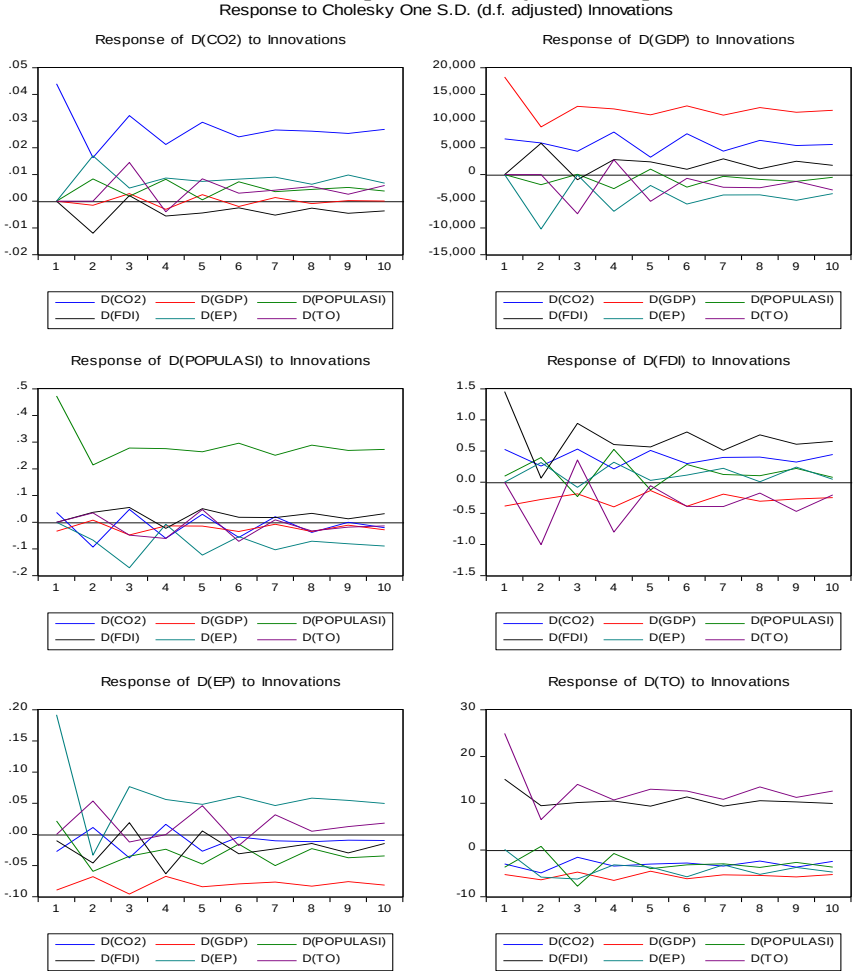
Standard errors in parentheses
***stationary at 5% alpha

The stability of the PVECM model is reflected in the inverse roots of the characteristic AR polynomial. In the image above, all of the scatter markers in the model are in the model stability landscape. It can be concluded that the PVECM model used in this research can analyzetime and region simultaneously.

1.2.8 Variance Decomposition Analysis

Explicitly, the variance decomposition test is part of the VECM analysis, which is able to project shocks onto other variables to predict what contribution each change will make in the system.

Table 9:Results of Variance Decomposition Analysis of Dependent Variable (Co^2)



The IRF analysis of CO^2 variables for the next 10 periods can be seen from the initial response of CO2 to GDP. In periods 1 and 2 it is close to a standard deviation of 0, but in the next period it fluctuates until period 8, but in period 10 it is again close to a standard deviation of zero. Meanwhile the reaction to itself is quite high and approaches a standard deviation of 0.5, then in period 2 it drops to a standard deviation of 0.2, the next period fluctuates towards a standard deviation of 0.3 until period 10. Next, the third response to the population variable based on the graphical image for the first period is exactly at a standard deviation of 0.0 for periods 2 to 9, moves and fluctuates, for period 10 it again approaches a standard deviation of 0, 0. In the fourth FDI response, the standard deviation position was 0.0 in the first period, in the second period it showed a decline close to a standard deviation of -0.2, then it moved again in period 3 and returned to its original value in the tenth period back original level towards a standard deviation of 0.0. In the fifth answer, the EP variable is reflected at the beginning of the period, the position at a standard deviation of 0.0 in the second period jumps to a standard deviation of 0.2, the next period fluctuates and in the 10th period it approaches again a standard deviation of 0.0. The final response, namely the TO variable, can be seen in periods 1 and 2. The response is close to a standard deviation of 0.0 in the third period, increases to a standard deviation of 0.2, but decreases again in period 4 and approaches a standard deviation of -0.1 for the next period to 10 and approaches has a standard deviation of 0.1.

IRF analysis of GDP for 10 periods to see that the reaction to itself reaches a creeping peak at the beginning of the period, namely at a standard deviation of 20,000, but in the second period there was turbulence, which further increased to a standard deviation of 5,000 fell, another period 3 showed a development until the 10th period, which increased to the standard deviation of 10,000. Second, looking at the response of $CO^2$to GDP, we see that the response rose to a high level in Period 1, approaching a standard deviation of 15,000, but fell significantly to a standard deviation of 0 in Periods 2 and 3. Then in period 4 there was movement, which increased again to a standard deviation of 10,000. The fluctuating 5-10 period move ended in one period exactly at a standard deviation of 5,000. Furthermore, the population response to GDP appears to be weak, with the standard deviation value being 0 in Period 1 and an increase to -5,000 in Period 2. However, there was development in period 3 until period 10 had a standard deviation value of 0. The fourth response, namely foreign direct investment, was reflected at the beginning of the period at a standard deviation of 0, in period 2 it showed good prospects, reflected at a standard deviation value of 5,000. The movement of the FDI response to GDP fluctuated widely until it fell back to almost 0 in the 10th period. The fifth response in the EP variable was related to GDP. Figure 4.8 reflects the weakening of institutional governance, as seen in the graph for periods 1-10. Where the standard deviation value increases from standard deviation 0 to -5,000. The response of the six TOs to GDP is almost the same as the response of the EP to GDP. It can be seen that for periods 1 and 2 the standard deviation value is 0 and for period 3 it has significantly decreased to a standard deviation value of -10,000. Furthermore, period 4 shows a good response, reflected in a standard deviation value close to 5,000. However, in period 5 there was another shock, causing the value to fall again to the value of -5,000. Furthermore, periods 6 to 10 demonstrate its ability to maintain shocks at 0 standard deviation.

1.2.9 Impluse Respons Function

The capacity of the IRF test is to detect whether a shock occurs due to changes in one variable relative to another variable. Furthermore, we will also review the long-term dynamic response and the level of shock effects that occur, reflected in the IRF test graph.

Table 10:Impulse response function CO2 response to GDP, population, foreign direct investment and TO.

Periode	S,E	D(CO2)	D(GDP)	D(POPULASI)	D(FDI)	D(EP)	D(TO)
1	0.043988	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.052022	81.35242	0.082569	2.558490	5.309510	10.69710	5.59E-07
3	0.063147	81.03484	0.260545	1.826215	3.716212	7.869738	5.292446
4	0.068100	79.39983	0.426020	3.038979	3.857937	8.394246	4.882984
5	0.075266	80.46915	0.456783	2.493018	3.497905	7.845189	5.237950
6	0.079911	80.46188	0.466615	3.045373	3.197947	8.035899	4.792290
7	0.085086	80.82656	0.438162	2.861652	3.190620	8.219834	4.463172
8	0.089583	81.48695	0.404468	2.826055	2.961490	7.915975	4.405060

9	0.093917	81.44561	0.368665	2.876487	2.926371	8.295004	3.898917
10	0.098258	81.92732	0.336897	2.780697	2.806335	8.053379	4.095371

The results of the variance decomposition analysis show that after a time interval of 10 periods, it is known that the CO2 variable in the first period was 100% influenced by the CO2 variable in the previous period. In the following period, the CO2 movement is then influenced by other variables that play different roles depending on the size of the coefficient produced. If we look at the results of the variance decomposition analysis over the ten time periods, the variables that contributed the most to CO2 are government effectiveness (EP) and trade openness (TO).

In addition, it can be seen from the above table that the role and effectiveness of the government is the greatest when it comes to CO2. The contribution to government effectiveness varied over ten periods, but was largest overall. Furthermore, the trade openness variable is the second largest contributor after government effectiveness. The variable with the smallest CO2 contribution, namely the GDP variable, is reflected in period 2, which has a contribution of 0.08 percent, and in period 10 this is 0.33 percent.

1.2.10 Classical Assumption Test.

The classical assumption test is used to determine whether the parameter estimates are free from indications of normality, heteroscedasticity and autocorrelation.

Table 11: Classical Assumption Test

Classical Assumption Test	Test	Probability	Explanation
Normality	Jarquebera	0.2287	Normally Distibuted
Heteroskedasticity	White-Heteroscedasticity	0.1757	Heteroskedasticity does not occur
Autocorrelation	LM test	0.5809	Autocorrelation does not occur

Standard errors in parentheses

***stationary at 5% alpha

hows the results of the classical assumptions in this research. The normality test results indicated by the Jaque-Berra probability value are 0.2287. This reflects normally distributed data as the probability value > alpha value is 5%. In addition, the heteroscedasticity test using white heteroscedasticity has a probability value of 0.1757, which means that there are no symptoms of heteroscedasticity. Finally, the autocorrelation test uses the LM test with a probability result of 0.5809, which is greater than the determined alpha value 5%. It can be concluded that the model is free of autocorrelation problems.

RESULTS AND DISCUSSIONS

1.2.11 The Impact of GDP on Environmental Quality in ASEAN-7

The main source of supporting the economy is GDP, the GDP contribution of natural resources and human capital in the form of knowledge and innovation to the production of products as the engine of economic growth (Romer, 1990). In the era of globalization, an economic transformation is emerging, where an economic transition is taking place, leading to a low-carbon economy that is safe and affordable for sustainable economic growth and social development. Based on the estimation results, the GDP variable has a positive and significant impact on environmental quality in the long run. This research is consistent with the empirical study by Hao L.N et al.,2021, in which an increase in real GDP has a long-term impact on environmental quality. In the short run, the results of the estimation of the GDP variables show that there is a different influence at each lag. In the first and second lags the negative effect is not significant, while in the third lag the effect is positive and significant. It can be concluded that the GDP variable has no influence on environmental quality in the short run. This research is consistent with the hypothesis of Simon Kuznet (EKC), which explains that countries with high per capita income reflect economic growth consistent with high environmental awareness. In general, countries with rapid economic development not only focus on the

area of production, but also pay attention to the impact of externalities of economic activities, especially on environmental quality (Dauda L et al., 2019).

1.2.12 The Impact of Population on Environmental Quality in ASEAN-7

Based on the estimation results, it is shown that population variables have a negative and significant influence on environmental quality in the long term. This means that an increase in population not only increases the workforce but also increases diversity in developing innovations and using technology to overcome environmental degradation, which is consistent with the neo-Malthusian neoclassical view that population changes are evidence for long-term development, economic growth is accompanied by economic convergence (Solow, 1956). In the short term, the results of estimating the population variable show that it has a positive and significant impact on environmental quality from lags one to three. The analogy is that the relationship between population and economic activity is very important, where population has double namely population contributes to environmental degradation, on the other hand population has an impact on carbon emissions (Maltus T, 1798). The results of this research are consistent with the empirical study by Dong K et al. from 2018, which states that population and environmental degradation are very important because economic growth has a large impact on the ecosystem and carbon emissions are mainly caused not by population growth but by economic expansion.

1.2.13 The Impact of Foreign Direct Investment on Environmental Quality in ASEAN-7

Based on the estimation results, it is shown that the FDI variable has a significant negative impact on environmental quality in the long run. This means that an increase in foreign direct investment (FDI) actually reduces environmental quality (Co2). The results of this study are consistent with the empirical study by Ashraf et al. from 2021, which states that the inflow of foreign investment in industries that are not environmentally friendly and, indirectly, the heavy inflow of foreign direct investment funds will affect environmental quality. This is because foreign direct investment has the potential to increase economic growth as well as the impact of externalities of economic activity on environmental quality (Gokmen O, 2021; Khan H, et al, 2022). In the short run, the foreign direct investment (FDI) variable shows a significant positive effect on environmental quality at lags 1, 2, 3. This means that the influx of foreign direct investment into the host and the accompanying transfer of environmentally friendly technology in production will improve the quality of the old domestic environment. Indirectly, improving environmental quality through technology transfer has shifted the labor industry to high-tech industry (Zhang J et al, 2019). In addition, a conducive inflow of foreign direct investment will increase economic growth, and FDI flows significantly increase GDP through new knowledge and technology, in line with Paul M. Romer's endogenous growth theory in the era of globalization, science and technological development an important role in promoting economic growth. ,Advanced technology is assumed to be a spearhead for economic actors to ,invest in private knowledge (Erikson, 1996).

1.2.14 The Impact of Effectiveness Government on Environmental Quality in ASEAN-7

Based on the estimation results, it is shown that the variable "Government Effectiveness" has a long-term negative impact on environmental quality in ASEAN-7. The analogy is that any change in government effectiveness reduces environmental quality in the long run. This research is consistent with Gani's 2012 empirical study that there is a negative relationship between institutional effectiveness and carbon emissions. There are three indicators that influence institutional effectiveness, namely political stability, rule of law and anti-corruption (Khan H et al, 2021). Because in the long run, the role of government is very important both directly and indirectly in managing environmental quality (Ulucak et al, 2020). The research findings are in line with the neo-Maltusian view, which states that in addition to population pressure and market failure, government failure is also the cause of environmental damage, due to lack of government effectiveness and high levels of corruption, collusion and nepotism (Le H & Ozturk I, 2020). Meanwhile, variable government effectiveness on environmental quality at lags 1, 2, 3 has a positive and significant effect in the short run. It is noted that the government's effectiveness is reflected in the government's ability to provide governance that can reduce risks and play an important role in developing renewable energy innovations that address environmental conditions (Luo R et al., 2021). The estimation results are consistent with the empirical study by Teng J Z et al., 2020, which states that the institutional dimension reflected in the government's

effectiveness in combating corruption and tightening regulations has been shown to contribute to certain environmental damages minimize and significantly reduce CO2 carbon emissions (Bakhsh S et al., 2021)

1.2.15 The Impact of Trade Opennes on Environmental Quality in ASEAN-7

Based on the estimation results, it is shown that the trade openness variable has a negative impact on environmental quality in the long term. Economic openness leads to economic expansion, which arises from increasing demand for manufactured goods to fulfill exports. Indirectly, countries tend to specialize in certain sectors and create competitive advantages through trade liberalization, but on the one hand, countries with weak environmental regulations, trade liberalization forms industries that are not environmentally friendly, so carbon emissions resulting from production increase (Leal P & Marques A, 2022). The results of this research are consistent with the empirical study by Le et al., 2016, which states that economic openness, characterized by trade openness, increases carbon emissions and reduces environmental quality. In the short term, the estimation results show that lag 1 has a positive effect, lag 2 has a negative effect, and lag 3 has a positive effect. These results reflect the presence of different influences. This suggests that trade openness has a positive short-term impact on environmental quality. The research results are consistent with the empirical study by Ms. M et al. from 2019, which states that there is a positive relationship between economic openness and environmental quality.

Furthermore, there is a one-way causal relationship between the trade openness variable and environmental quality. The results of this research are consistent with the empirical study by Khan Z et al., 2020, which explains that based on the Granger causality test, policies related to economic openness related to export and import significantly alter carbon (Co2) emissions . The relationship between economic openness, trade openness and environmental quality is discussed extensively within the framework of the Kuznet hypothesis (EKC), which is derived from the original Kuznet curve in relation to income and inequality (Grossman & Krueger 1993, 1995). The EKC hypothesis states that carbon emissions increase as per capita income increases until they reach a tipping point (per capita income threshold), after which carbon emissions begin to decline (Yu C et al, 2019).

CONCLUSION

Overall, the research findings explain the environmental quality influenced by GDP, foreign direct investment, population, government effectiveness and economic openness in ASEAN-7. The first result explains that the GDP variable has a positive and significant influence on environmental quality in ASEAN-7 in both the short and long term. This situation shows that economic growth in ASEAN-7 is difficult for the majority of countries to get out of the middle-income trap. The government is expected to adjust its policies to increase environmentally based economic growth. According to the Kuznet Hypothesis (EKC), environmental awareness is achieved when income reaches a certain point, environmental regulations become stricter, and environmental degradation decreases as economic growth increases.Second, population variables have a negative effect on environmental quality in the long term, while population variables have a positive effect on environmental quality in the short term in ASEAN-7. Demographic growth represents a concrete reality in which population has multiple impacts on environmental quality. The population explosion explicitly contributes to environmental destruction, but on the other hand, population has an influence on carbon emissions, which is consistent with the neo-Malthusian view.The three FDI variables have a negative impact on environmental quality in the long run, while the FDI variables have a positive impact on environmental quality in the short run in ASEAN-7. The entry of foreign direct investment implies a transfer of technology, knowledge and skills. As an ASEAN-7 middle-income country, foreign direct investment access is more labor-intensive as the main goal is to increase production, which directly increases economic growth and minimizes environmental impact.The four government effectiveness variables have a negative impact on environmental quality in the long run, while the government effectiveness variables have a positive impact on environmental quality in the short run in ASEAN-7. And there is a one-way quality relationship between government effectiveness and environmental quality in ASEAN-7. and fifth, the trade openness variable has a negative impact on environmental quality in the long run, while the trade openness variable has a positive impact on environmental quality in the short run in ASEAN-7. And in ASEAN-7, there is a one-way quality relationship between trade openness and environmental quality.

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