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*Research Article*

# Does Environmental Degradation Drive Economic Growth? Evidence from Indonesia and Vietnam

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***Abstract:*** *This study discusses the effect of Foreign Direct Investment, Human Development Index, and Emissions on economic growth in Indonesia and Vietnam using time series data from 1990-2023. The analytical tool used is the Vector Error Correction Model (VECM). The results indicate that, in both the short and long term, the FDI variable has a positive impact on economic growth in Indonesia and Vietnam. The Human Development Index (HDI) variable has a negative impact on the short- and long-term economic growth of Indonesia and Vietnam. The Emissions variable has a positive influence on the economic growth of Indonesia and Vietnam in the short and long term.*

***Keywords:*** *FDI, HDI, Emissions, Economic Growth.*

## I. INTRODUCTION

Indonesia and Vietnam are countries that focus on creating equitable social welfare. One important factor in creating social welfare is economic growth. If averaged over the last five years, Indonesia's economic growth is 3.38%, while Vietnam's average economic growth reaches 5.2%. Both countries also experienced a sharp contraction in economic growth in 2020, largely due to the COVID-19 pandemic. However, Vietnam was able to maintain stable economic growth at 2.9%, while Indonesia experienced a decline in economic growth at -2.07% (Central Bureau of Statistics, 2021).

Economic growth is often accompanied by increased industrial activity, fossil energy consumption, and urbanization, which in turn has an impact on increasing greenhouse gas emissions, especially Carbon Dioxide ($CO_2$). Carbon emissions are a primary contributor to climate change, impacting environmental stability and long-term economic sustainability. In the midst of demanding development, developing countries such as Indonesia and Vietnam face a dilemma between promoting economic growth and preserving the environment. Kuznets explained his theory, known as the Environmental Kuznets Curve (EKC), which posits that environmental degradation is caused by increased emissions resulting from the expansion of mass production, driven by changes in economic structure from agriculture to industry. (Shaharir & Alinor, 2013).

Over the last 5 years, the average amount of emissions in Indonesia has been 647.9 million tons, representing an increase of approximately 3.57%. In contrast to Vietnam, in the last 5 years, the average emission is 333.4 million tons or 3.13%%. This is very interesting because Kuznets' Environmental Theory explains that the higher the emissions caused by production activities, the more it will encourage economic growth. But in reality, Indonesia's economic growth is still smaller than Vietnam's despite having a larger amount of emissions. Based on the IETO 2024 study, Indonesia's industrial sector emissions increased by 30% from the previous year, 2022. This increase is attributed to the expansion of industrial processes that require high thermal energy, underscoring the need for decarbonization efforts to support economic growth (IESR, 2024).

Furthermore, the continued reliance on fossil fuels has reached a peak, contributing to increased emissions and environmental degradation (Siregar, 2024). A number of policies to reduce emissions in Indonesia still have obstacles in implementation, one of which is based on data that is still not valid. Meanwhile, Vietnam has a legal framework that supports the implementation of the Nationally Determined Contribution (NDC), with numerous laws and national strategies and imposes emission limits on companies to ensure the effective implementation of emission reduction policies (Raihan et al., 2025).

## II. LITERATURE REVIEW

### *A) Harrod Domar's Theory of Exogenous Economic Growth*

Harrod Domar's theory of growth was put forward separately. Harrod explained his theory in 1939 in the journal economics journal. Domar stated his theory in 1947, based on the same theory. The Harrod-Domar theory explains the requirements a country needs for its economy to grow and develop in the long run, which creates an investment that plays a crucial role in economic growth. Investment plays two key roles in maintaining economic growth: increasing a country's income and augmenting its capital stock in production activities (Elina, 2023).

A book written by Elina (2023) explains that Harrod-Domar tries to explain that a country's economic growth can grow and develop in a steady state (steady growth). There are several assumptions used. These assumptions include:

1) All capital goods and labor are fully used in production activities (full employment),
2) The economy consists of only two sectors: households and firms. There is no government and no international trade
3) The amount of savings rate is proportional to national income.
4) Marginal Propensity To Save (MPS), Capital-Output Ratio (COR), and incremental capital-output ratio (ICOR) are considered constant.

***B) Paul Romer's Endogenous Economic Growth Theory***

This theory puts forward the view that economic growth is generated by endogenous processes and not external ones (Romer, 1994). Endogenous growth theory emphasizes the influence of human capital investment, innovation, and knowledge on economic growth. The focus of this theory is on externalities and spillover effects that stem from the knowledge-based economy and indirectly affect economic development. Economic growth is an important topic for both developed and developing countries seeking growth in production and consumption. There are several benefits for countries seeking to improve economic development through human development investment. The main benefit is to improve the welfare of citizens. (Bagianto, A., & Zulkarnaen, W. 2020: 317).

Paul Romer is one of the key researchers in the development of endogenous growth theory. Paul Romer, in his research titled "Increasing Returns and Long-Run Growth" (1986), found that human capital has a positive influence on economic growth. Human capital, as adopted by Romer, refers to the knowledge of labor utilized during the production process. Productivity produced by labor with knowledge is higher than productivity produced by labor without knowledge. The basic model in endogenous growth theory is as follows:

$$Y = K, H, A, L$$

Dimana:
Y= economic growth
H= Human Capital
A= Technology
L= Labor

***C) Environmental Kuznet Curve Theory (EKC)***

Economic growth and CO2 emissions are explained by a hypothesis known as the Environmental Kuznets Curve (EKC). The EKC hypothesis suggests that economic growth contributes to higher emissions, but further economic growth can then help reduce environmental degradation. This is due to technological advances and the shift to a service-based economy (Galeotti, 2007). The EKC hypothesis posits that economic growth initially leads to increased environmental degradation. This is because countries often focus on increasing production without considering environmental aspects. The continuous production process will ultimately lead to environmental degradation, resulting in pollution of land, water, and air. Economic growth at a certain point will then make people realize that the need for good environmental quality is very important. This point is referred to as a turning point, where economic growth can help reduce environmental degradation (Shaharir & Alinor, 2013).

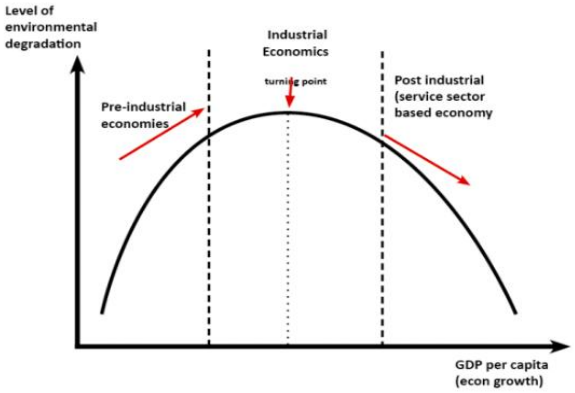



**Figure 1 Environmental Kuznet Curve**

***Source:*** *(Shaharir & Alinor, 2013)*

Figure 1 explains the stages in the relationship between economic growth and environmental quality, showing that the EKC stages are divided into three. The first explanation of Kuznet's inverted-U curve relationship is the stage of economic

growth, transitioning from agriculture to industry, followed by a post-industrial era with a service-based economic system. Environmental damage tends to increase as the economic structure shifts from rural to urban and from agriculture to industry, with the growth of mass production and consumption. It then decreases with the second change in economic structure from energy-based heavy industry to technology-based industry and services (Panayotou, 1993). In the first stage of industrialization, pollution increased rapidly because people were more interested in jobs and income than clean air and water. Relatedly, people are too poor to afford controls, and environmental regulation is deemed irresponsible (Dasgupta, Laplante, Wang, & Wheeler, 2002).

At low-income levels, countries shift from agriculture to industry, and pollution intensity rises as a result of growing mass production and consumption. This is due to the greater use of natural resources, increased pollution emissions, and demands for higher output. Meanwhile, at high-income levels, the progress of economic development is dominated by the post-industrial or service economy. At this stage, environmental awareness rises, spending on the environment is higher, technological efficiency is increased, and demand for environmentally friendly goods/services increases (Mardani et al., (2019). The movement of the curve that begins to balance brings the industrial sector cleaner, people value the environment more, and regulation becomes more effective (Dasgupta et al., 2002).

***D) Previous Research***

Research from Adzawla et al. (2019) entitled "Greenhouse Gasses Emission And Economic Growth Nexus Of Sub-Saharan Africa" explains that there is a monotonic decreasing relationship between economic growth and environmental quality in the long run. Global CO2 emissions have a significant negative impact on the economic growth of SSA. Green technology policies are needed to maintain economic growth without increasing GHG emissions. Furthermore, the research of Dankyi et al. (2022) entitled "Human Capital, Foreign Direct Investment, And Economic Growth: Evidence From ECOWAS In A Decomposed Income Level Panel" explains that human capital, FDI, CO2, and urbanization have a positive effect on economic growth in ECOWAS. However, the effect varies depending on the income group (LMIC and LIC).

Furthermore, research that discusses human capital or the Human Development Index is research from Khan et al. (2023) entitled "Do Natural Disasters Affect Economic Growth? The Role Of Human Capital, Foreign Direct Investment, And Infrastructure Dynamics" explains that the positive relationship between human capital and economic growth in High-Income Countries (HIC), Upper-Middle Income Countries (UMIC), and Low Middle-Income Countries (LMIC). The next study, Muqorrobin (2017), titled "The Effect of the Human Development Index (Ipm) on Economic Growth in East Java Province," explains that the human development index variable has a negative and significant effect on economic growth in East Java Province. Where every economic growth increases by 1%, the human development index will decrease by 0.19%. Conversely, if the human development index increases by 1%, economic growth will decrease by 19.29%.

The research discusses investment in research by Darwanti et al. (2021) in their study entitled "Contribution Of Domestic Direct Investment And Direct Foreign Investment To Economic Growth In Indonesia Joko Widodo Era," explaining that FDI has a partially negative effect on economic growth in Indonesia. Further research, specifically Ayenew (2022), entitled "The Effect Of Foreign Direct Investment On The Economic Growth Of Sub-Saharan African Countries: An Empirical Approach," explains that in the long run, foreign direct investment has a positive and significant effect, but is statistically insignificant in the short term. The study concluded that foreign direct investment increases long-term economic growth.

## III. RESULTS AND DISCUSSION

***A) Stationarity Test***

The first step in using the VAR / VECM model is to conduct a stationary test. The stationary test aims to avoid autocorrelation problems that cause data to be non-stationary. Non-stationary data will result in biased data processing results. This test was developed by Dickey and Fuller using the Augmented Dickey-Fuller Test (ADF). The stationarity test that will be used is the ADF (Augmented Dickey-Fuller) test, with a 5% real level. This unit root test is conducted at the level and the first difference. Since most of the data did not pass at the level level, the test was continued at the first difference level. The ADF stationary test results are presented in Table 1 as follows:

**Table 1 Stationary Test Results**

| Indonesia | | | Vietnam | | |
|---|---|---|---|---|---|
| **Variable** | **Probability** | **Level** | **Variable** | **Probability** | **Level** |
| PE | 0.0000 | 1st Difference | PE | 0.0000 | 1st Difference |
| FDI | 0.0001 | 1st Difference | FDI | 0.0001 | 1st Difference |
| IPM | 0.0003 | 1st Difference | IPM | 0.0000 | 1st Difference |
| Emisi | 0.0002 | 1st Difference | Emisi | 0.0094 | 1st Difference |

Based on Table 1, it can be seen that both Indonesian and Vietnamese data have a probability value of less than 5%, indicating that both datasets are stationary at the first difference.

***B) Optimal Lag Test***

The next step in estimating the VAR model is to determine the optimal lag to be used in the VAR estimation. The determination of the number of lags (order) to be used in the VAR model can be determined based on the criteria of the minimum Aike Information Criterion (AIC) value.

**Table 2 Optimal Lag Test**

Indonesia

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -219.3637 | NA | 34.44990 | 14.89092 | 15.07774 | 14.95068 |
| 1 | -114.1130 | 175.4179* | 0.090892* | 8.940867* | 9.874999* | 9.239704* |
| 2 | -104.1260 | 13.98185 | 0.144624 | 9.341731 | 11.02317 | 9.879637 |
| 3 | -88.78704 | 17.38412 | 0.178990 | 9.385802 | 11.81454 | 10.16278 |
| 4 | -67.54107 | 18.41317 | 0.181232 | 9.036071 | 12.21212 | 10.05212 |

Vietnam

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -229.2104 | NA | 40.22210 | 15.04584 | 15.23087 | 15.10615 |
| 1 | -122.0252 | 179.7946* | 0.113356 | 9.162915 | 10.08807* | 9.464492 |
| 2 | -103.5749 | 26.18746 | 0.102499 | 9.004834 | 10.67011 | 9.547672 |
| 3 | -81.92134 | 25.14610 | 0.082828* | 8.640087* | 11.04548 | 9.424186* |

Based on the results of data processing, it can be seen that for the Indonesian data, the minimum AIC value, marked by the sign (*), is located at lag 1. So, it can be concluded that the optimum lag length to be used by Indonesian data is at lag 1. For Vietnamese data, the minimum AIC value marked by (*) is located at lag 3, so in this data, the optimum lag length to be used is lag 3.

***C) VAR Stability Test***

Before entering the further stages of analysis, the estimation results of the VAR system of equations that have been formed need to be tested for stability. The VAR stability test is needed because if the VAR stability estimation result is unstable, the IRF and FEVD analysis will be invalid. Based on the test results, a VAR system is said to be stable if all of its roots have a modulus smaller than one.

**Table 3 VAR Stability Test**

Indonesia

| Root | Modulus |
|---|---|
| 0.101747 - 0.634475i | 0.642582 |
| 0.101747 + 0.634475i | 0.642582 |
| -0.238862 | 0.238862 |
| -0.154599 | 0.154599 |

Vietnam

| Root | Modulus |
|---|---|
| 0.957367 | 0.957367 |
| -0.269054 - 0.893882i | 0.933497 |
| -0.269054 + 0.893882i | 0.933497 |
| 0.781568 - 0.234281i | 0.815927 |
| 0.781568 + 0.234281i | 0.815927 |
| -0.096745 - 0.753784i | 0.759967 |
| -0.096745 + 0.753784i | 0.759967 |
| 0.317642 - 0.645315i | 0.719256 |
| 0.317642 + 0.645315i | 0.719256 |
| -0.540485 | 0.540485 |
| 0.432906 | 0.432906 |
| 0.102966 | 0.102966 |

Based on the data processing of the Indonesian and Vietnamese data, the root value has a modulus greater than 1, indicating that the two datasets can be declared stable.

***D) Granger Causality Test***

The causality test is conducted to determine whether an endogenous variable can be treated as an exogenous variable. This stems from the ignorance of the influence between variables. In this concept, a variable X is said to cause Y if the realization of X occurs first, then Y and the realization of Y does not precede the realization of X. Thus, the Granger causality test can be tested with the VAR model.

**Table 4 Granger Causality Test**

| Indonesia | | | | Vietnam | | | |
|---|---|---|---|---|---|---|---|
| Null Hypothesis: | Obs | F-Statistic | Prob. | Null Hypothesis: | Obs | F-Statistic | Prob. |
| FDI does not Granger Cause PE | 32 | 0.40579 | 0.6704 | FDI does not Granger Cause PE | 32 | 2.62979 | 0.0905 |
| PE does not Granger Cause FDI | | 0.37664 | 0.6897 | PE does not Granger Cause FDI | | 2.23714 | 0.1262 |
| IPM does not Granger Cause PE | 32 | 0.57342 | 0.5703 | IPM does not Granger Cause PE | 32 | 2.54413 | 0.0972 |
| PE does not Granger Cause IPM | | 1.07272 | 0.3562 | PE does not Granger Cause IPM | | 0.28131 | 0.7570 |
| LOGEMISI does not Granger Cause PE | 32 | 0.29142 | 0.7495 | LOGEMISI does not Granger Cause PE | 32 | 3.59504 | 0.0413 |
| PE does not Granger Cause LOGEMISI | | 0.09569 | 0.9091 | PE does not Granger Cause LOGEMISI | | 0.90053 | 0.4182 |
| IPM does not Granger Cause FDI | 32 | 1.96083 | 0.1603 | IPM does not Granger Cause FDI | 32 | 0.88733 | 0.4234 |
| FDI does not Granger Cause IPM | | 11.3115 | 0.0003 | FDI does not Granger Cause IPM | | 1.29305 | 0.2909 |
| LOGEMISI does not Granger Cause FDI | 32 | 1.33180 | 0.2808 | LOGEMISI does not Granger Cause FDI | 32 | 1.93112 | 0.1645 |
| FDI does not Granger Cause LOGEMISI | | 0.62043 | 0.5452 | FDI does not Granger Cause LOGEMISI | | 0.10384 | 0.9017 |
| LOGEMISI does not Granger Cause IPM | 32 | 1.45817 | 0.2504 | LOGEMISI does not Granger Cause IPM | 32 | 12.9276 | 0.0001 |
| IPM does not Granger Cause LOGEMISI | | 1.69697 | 0.2022 | IPM does not Granger Cause LOGEMISI | | 1.40144 | 0.2636 |

Based on data processing of Indonesian and Vietnamese data, variables with a causal relationship are those that have a probability value greater than 0.05. The variable has a causal relationship with the FDI variable and HDI, with a probability value of 0.0003. According to Vietnam's data, the Emissions variable has a causal relationship with the PE variable, with a probability of 0.0413. In addition, the Emissions variable also has a causal relationship with the HDI variable, which has a probability value of 0.0001.

### *E) Cointegration Test*

The cointegration test is conducted to determine the existence of a long-term and short-term relationship between variables. If there is cointegration in variables that have a probability value of less than 0.05, it can be ascertained that there is a long-term relationship. The method that can be used to test for the existence of cointegration is the Johansen Cointegration method.

**Table 5 Cointegration Test**

| Indonesia | | | | | Vietnam | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Unrestricted Cointegration Rank Test (Trace) | | | | | Unrestricted Cointegration Rank Test (Trace) | | | | |
| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** | Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
| None * | 0.634703 | 49.69793 | 47.85613 | 0.0332 | None * | 0.687293 | 76.03123 | 47.85613 | 0.0000 |
| At most 1 | 0.263595 | 17.47248 | 29.79707 | 0.6051 | At most 1 * | 0.571923 | 41.15661 | 29.79707 | 0.0016 |
| At most 2 | 0.203825 | 7.681293 | 15.49471 | 0.5001 | At most 2 * | 0.310246 | 15.70307 | 15.49471 | 0.0465 |
| At most 3 | 0.012031 | 0.387339 | 3.841465 | 0.5337 | At most 3 * | 0.141025 | 4.560475 | 3.841465 | 0.0327 |

Based on the data processing that has been done, the Indonesian data has 1 rank indicator that has cointegration, where the trace statistic value is greater than the critical value, which has a probability value of <0.05. In Vietnam data, 4 rank indicators have a cointegration value where the trace statistic value is greater than the critical value and has a probability value <0.05. Thus, it can be concluded that the Indonesian and Vietnamese data exhibit a long-term equilibrium, and the next suitable model is the Vector Error Correction Model (VECM).

### *F) VECM (Vector Error Correction Model) Estimation Results*

Regarding the estimation results of previous studies, a cointegration relationship is identified, so the next step is to employ the VECM method. The VECM estimation results will obtain the short-term and long-term relationship between the independent variable and the dependent variable.

**Table 6 Short-term Estimates**

| Indonesia | | | |
|---|---|---|---|
| Variable | Coefficient | t-statistic | Prob |
| CointEq1 | -0.811053 | -3.07013 | 0.0050 |
| PE | 0.131052 | 0.70378 | 0.4878 |
| FDI | 0.608620 | 2.23053* | 0.0346 |
| IPM | -4.815944 | -2.84355* | 0.0086 |
| Emisi | 29.92981 | 1.57492 | 0.1274 |

| Vietnam | | |
|---|---|---|
| Variable | Coefficient | Prob |
| FDI | 1.590667 | 0.2308 |
| IPM | 2.961927 | 0.0636 |
| Emisi | 3.324221 | 0.0465 |

Based on Table 6 on Indonesian data, it can be concluded that in the short term, the FDI variable has a positive and significant effect on the PE variable with a t-statistic of 2.23053 < t-table with a coefficient of 0.608620, which means that when FDI increases by 1 million dollars in the previous period, it will increase economic growth in the current year by 0.608620%.

The HDI variable has a negative and significant effect on the PE variable with a t-statistic -2.884355>t-table with a coefficient of -4.815944, which means that when the HDI variable increases by 1 index point in the previous period, it will reduce economic growth in the current year by 4.815944%. The last is the Emissions variable, which has a positive and insignificant effect on the PE variable with a t-statistic of 1.57492 < t-table with a coefficient of 29.92981, which means that when emissions increase by 1 percent in the previous period, it will increase economic growth in the current year by 29.92981%.

Furthermore, in Table 6 Vietnamese data, it can be concluded that in the short term, the FDI variable has a positive and insignificant effect on PE with a probability value of 0.2308>0.05 and a value of 1.590667 which means that when FDI increases by 1 million dollars, it will increase economic growth by 1.590667%. Furthermore, the HDI variable has a positive and insignificant effect on economic growth, with a probability of 0.0636 > 0.05 and a value of 2.961927. This means that if the HDI increases by 1 index, economic growth will increase by 2.961927%. Finally, the emissions variable has a positive and significant effect on economic growth, with a probability value of 0.0465 < 0.05 and a coefficient of 3.324221. This means that a 1% increase in emissions will result in a 3.324221% increase in economic growth.

Furthermore, the long-term estimation results of Indonesia and Vietnam can be seen in table 7 below:

**Table 7 Long-term Estimation**

Indonesia

| Variable | Coefficient | t-statistic | Prob |
|---|---|---|---|
| FDI | 0.286391 | 3.10069 | 0.0020 |
| IPM | -5.192664 | -5.52827 | 0.0001 |
| Emisi | 72.05822 | 5.93889 | 0.0001 |

Vietnam

| Variable | Coefficient | t-statistic | Prob |
|---|---|---|---|
| FDI | 2.582101 | 4.25111 | 0.0010 |
| IPM | -2.678524 | -5.57436 | 0.0001 |
| Emisi | 24.63324 | 5.37424 | 0.0001 |

Based on Table 7, it can be seen that in the long run on Indonesian data, the FDI variable has a positive and significant effect with a t-statistic of 3.10069> t-table with a coefficient of 0.286391, which means that when FDI increases by 1 million US dollars in the previous period, it will increase economic growth by 0.286391 percent in the current year. The HDI variable has a negative and significant effect with a t-statistic of -5.52827>t-table with a coefficient of -5.192664, which means that when HDI increases by 1 index in the previous period, it will reduce economic growth by 5.192664 percent in the current year. The Emissions variable has a positive and significant effect with a t-statistic of 5.93889>t-table with a coefficient of 72.05822, which means that when emissions increase by 1 percent in the previous period, it will increase economic growth by 72.05822% in the current year.

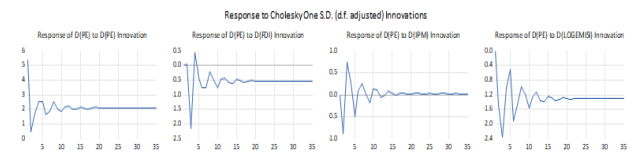
Furthermore, the Vietnamese data concluded in the long term that the FDI variable has a positive and significant effect on the PE variable with a t-statistic of 4.25111>t-table and has a coefficient of 2.2582101 which means that when FDI has increased by 1 million dollars in the previous period, it will increase economic growth in the current year by 2.2582101%. Furthermore, the HDI variable has a negative and significant effect on the PE variable with a t-statistic of -5.57436> t-table with a coefficient of -2.678524, which means that when HDI increases by 1 index in the previous period, it will increase economic growth in the current year by 2.678524%. The last is the Emissions variable, which has a positive and significant effect on the PE variable, with a t-statistic of 5.37424 (greater than the t-table) and a coefficient of 24.63324. This means that when Emissions increase by 1 percent, economic growth will decrease by 24.63324%.

### *G) Impulse Response Function Analysis*

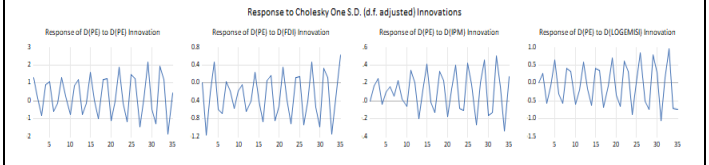
The variable behavior in the shock rate is evident in the Impulse Response Function (IRF) results. The following IRF results can be seen in Table 8 below:

**Table 8 IRF**

Indonesia




Vietnam




Based on Table 8, it can be seen that the Indonesian data includes 4 graphs that illustrate the response to other variables. The first is the response of economic growth (PE) to a shock on PE itself, which shows that the response is initially positive, then

decreases in the period 5 to 15, and finally stagnates in the period 20 to 35. The second is the response of economic growth (PE) to a shock in FDI, which shows that PE responds positively at first but then stabilizes near zero in the period 20-35, indicating The third is the PE response to a shock on HDI, which shows that the graph shows small fluctuations, which then stabilizes near zero in the period 16-35. This indicates that the effect of HDI on PE is relatively small and quickly reaches equilibrium. The fourth is the response of PE to a shock on emissions, which shows that initially, the response is positive, then decreases and stabilizes in the 22-35 period, indicating that increased emissions contribute to PE, but only in the short term.

Next is the response result from Vietnam data, namely, PE responds to a shock to itself. There is a sizable spike around 2.5 in the early period, followed by a slow decline while fluctuating. The second is the response of PE to the FDI shock, where the initial response is positive, at around 0.6 in the first period, followed by small fluctuations of around 0.2-0.4. In the short term, the direct effect is positive, indicating that an increase in FDI can push up economic growth. Between 15-35, the response tends to fluctuate but remains stable and positive, indicating that, in the long run, FDI can boost economic growth. The third response of PE to the shock in the HDI (Human Development Index) is a small negative response (- 0.2) at the beginning of the period, which then fluctuates and persists for a long time. In the short and long term, an increase in HDI leads to economic growth decline due to significant government spending aimed at improving the human development index. Finally, the response of PE to the shock in Emissions. At the beginning of the period, it responds positively (around 0.3-0.4), then fluctuates up and down in the long run. This suggests that the rise in emissions is attributed to an increase in the production of goods and services.

### *H) Variance Decomposition*

Forecast Error Variance Decomposition (FEVD) decomposes the innovations in a variable into components of other variables in a VAR. The information conveyed in the FEVD is the proportion of sequential movements that are due to the shocks themselves and the variables themselves.

**Table 9 Variance Decompotition**

Indonesia

Variance Decomposition of D(PE):

| Period | S.E. | D(PE) | D(FDI) | D(IPM) | D(LOGEMISI) |
|---|---|---|---|---|---|
| 1 | 5.383287 | 100.0000 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 5.674880 | 90.77062 | 0.008174 | 2.408395 | 6.812810 |
| 3 | 6.769244 | 70.05675 | 10.21268 | 2.900466 | 16.83011 |
| 4 | 7.309080 | 71.93708 | 9.124035 | 2.611378 | 16.32751 |
| 5 | 7.782168 | 74.10855 | 8.333733 | 2.729837 | 14.82788 |
| 6 | 8.215589 | 70.43863 | 8.374010 | 2.463300 | 18.72406 |
| 7 | 8.599006 | 69.13243 | 8.465683 | 2.331411 | 20.07047 |
| 8 | 9.015639 | 70.66299 | 7.760508 | 2.120924 | 19.45558 |
| 9 | 9.335003 | 70.67356 | 7.517392 | 2.013012 | 19.79604 |
| 10 | 9.685467 | 69.49305 | 7.598612 | 1.887188 | 21.02115 |
| 11 | 10.01366 | 69.56438 | 7.344491 | 1.775966 | 21.31517 |
| 12 | 10.33144 | 70.01214 | 7.073740 | 1.670935 | 21.24319 |
| 13 | 10.62945 | 69.73715 | 6.978813 | 1.578633 | 21.70541 |
| 14 | 10.92748 | 69.43557 | 6.912315 | 1.499175 | 22.15294 |
| 15 | 11.21877 | 69.57260 | 6.744618 | 1.423174 | 22.25961 |
| 16 | 11.49705 | 69.62990 | 6.619049 | 1.353319 | 22.39573 |
| 17 | 11.77001 | 69.46343 | 6.555010 | 1.293871 | 22.68769 |
| 18 | 12.03871 | 69.40626 | 6.470488 | 1.238280 | 22.88497 |
| 19 | 12.30104 | 69.45838 | 6.369853 | 1.186170 | 22.98559 |
| 20 | 12.55614 | 69.42577 | 6.297708 | 1.138544 | 23.13798 |
| 21 | 12.80726 | 69.35408 | 6.240397 | 1.095019 | 23.31050 |
| 22 | 13.05411 | 69.34606 | 6.172390 | 1.054513 | 23.42704 |
| 23 | 13.29563 | 69.34873 | 6.107930 | 1.016703 | 23.52664 |
| 24 | 13.53266 | 69.31416 | 6.056878 | 0.981677 | 23.64729 |
| 25 | 13.76609 | 69.28516 | 6.007983 | 0.949116 | 23.75774 |
| 26 | 13.99564 | 69.27940 | 5.957171 | 0.918526 | 23.84490 |
| 27 | 14.22116 | 69.26672 | 5.911615 | 0.889839 | 23.93182 |
| 28 | 14.44325 | 69.24385 | 5.871375 | 0.862987 | 24.02179 |
| 29 | 14.66214 | 69.22946 | 5.831639 | 0.837722 | 24.10118 |
| 30 | 14.87772 | 69.22072 | 5.793144 | 0.813859 | 24.17228 |
| 31 | 15.09013 | 69.20695 | 5.758186 | 0.791344 | 24.24352 |
| 32 | 15.29968 | 69.19242 | 5.725422 | 0.770083 | 24.31208 |
| 33 | 15.50643 | 69.18237 | 5.693477 | 0.749931 | 24.37422 |
| 34 | 15.71039 | 69.17282 | 5.663237 | 0.730807 | 24.43313 |
| 35 | 15.91174 | 69.16151 | 5.635057 | 0.712656 | 24.49078 |

Vietnam

Response of D(PE):

| Period | D(PE) | D(FDI) | D(IPM) | D(LOGEMISI) |
|---|---|---|---|---|
| 1 | 1.296477 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 0.141841 | -1.171837 | 0.165477 | 0.276048 |
| 3 | -0.822337 | -0.227824 | 0.253453 | -0.553579 |
| 4 | 0.926984 | 0.455727 | -0.039857 | -0.088965 |
| 5 | 1.097647 | -0.600505 | 0.105018 | 0.643760 |
| 6 | -0.581740 | -0.690350 | 0.157220 | -0.312170 |
| 7 | -0.149151 | 0.028977 | 0.052343 | -0.567237 |
| 8 | 1.315592 | -0.184739 | 0.223527 | 0.422787 |
| 9 | 0.292350 | -0.578724 | 0.024661 | 0.321688 |
| 10 | -0.779059 | -0.179951 | -0.060278 | -0.586756 |
| 11 | 0.828336 | -0.049498 | 0.341627 | -0.186558 |
| 12 | 1.171166 | -0.642126 | 0.197757 | 0.596386 |
| 13 | -0.749218 | -0.415429 | -0.202574 | -0.154375 |
| 14 | -0.117401 | 0.234698 | 0.120549 | -0.622637 |
| 15 | 1.616950 | -0.398135 | 0.405630 | 0.400080 |
| 16 | 0.061169 | -0.866378 | -0.016683 | 0.356843 |
| 17 | -1.001108 | 0.063753 | -0.134147 | -0.695059 |
| 18 | 1.169465 | 0.161631 | 0.324710 | -0.091500 |
| 19 | 1.227798 | -0.854862 | 0.232166 | 0.706429 |
| 20 | -1.087294 | -0.510703 | -0.180838 | -0.344358 |
| 21 | -0.023511 | 0.362679 | 0.131423 | -0.665006 |
| 22 | 1.893890 | -0.387847 | 0.394260 | 0.611623 |
| 23 | -0.160873 | -0.910609 | -0.082724 | 0.329293 |
| 24 | -1.168879 | 0.113713 | -0.109945 | -0.886840 |
| 25 | 1.487486 | 0.133347 | 0.420969 | -0.000143 |
| 26 | 1.235250 | -0.947015 | 0.180343 | 0.851592 |
| 27 | -1.435145 | -0.409776 | -0.271271 | -0.495407 |
| 28 | 0.154698 | 0.463146 | 0.206060 | -0.730690 |
| 29 | 2.180153 | -0.554556 | 0.455393 | 0.798817 |
| 30 | -0.500312 | -0.975770 | -0.168664 | 0.290527 |
| 31 | -1.309237 | 0.319110 | -0.130541 | -1.064851 |
| 32 | 1.918696 | 0.130105 | 0.505537 | 0.142250 |
| 33 | 1.177073 | -1.150028 | 0.156062 | 0.970362 |
| 34 | -1.861389 | -0.326556 | -0.338592 | -0.712920 |
| 35 | 0.419797 | 0.620750 | 0.271364 | -0.751962 |

Based on the FEVD estimation results for Indonesia, it can be seen that in the first period, 100% of the variation in D(GDP growth) is explained by its past values. FDI, HDI, and Emissions have not yet made a significant contribution in the initial period (all 0%). In the short term, fluctuations in economic growth are more influenced by its internal dynamics. By the fifth period, GDP growth contributes 55%, FDI contributes 12%, HDI contributes 5%, and Emissions contribute 26%. The contributions of FDI and Emissions begin to become significant, indicating that in the medium term, investment and emissions become important factors in explaining economic growth. In the 30th period, GDP growth contributes 47%, FDI contributes 8%, HDI contributes 1%, and Emissions Contribute 41%. In the long term, the contribution of emissions increases.

Furthermore, based on the FEVD estimation results for Vietnam in the first period, 100% of the variation in GDP growth comes from its past values (as the model has not yet incorporated the influence of other variables). In the fifth period, GDP growth contributes 60%, FDI contributes 27%, HDI contributes 1%, and Emissions Contribute 10%. The contribution of FDI becomes significant, indicating that, in the medium term, FDI is a crucial factor in driving economic growth. By the 30th period, GDP growth contributed 64%, FDI 17%, HDI 2%, and Emissions 15%, indicating that although the contributions of FDI and Emissions decreased compared to the medium term, they remained significant.

### *I) DISCUSSION*

#### a. The Impact of FDI on Economic Growth in the Short and Long Term

Based on the estimation results of the Vector Error Correction Model (VECM), it is found that Foreign Direct Investment (FDI) has a positive and significant effect on economic growth in Indonesia in the short term. This finding confirms the initial

hypothesis that FDI has a positive influence on economic growth. This aligns with the Investment Theory introduced by Harrod-Domar, which posits that investment affects both demand and supply. In the long run, investment leads to an increase in the capital stock, including roads, factories, and other forms of infrastructure. In an economy, investment plays a crucial role, as each additional unit of investment leads to a rise in the amount of output produced (Elina, 2023).

This result is consistent with the study by Arbia et al. (2024), which explains that FDI has a significant and positive impact on economic growth. According to Borensztein, De Gregorio, and Lee (1998), FDI not only brings capital but also transfers advanced technologies that enhance national productivity compared to domestic investment. This is especially relevant for developing countries like Indonesia. Similarly, the research conducted by Millia, Ernawati, and Heriberta (2023) found that FDI not only increases capital but also strengthens Indonesia's export capacity and integration into global supply chains. This study shows that the presence of FDI enhances the competitiveness of Indonesian products in international markets, as foreign investors often introduce international quality standards. Products from sectors that receive significant Foreign Direct Investment (FDI), such as electronics manufacturing, textiles, automotive, and palm oil, are better equipped to penetrate export markets.

Meanwhile, in Vietnam, the estimation results indicate that FDI has a positive but insignificant effect on economic growth in the short term. This indicates that foreign direct investment entering the country does not immediately drive economic growth. In the context of economic theory, this finding is consistent with the early perspectives of the Harrod-Domar growth model. According to Harrod (1939) and Domar (1946), economic growth strongly depends on the level of investment and the efficiency of capital utilization. However, Harrod-Domar also emphasizes that investment requires time to be converted into productive output through the full utilization of capital and labor (Elina, 2023). Thus, in the short term, a surge in FDI may not result in immediate economic growth due to the ongoing adjustment process within the domestic economic structure. The impact of foreign direct investment on economic growth also depends on the level of human development in absorbing technological advancements, as well as the host country's infrastructure capacity. When these conditions are not optimal, FDI may take longer to show its positive effects (Borensztein et al., 1998). This aligns with the study by Nguyen et al. (2021), which examined the impact of FDI on Vietnam's economic growth between 2000 and 2019. The study found that although FDI played a positive role in accelerating Vietnam's economic growth, its short-term impact was not statistically significant. This was attributed to both external and internal factors that reduced the immediate effectiveness of FDI on economic output. Tran et al. (2023) further explain that while FDI has a positive influence on Vietnam's economy, the inability to capitalize on the technological and managerial spillovers from FDI in the short term results in an insignificant effect on economic growth. Their study also highlights the importance of policy quality in optimizing the potential benefits of FDI.

In the long term, however, FDI has a positive and significant effect on Indonesia's economic growth. Foreign Direct Investment contributes positively and significantly in the long run because it not only brings capital inflows but also introduces advanced technologies that were previously unavailable to local firms. This not only enhances productivity but also creates opportunities for domestic companies to become suppliers to foreign enterprises, thereby fostering economic growth (Harianto, S. K., & Sari, D. W., 2020).

In Vietnam, FDI has a positive and significant impact on long-term economic growth. This is because FDI contributes to job creation. For example, foreign investment in Vietnam's manufacturing and heavy industry sectors has generated thousands of both direct and indirect jobs. FDI has a significantly positive influence on Vietnam's long-term economic growth, with the manufacturing and export sectors being the main beneficiaries of FDI inflows (Nguyen et al., 2023). According to Vietnam's General Statistics Office (2022), FDI-driven sectors such as electronics manufacturing and textiles have absorbed a substantial amount of labor and created more than 1.5 million new jobs over the past decade. This has contributed to reducing unemployment, increasing household income, and improving living standards in Vietnam. The largest sources of FDI are from Asian countries, particularly Japan, South Korea, and China, which focus on investments in the heavy industry and technology sectors. This aligns with the Vietnamese government's policy of continuously improving the investment climate and opening opportunities for the growth of these sectors (Vietnam General Statistics Office, 2022).

**b. The Impact of the Human Development Index (HDI) on Economic Growth in the Short and Long Term**

In the short term, the Human Development Index (HDI) has a negative and significant effect on economic growth in Indonesia. Based on these results, the hypothesis stating that HDI has a positive effect on economic growth is rejected, as the estimation results indicate the opposite. An increase in the Human Development Index appears to be associated with a reduction in economic growth in Indonesia. This finding is consistent with the study by Muqorrobin (2017), which found that the HDI variable had a negative and significant effect on economic growth in East Java Province.

This is an intriguing result, as the endogenous growth theory proposed by Romer (1994) explains that, in the long run, economic growth is influenced not only by external factors but also by internal factors such as innovation, human capital investment, and knowledge. The theory posits that investing in human capital is crucial when the HDI is high, as it should significantly contribute to increasing the production of goods and services (Muqorrobin, 2017). However, empirical conditions in Indonesia reveal a more complex dynamic. According to data from the Central Bureau of Statistics (BPS), Indonesia's Human Development Index (HDI) increased from 66.53 in 2010 to 74.39 in 2023 (BPS, 2024). Meanwhile, Indonesia's economic growth has exhibited fluctuating trends, with a noticeable slowdown over the past five years, largely due to the COVID-19 pandemic. The negative and significant impact of HDI on economic growth in both the short and long term can be attributed to the ongoing mismatch between education and employment opportunities, leading to an increase in educated unemployment. According to BPS (2024), the unemployment rate among university graduates (Bachelor's degree) rose from 5.18% in 2023 to 5.25% in 2024.

Meanwhile, in Vietnam, the Human Development Index (HDI) has a positive but insignificant effect on economic growth in the short term. This finding aligns with the theory proposed by Romer (1994), which posits that improvements in the quality of human capital can stimulate the production of goods and services. Vietnam's HDI has shown a consistent upward trend over the past decade, rising from 48.2 to 73.6 in 2023. This condition is also supported by Hoa et al. (2016), who found that while HDI has a positive impact on economic growth, the effect is not significant in the short term. This suggests that improvements in HDI components require time before they can make a meaningful contribution to economic growth.

However, in the long term, HDI has a negative and significant impact on economic growth in both Indonesia and Vietnam. The increase in HDI appears to be associated with a decline in economic growth over time. This negative long-term effect is partly due to various issues in the education sector that result in inefficiencies and economic losses. According to Indonesia's Ministry of Health (2024), the national education budget increased in 2024 to IDR 665 trillion, up 8.1% from the previous year's IDR 612 trillion. However, this continuous increase over the past five years has not been matched by improvements in educational quality. A session of Indonesia's House of Representatives, published by Emedia RI (2025), reported that around 4% of the education budget in 2024, or approximately IDR 111 trillion, was not absorbed. These funds could have been used to improve school infrastructure and teacher welfare but remained unutilized due to ineffective budget management. Additionally, Indonesia continues to face corruption in the education sector, with approximately 21.7% of reported corruption cases involving the misuse of BOS (School Operational Assistance) funds—resources intended to support school operations (Sustain, 2024).

In Vietnam, HDI also has a negative effect on long-term economic growth, primarily due to the high expenditures in the health sector. In 2022, health spending reached USD 18.5 billion (equivalent to 4.6% of the country's GDP) and rose to 5.1% in 2023. Meanwhile, corruption scandals such as the procurement of COVID-19 testing equipment involving the government and Việt Á Technology Corporation resulted in losses amounting to USD 22 million. According to the Vietnam General Statistics Office (2024), the yearly increase in HDI has not been accompanied by sufficient job creation. As a result, in 2023, the unemployment rate among the highly educated reached 2.69% of the total labor force with higher education, higher than the national average unemployment rate of 1.60% in the same year. Rising educated unemployment imposes an economic burden on the government and weakens the potential impact of HDI improvements on long-term economic growth.

**c. The Impact of Emissions on Economic Growth in the Short and Long Term**

Based on the estimation results from the Vector Error Correction Model (VECM), emissions have a positive but insignificant effect on short-term economic growth in Indonesia. These findings suggest that the hypothesis stating that emissions have a positive impact on economic growth is accepted. This result aligns with the Environmental Kuznets Curve (EKC) theory, which posits that environmental degradation, as indicated by rising emissions, is a consequence of mass production driven by structural economic shifts from agriculture to industry (Shaharir & Alinor, 2013). This condition is also consistent with the study by Amalina et al. (2023), which explained that $CO_2$ emissions become significant when non-renewable energy consumption leads to increased production, thereby boosting GDP. However, when emissions continue to rise to the point that the government must allocate increasing environmental restoration costs, the effect of emissions on GDP becomes insignificant. Similarly, Dankyi et al. (2022) found that human capital, Foreign Direct Investment (FDI), Carbon Dioxide ($CO_2$) emissions, and urbanization all have a positive impact on economic growth. In the short term, emissions have a limited impact on economic growth due to unstable structural transitions.

Meanwhile, the VECM estimation for Vietnam indicates that emissions have a positive and statistically significant impact on short-term economic growth. This result also supports the Environmental Kuznets Curve (EKC) theory, which suggests that environmental degradation caused by rising emissions is linked to mass production and structural economic shifts from agriculture to industry (Shaharir & Alinor, 2013). The Asian Development Bank (ADB) Report (2022) also noted

that the development of Vietnam's export-oriented, energy-intensive manufacturing sector has consistently driven economic growth, albeit at the cost of higher carbon emissions.

However, in the long-term estimation, emissions have a positive and significant effect on Indonesia's economic growth. Indonesia is ranked among the top ten global emitters of carbon. This is evident from the continuous rise in Indonesia's total carbon emissions. The main reason behind this trend is the country's heavy dependence on non-renewable energy sources, particularly fossil fuels, to support its economic activities. As economic activity increases, GDP also rises accordingly (Amalina et al., 2023). These findings align with the study conducted by Rahmandani and Dewi (2023), which found a positive and significant relationship between $CO_2$ emissions and GDP. The use of fossil fuels remains a core component of industrial production processes, directly linked to economic growth and resulting in higher carbon emissions (Ningtyas et al., 2024).

Similarly, in Vietnam, emissions also exhibit a positive and significant influence on long-term economic growth. This finding aligns with the Environmental Kuznets Curve (EKC) theory, which suggests that environmental degradation resulting from rising emissions is due to mass production driven by a structural economic transition from agriculture to industry (Shaharir & Alinor, 2013). This is further supported by Vo and Nguyen (2020), who explain that carbon emissions in Vietnam are statistically positively and significantly related to long-term GDP growth due to the country's high reliance on fossil-fuel-based industrial and export sectors.

## IV. CONCLUSION

This journal examines the relationship between environmental degradation and economic growth in Indonesia and Vietnam, considering both the short-term and long-term perspectives. Based on the research findings, several key points can be concluded:

1. The Impact of FDI on Economic Growth:

   In the case of Indonesia, FDI has a positive and significant impact on economic growth in both the short and long term. This is consistent with the Harrod-Domar theory, which emphasizes the role of investment in boosting economic output. Similarly, in the case of Vietnam, FDI has a positive but insignificant impact in the short term but becomes significant in the long term. This suggests that the effects of FDI take time to materialize, particularly in terms of job creation and technology transfer.
2. The Impact of HDI on Economic Growth:

   In both Indonesia and Vietnam, HDI has a negative and significant impact on long-term economic growth. The increase in HDI is not matched by sufficient employment absorption, resulting in educated unemployment and inefficiencies in education and healthcare spending.
3. The Impact of Emissions on Economic Growth:

   In both countries, emissions have a positive and significant effect on long-term economic growth, consistent with the Environmental Kuznets Curve (EKC) theory. The dependence on fossil fuels and industrialization are the main factors driving the rise in emissions and economic growth.
4. Policy Implications:
   a) The a need for balanced policies that promote both economic growth and environmental protection, such as decarbonizing industrial sectors and promoting green technologies.
   b) Improvements in education and healthcare quality must be accompanied by adequate job creation to maximize the benefits of human development.
   c) Optimizing FDI through policies that support technology transfer and the capacity building of local labor.

**Appendix**

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