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Does Regulatory Quality Matter? Evidence from FDI, Carbon Emissions, and Economic Growth in ASEAN Countries

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Abstract. Economic growth in ASEAN countries is closely linked to the role of foreign investment and environmental issues influenced by institutional quality. This study aims to analyze the effects of Foreign Direct Investment (FDI) and carbon emissions (CO_2) on economic growth, as well as to examine the role of regulatory quality as a moderating variable. This research adopts a quantitative approach using a panel data design across several ASEAN countries. The population consists of ASEAN member states, with the sample including Indonesia, Malaysia, Thailand, Vietnam, and the Philippines. Secondary data were obtained from the World Bank and the Worldwide Governance Indicators. The variables used in this study include GDP, FDI, CO_2 emissions, and regulatory quality. Data analysis was conducted using Moderated Regression Analysis (MRA). The results show that FDI and carbon emissions do not have a statistically significant effect on economic growth, while regulatory quality has a positive and significant effect. Moreover, regulatory quality moderates the relationship between FDI and economic growth in a negative direction. In conclusion, regulatory quality is a key factor in determining the effectiveness of foreign investment. The implication of this study is that strengthening governance is essential to promote sustainable economic growth in ASEAN countries.

Keywords: Foreign Direct Investment; Carbon Emissions; Regulatory Quality; Economic Growth; Moderated Regression Analysis.

I. Introduction

Economic growth is one of the key indicators of a country's development performance, particularly in developing regions such as ASEAN. Over the past few decades, ASEAN countries have demonstrated relatively strong economic growth, with an average Gross Domestic Product (GDP) growth rate of approximately 4–6% per year (World Bank, 2025b). In an effort to sustain this growth, ASEAN countries have actively attracted foreign investment as a source of financing and technology transfer. Empirical data indicate that Foreign Direct Investment (FDI) inflows to the ASEAN region reached more than USD 220 billion in 2022, positioning the region as one of the major global investment destinations. However, this economic expansion is often accompanied by increasing environmental pressures, particularly in the form of rising carbon emissions. This situation creates a persistent trade-off between economic growth and environmental sustainability, making it an increasingly relevant issue for academic inquiry.

On the other hand, carbon emissions are an important indicator in assessing the environmental impact of economic activities. The ASEAN region has experienced a significant increase in carbon emissions in recent years, in line with economic growth and industrialization. According to the International Energy Agency (IEA, 2022), carbon emissions in Southeast Asia have more than doubled since 2000, largely driven by high dependence on fossil fuels. Nevertheless, in the short run, rising carbon emissions are often positively associated with economic growth, particularly in developing countries that remain reliant on energy-intensive sectors. This condition reflects a complex and non-linear relationship between economic growth and environmental quality, highlighting the ongoing trade-off between development objectives and environmental sustainability.

The role of policy quality is crucial in bridging the relationship between foreign investment, carbon emissions, and economic growth. Regulatory quality, in particular, determines the extent to which economic activities are conducted efficiently and sustainably. Data from the Worldwide Governance Indicators show that regulatory quality across ASEAN countries remains heterogeneous, with some countries experiencing improvements, while others continue to face challenges in policy effectiveness (World Bank, 2025a). Countries with stronger regulatory quality tend to be more capable of mitigating the negative environmental impacts of investment and economic activities while still promoting economic growth. In contrast, weak regulatory frameworks may exacerbate environmental degradation without generating optimal economic benefits.

Although extensive studies have examined the relationship between foreign investment, carbon emissions, and economic growth, the empirical findings remain inconsistent. Some studies report a positive effect of foreign investment on economic growth, whereas others find insignificant or even negative relationships. Similarly, the nexus between carbon emissions and economic growth remains debated, particularly regarding the moderating role of institutional and policy factors. In this context, this study

proposes an integrated framework that combines foreign investment, carbon emissions, and regulatory quality within a single analytical model by incorporating a moderating variable, focusing on ASEAN countries with diverse economic and environmental characteristics. This approach is expected to provide a more comprehensive perspective compared to previous studies.

Based on this background, the objective of this study is to analyze the effect of foreign investment and carbon emissions on economic growth, as well as to examine the role of regulatory quality as a moderating variable in these relationships within ASEAN countries. This study is important as it offers a more comprehensive understanding of how institutional quality influences the interaction between economic growth and environmental sustainability. Furthermore, the findings are expected to contribute to the formulation of more effective policies aimed at achieving sustainable economic growth.

II. Literature Review

Economic growth is a central objective of macroeconomic policy, particularly in developing countries. According to neoclassical growth theory, economic growth is determined by the accumulation of capital, labor, and technological progress (Solow, 1956). In addition, endogenous growth theory emphasizes the crucial role of technological advancement and knowledge spillovers in sustaining long-term economic growth (Romer, 1990). In this context, foreign investment serves as an important source of capital accumulation and technology transfer that can enhance economic performance.

Foreign Direct Investment (FDI) is explained through Dunning's Eclectic Paradigm (1988), which posits that investment flows are driven by ownership, location, and internalization advantages. Countries with favorable economic conditions and supportive policy environments are more likely to attract foreign investment. Accordingly, FDI is expected to contribute positively to economic growth through capital inflows and productivity improvements.

However, the relationship between FDI and economic growth is not necessarily linear. The Pollution Haven Hypothesis suggests that multinational firms tend to relocate pollution-intensive production to countries with weaker environmental regulations (Copeland & Taylor, 2004). As a result, increased FDI inflows may also contribute to higher carbon emissions, particularly in developing economies.

Carbon emissions are closely associated with economic activities, especially those involving industrial production and energy consumption. Higher emissions often reflect increased economic activity; however, they also indicate growing environmental pressure. While some studies suggest that environmental degradation may negatively affect long-term economic sustainability, others argue that developing economies remain highly dependent on emission-intensive sectors for growth.

The relationship between economic growth and environmental degradation is commonly explained by the Environmental Kuznets Curve (EKC) framework, which proposes an inverted U-shaped relationship between income levels and environmental degradation (Grossman & Krueger, 1995). However, this study does not explicitly test the EKC hypothesis, but instead focuses on the direct impact of carbon emissions on economic growth.

Institutional theory highlights the importance of governance quality in shaping economic outcomes (North, 1990). Good governance, particularly regulatory quality, plays a key role in ensuring that economic activities are conducted efficiently and sustainably. Governance indicators developed by Kaufmann et al.(2010), such as the Worldwide Governance Indicators, provide a comprehensive measure of institutional quality, including regulatory effectiveness.

In this study, regulatory quality is expected to function as a moderating variable in the relationship between FDI, carbon emissions, and economic growth. Strong regulatory frameworks may enhance the positive effects of foreign investment while mitigating its negative environmental consequences. Conversely, weak governance may allow environmentally harmful economic activities to persist, thereby shaping the overall relationship between economic growth and environmental factors.

Based on this theoretical framework, this study aims to analyze the impact of foreign investment and carbon emissions on economic growth, as well as the moderating role of regulatory quality in these relationships.

III. Research Method

This study employs a quantitative approach to analyze the effects of foreign investment and carbon emissions on economic growth, as well as to examine the role of regulatory quality as a moderating variable. The analytical method used is panel data regression, which combines cross-sectional and time-series data to provide a more comprehensive empirical analysis.

The study focuses on ASEAN countries, namely Indonesia, Malaysia, Thailand, the Philippines, and Vietnam, over the observation period 2013–2023. The data used are secondary data obtained from official

sources, including the World Bank (World Development Indicators) and the Worldwide Governance Indicators (WGI). Data collection was conducted through documentation by retrieving datasets from the respective official databases.

The dependent variable in this study is economic growth, proxied by the natural logarithm of Gross Domestic Product (log GDP) at constant prices. The logarithmic transformation is applied to stabilize variance and reduce potential heteroskedasticity. The independent variables consist of Foreign Direct Investment (FDI), measured as net inflows as a percentage of GDP, and carbon dioxide (CO_2) emissions, measured in metric tons. The moderating variable is regulatory quality, proxied by the Regulatory Quality indicator from the Worldwide Governance Indicators, ranging from -2.5 to 2.5. In addition, the study includes trade openness as a control variable, measured as the ratio of total exports and imports to GDP.

This study applies Moderated Regression Analysis (MRA) using a stepwise estimation approach to examine the moderating effect of regulatory quality (Helm & Mark, 2012). The empirical model is constructed in three stages. The first model is used to estimate the direct effects of the independent variables on the dependent variable.

$$Yit = \beta0 + \beta1X1it + \beta2X2it + \varepsilon it$$

The second model is specified to assess the combined effects of the independent variables and the moderating variable on the dependent variable.

$$Yit = \beta0 + \beta1X1it + \beta2X2it + \beta3Zit + \varepsilon it$$

The third model is used to test the moderating effect through the interaction between the independent variables and the moderating variable. Mathematically, the regression models used in this study are specified as follows:

$$Yit = \beta0 + \beta1X1it + \beta2X2it + \beta3Zit + \beta5(X1it \times Zit) + \beta6(X2it \times Zit) + \varepsilon it$$

where i represents the cross-sectional unit (country) and t represents the time period.

Data analysis in this study is conducted in several stages. The first stage involves panel data model selection to determine the most appropriate model among the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). The selection process is carried out using the Chow test, Hausman test, and Lagrange Multiplier test. The second stage involves classical assumption testing, including tests for normality, multicollinearity, and heteroskedasticity, to ensure the validity and reliability of the regression model. The third stage applies Moderated Regression Analysis (MRA) using a stepwise approach by comparing the results across the three regression models. The moderating effect is confirmed when the interaction term exhibits a probability value below the predetermined significance level ($\alpha = 0.05$). The final stage consists of hypothesis testing, including the t-test to assess partial effects, the F-test to evaluate simultaneous effects, and the coefficient of determination (R^2) to measure the explanatory power of the model.

All data processing and statistical analyses are performed using EViews software. The estimation results are then interpreted to address the research objectives and to examine the moderating role of regulatory quality in the relationship between foreign investment, carbon emissions, and economic growth.

IV. Results and Discussion

1. Results

This study begins with model selection using the Chow test, Hausman test, and Lagrange Multiplier test to determine the most appropriate panel data estimation model.

Table 1 Model Selection Test Results

Chow Test	Hausman Test	Lagrange Multiplier
0.0000 < 0.05	0.0000 < 0.05	0.0000 < 0.05
FEM	FEM	REM

Based on the results presented in the table above, two consecutive tests indicate that the Fixed Effect Model (FEM) is the most appropriate specification. Therefore, the FEM is selected as the preferred estimation model for further analysis. Following this selection, the study proceeds with classical assumption testing:

Table 2. Classical Assumption Test Results

Uji	Indikator	Hasil
Multikolinieritas	VIF < 10	No evidence of multicollinearity is detected.
Heteroskedastisitas	Prob. < 0.05	Heteroskedasticity is present in the model
Normalittas	*Jarque-Bera > 0.05*	The data are normally distributed

The results reveal the presence of heteroskedasticity, as the p-value is below the 0.05 significance level (Baltagi, 2008). Accordingly, robust standard errors are applied to obtain consistent and reliable estimates.

Table 3. Baseline Regression Results (Non-Moderated Model)

Variabel	Koefisien	t-statistik	Prob.	Keterangan
X1	-0.047803	-2.087584	0.0422	significant
X2	5.06E-10	2.633707	0.0113	significant

The estimation results show that all variables are statistically significant. FDI exhibits a negative and significant effect on GDP, whereas CO_2 emissions have a positive and significant effect on economic growth.

Table 4. Regression Results with Moderating Variable

Variabel	Koefisien	t-statistik	Prob.	Keterangan
X1	-0.027100	-1.179581	0.2441	Not significant
X2	3.57E-10	1.881995	0.0660	Not significant
Z	0.642113	2.640406	0.0112	significant

The results indicate that Foreign Direct Investment (FDI) and carbon emissions (CO_2) do not significantly affect Gross Domestic Product (GDP). In contrast, the moderating variable shows a positive and statistically significant effect.

Table 5. Regression Results of the Moderated Model

Variabel	Koefisien	t-statistik	Prob.	Keterangan
X1	-0.017168	-0.742857	0.4614	Not significant
X2	1.89E-10	0.780144	0.4394	Not significant
Z	1.277995	2.489930	0.0165	significant
X1*Z	-0.138219	-2.060490	0.0452	significant
X2*Z	-8.00E-10	-0.765554	0.4479	Not significant

The results indicate that both Foreign Direct Investment (FDI) and carbon emissions (CO_2) do not have a statistically significant effect on Gross Domestic Product (GDP). In contrast, regulatory quality as a moderating variable exhibits a positive and statistically significant effect on economic growth. For the interaction terms, the results show a significant negative effect in the interaction between FDI and regulatory quality, indicating the presence of a moderating effect. Conversely, the interaction between carbon emissions and regulatory quality is found to be statistically insignificant. Accordingly, regulatory quality can be classified as a quasi-moderator, as it exerts a direct effect on the dependent variable while also significantly moderating the relationship between FDI and economic growth.

Table 6. Results of the Coefficient of Determination (R^2)

R-Squared	Adjusted R-Squared
0.945194	0.934233

The R-squared value of 0.945194 (close to 1) indicates that Gross Domestic Product (GDP) across the five ASEAN countries is jointly explained by the independent variables,

namely Foreign Direct Investment (FDI), carbon emissions (CO_2), regulatory quality, and the interaction terms included in the model. The remaining variation is explained by other factors outside the model.

Table 7. F-Statistic Test Results

F-Statistik	F-Tabel	Prob. (F-Statistik)	Keterangan	Kesimpulan
86.23087	2.40	0.000000	F-Statistik > F-Tabel	significant

The F-test results indicate that the F-statistic value is greater than the F-table value, with a statistically significant probability. Therefore, it can be concluded that all independent variables jointly have a significant effect on Gross Domestic Product (GDP) as a proxy for economic growth.

Table 8. t-Statistic Test Results

Variabel	t-Statistic	t-Tabel	Prob.	Keterangan	Kesimpulan
X1	-0.742857	2.009	0.4614	t-statistik < t-tabel	H1: Negatif – Not significant
X2	0.780144	2.009	0.4394	t-statistik < t-tabel	H2 : Positif – Not significant
Z	2.489930	2.009	0.0165	t-statistik > t-tabel	H4: Negatif – Significant
X1*Z	-2.060490	2.009	0.0452	t-statistik > t-tabel	H5 : Negatif - Significant
X2*Z	-0.765554	2.009	0.4479	t-statistik < t-tabel	H7 : Positif – Not significant

The t-test results indicate that Foreign Direct Investment (FDI) (X1) and carbon emissions (X2) do not have a statistically significant effect on economic growth, as their t-statistics are lower than the t-table values and their probability values exceed 0.05. Accordingly, H1 and H2 are rejected. In contrast, regulatory quality (Z) has a statistically significant effect on economic growth, as indicated by a t-statistic higher than the t-table value and a probability value below 0.05; thus, the hypothesis is accepted. Regarding the moderating effects, the interaction between FDI and regulatory quality (X1×Z) is statistically significant with a negative coefficient, indicating the presence of a moderating effect; therefore, H5 is accepted. Conversely, the interaction between carbon emissions and regulatory quality (X2×Z) is not statistically significant, leading to the rejection of H7.

2. Discussion

The findings of this study indicate that the effect of Foreign Direct Investment (FDI) on economic growth in ASEAN countries is not consistent. In the baseline model, FDI shows a negative and statistically significant relationship with GDP; however, this relationship becomes statistically insignificant after the inclusion of regulatory quality in the moderated model. This result suggests that the impact of FDI on economic growth cannot be separated from the institutional context of a country. In practice, foreign capital inflows do not always translate into higher economic output, particularly when institutional capacity and regulatory quality are not sufficiently effective in channeling and absorbing the benefits of investment. This finding is consistent with endogenous growth theory, which emphasizes that the growth effects of FDI depend on a country's ability to adopt technology and enhance productivity.

A similar pattern is observed for carbon emissions (CO_2), which do not exhibit a statistically significant effect on economic growth in the moderated model. This suggests that the relationship between economic activity and environmental degradation is not necessarily direct in the short run. Within the Environmental Kuznets Curve (EKC) framework, this relationship tends to be non-linear, where environmental impacts become more pronounced at

certain stages of economic development. Accordingly, in the context of ASEAN countries, carbon emissions do not yet represent a primary determinant of economic growth variation.

In contrast, regulatory quality has a positive and statistically significant effect on economic growth. This finding highlights the critical role of institutional quality in enhancing economic performance. Effective and stable regulatory frameworks create economic certainty, improve market efficiency, and strengthen investment attractiveness. This result is consistent with institutional literature, which identifies governance quality as a key factor explaining cross-country differences in economic growth performance.

Regarding the moderating effects, regulatory quality is found to significantly moderate the relationship between FDI and economic growth, with a negative coefficient. This indicates that improvements in regulatory quality may reduce the short-term impact of FDI on economic growth. One possible explanation is that stricter regulations increase compliance costs or limit the operational flexibility of foreign investors. However, this condition may also reflect an institutional effort to channel FDI toward higher-quality and more sustainable investments. Thus, regulatory quality does not only function as a direct determinant of growth but also acts as a mechanism that reshapes the strength of FDI's impact on economic performance, thereby classifying it as a quasi-moderator.

In contrast, the interaction between carbon emissions and regulatory quality is found to be statistically insignificant. This suggests that regulatory quality in ASEAN countries has not yet been effective in influencing the relationship between emission-intensive economic activities and economic growth. This condition may reflect limited effectiveness of environmental regulations or an unresolved trade-off between economic growth and environmental sustainability.

Overall, the findings suggest that the effects of FDI and carbon emissions on economic growth cannot be fully understood without considering the institutional context. This study reinforces empirical evidence that regulatory quality plays a crucial role not only as a direct driver of economic growth but also as a factor that shapes how other economic variables operate within the system. Furthermore, these findings are consistent with previous literature emphasizing that differences in institutional quality help explain variations in the impact of investment and environmental factors on economic growth in developing countries, particularly in the ASEAN region.

V. Conclusion

This study examines the effects of Foreign Direct Investment (FDI) and carbon emissions (CO_2) on economic growth in ASEAN countries, with regulatory quality as a moderating variable using the Moderated Regression Analysis (MRA) approach. The empirical results indicate that the impact of FDI on economic growth is not stable, as it becomes statistically insignificant after the inclusion of institutional variables. Similarly, carbon emissions do not exhibit a statistically significant effect on economic growth. In contrast, regulatory quality is found to have a positive and statistically significant effect, highlighting the importance of institutional quality as a key determinant of economic growth dynamics in developing countries.

The main findings further reveal that the effect of FDI on economic growth is highly contingent on regulatory quality. Regulatory quality not only functions as a direct determinant of economic performance but also significantly moderates the relationship between FDI and economic growth in a negative direction. This provides empirical evidence that, in the ASEAN context, the benefits of FDI are not automatic but strongly depend on the effectiveness of institutions in channeling and filtering foreign investment impacts. However, regulatory quality does not significantly moderate the relationship between carbon emissions and economic growth, suggesting that the economy–environment nexus is more influenced by other structural factors.

From a theoretical perspective, this study strengthens the institutional economics literature, which emphasizes governance quality as a key mechanism shaping the effectiveness of macroeconomic variables such as foreign investment and economic growth. Accordingly, the novelty of this study lies in identifying regulatory quality as a quasi-moderator in the FDI–growth relationship, which has rarely been examined simultaneously within the ASEAN context.

The policy implications of this study suggest that efforts to enhance economic growth in ASEAN countries should not solely focus on increasing foreign investment inflows, but also prioritize strengthening

regulatory quality to ensure that the benefits of FDI are effectively realized. Furthermore, investment policy design should emphasize not only the quantity of FDI but also the quality of institutions governing investment flows, in order to achieve more sustainable economic growth outcomes.

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