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Impact of Foreign Direct Investment and Carbon Emission on Economic Development in Indonesia with Renewable Energy Consumption as a Moderating Variable

Impact of Foreign Direct Investment and Carbon Emission on Economic Development in Indonesia with Renewable Energy Consumption as a Moderating Variable

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Abstract

Indonesia's economic development faces the challenge of achieving sustainability amid global integration. Foreign direct investment (FDI) plays an important role in driving development but is often accompanied by increased carbon emissions that have a negative impact on the environment. Renewable energy consumption can be a solution to reduce these impacts and support sustainable economic development.The purpose of this study is to see the effect between Foreign Direct Investment and Carbon Emissions on Economic Development in Indonesia with Renewable Energy Consumption, whether it can moderate the relationship between these influences with a time span of 1990 - 2021. The type of research used is descriptive quantitative, which is a descriptive approach with a quantitative approach. The data used is secondary data, this research is time series data research using Multiple Linear Regression Analysis and Moderate Regression Analysis (MRA) methods assisted by IBM SPSS Statistic 26 software. The results of this study indicate that foreign direct investment and carbon emission has a positive and significant effect on economic development in Indonesia, foreign direct investment and carbon emissions simultaneously affect economic development in Indonesia, renewable energy consumption can moderate by weakening the influence between foreign direct investment and economic development in Indonesia, and renewable energy consumption can moderate by weakening the influence between carbon emissions and economic development in Indonesia

Keywords: Economic Development; Foreign Direct Investment; Carbon Emission; Renewable Energy Consumption

1. Introduction

The economic performance of a country can be seen from the direction and quality of economic development, which includes structural changes and improving the quality of life of the community in a sustainable manner, not only in terms of output growth. According to [1] , Gross Domestic Product (GDP) is the main indicator in assessing economic performance because it reflects a country's capacity to produce goods and services.

In the image above, on a global scale, Indonesia is in 7th position as the country with the highest CO2 emission contributor with 839.6 million tons. If left unchecked, in the long term this can have an impact on slowing economic growth. Environmental damage that occurs causes a decrease in the productivity of natural resources as well as the emergence of various health problems and disruptions in the quality of life. Finally, all of these impacts will incur very large costs, which in turn affect the decline in GDP per capita of the population [2]

The decline in air quality due to carbon emissions needs to be addressed through the implementation of environmentally friendly activities, one of which is by switching to the use of clean energy or renewable energy that does not damage the environment. Renewable energy is energy that comes from natural resources that can be continuously renewed and processed into new energy without causing negative impacts on the environment, such as pollution.
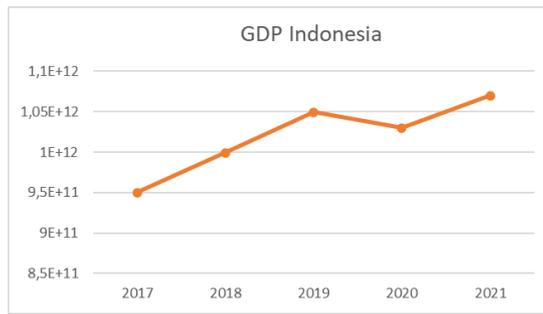
Figure 1.1 Gross Domestic Product of Indonesia 2017-2021
Source: World Bank, data processed by researchers

Indonesia as a developing country continues to strive to encourage economic growth through strategies such as increasing foreign direct investment (FDI). FDI is considered important because it contributes to capital flows, job creation, and technology transfer. However, behind these economic benefits, there are challenges in the form of increasing carbon emissions, especially from the industrial and manufacturing sectors, which can damage the environment and hinder sustainable development.

Figure 1.2 Carbon Emission Levels in Indonesia 2017 – 2021
Source: Statistical Review of World, data processed by researchers

Figure 1.3 Huge Potential of Renewable Energy in Indonesia
Source: Ministry of energy resources and minerals Indonesia

The image above shows that Indonesia has great potential for renewable energy sources. According to the image above , Indonesia has very abundant New and Renewable Energy (EBT) potential. Starting from solar, wind, hydro, bioenergy, geothermal, and also marine energy with a total potential of 3,686 gigawatts (GW). The largest potential comes from solar or the sun at 3,296 GW.

However, of the total 3,686 GW, only 12.54 GW or 0.3% has been utilized. Thus, this shows that Indonesia has very large renewable energy potential, but unfortunately, its utilization is still relatively minimal. This shows a significant gap between the available potential and the utilization carried out. The low utilization of renewable energy can be caused by various factors, such as limited infrastructure, high initial costs, lack of investment, technological challenges, and regulations that do not yet provide optimal support.

Therefore, this study aims to analyze the influence of Foreign Direct Investment and carbon emissions on economic development in Indonesia with renewable energy consumption as a moderating variable for the period 1990-2021, in order to provide a more comprehensive understanding and support the formulation of sustainable economic development policies.

2. Literature Review

2.1 Economic Development

According to [1], economic development is a multidimensional process that focuses not only on economic aspects, but also encompasses major changes in social structures, public attitudes, and national institutions. Economic development reflects comprehensive efforts to create social and institutional transformations that support long-term growth. This is typically measured through increases in national output such as Gross Domestic Product (GDP), which is considered the primary indicator for assessing the economic progress of a country or region.

2.2 Foreign Direct Investment

According to [3], Foreign Direct Investment is an investment made by the private sector from abroad or can be said to be an investment from one country to another on behalf of the government of the capital owner. Foreign investment consists of two parts, namely direct foreign investment and indirect foreign investment. This investment can increase productivity, product competitiveness, and technology transfer. Foreign Direct Investment has proven to be one of the main factors supporting the economies of various countries around the world.

2.2 Carbon Emission

Carbon emissions refer to the process of increasing carbon dioxide (CO_2) levels in the atmosphere, which can occur naturally or as a result of human activities, such as manufacturing, deforestation, and others. Carbon emissions have a complex impact on economic development. In the early stages of economic development, increased carbon emissions often occur due to reliance on fossil fuels to support industry and construction. However, high carbon emissions can damage the environment, reduce productivity and health, and increase recovery costs, which ultimately have a negative impact on the long-term economy.

2.2 Renewable Energy Consumption

According to [4]. in their book Renewable Energy Resources, renewable energy is energy derived from natural resources that can be naturally replenished in a short period of time, such as solar, wind, water, biomass, and geothermal energy. Renewable energy can reduce dependence on fossil fuels, which in turn reduces carbon emissions and their negative impacts on the environment and human health. By adopting renewable energy, countries can attract more foreign direct investment (FDI), as global companies are increasingly drawn to environmentally friendly and sustainable markets. Therefore, renewable energy plays a crucial role in improving environmental quality, enhancing investment appeal, and ultimately supporting a more sustainable economy.

2.3 Moderated Variable

The relationship between variables in economic phenomena is not only determined by independent variables or dependent variables, but often there are variables that can strengthen or weaken the relationship between independent variables and their dependent variables. Variables that can strengthen or weaken the relationship between independent variables and dependent variables are often called moderating variables [10]

3. Research Method

The method used in this research is quantitative method. The type of data collected in this study is secondary data. In this study, researchers will collect data obtained from the World Bank website, Our World in Data, journals, and other sources related to this study. This study uses Indonesia as its scope in the form of a time series spanning 31 years, from 1990 to 2021. This study uses one dependent variable, two independent variables, and one moderating variable. The dependent variable in this study is economic development (Y), the independent variables are foreign direct investment (X1) and carbon emissions (X2), and the moderating variable is renewable energy consumption (Z).

The data analysis techniques used are multiple linear regression analysis and moderate regression analysis (MRA). With multiple linear analysis techniques, this analysis technique is able to measure and analyze the simultaneous and partial effects of several independent variables on the dependent variable. This method makes it possible to determine the extent of each independent variable's contribution to economic development in Indonesia. Then, with moderate regression analysis, it is possible to see whether the moderating variable is able to moderate by strengthening or weakening the relationship between the independent variables and the dependent variable.

The multiple linear regression formula in this study is as follows :

$$Y = \alpha + \beta_1 \, FDI + \beta_2 \, CO2 + \varepsilon$$

Description:

Y   = Economic Development

α   = Constant

β1β2 = Regression Coefficient

FDI = Foreign Direct Invesment

CO2 = Carbon Emission

ε   = Error

The formula for moderate regression analysis is as follows :

$$Y = \alpha + \beta_1 \, FDI + \beta_2 \, CO2 + \beta_3 \, RNE + \beta_4 \, FDIRNE + \beta_5 \, CO2RNE + \varepsilon$$

Description:

Y   = Economic Development

α   = Constant

β1-β5   = Regression Coefficient

FDI   = Foreign Direct Invesment

CO2   = Carbon Emission

RNE   = Renewable Energy Consumption

FDIRNE = Interaction between Foreign Direct Investment and Renewable Energy Consumption

CO2RNE = Interaction between Carbon Emissions and Renewable Energy Consumption

ε   = Error

4. Results and Discussion

4.1 Descriptive Statistical Analysis

According to [5], descriptive statistical analysis is a statistical technique that aims to explain the data that has been collected without making generalizations or drawing conclusions that apply generally. Descriptive statistical analysis is observed from the mean value, maximum value, minimum value, and standard deviation, making it easier to understand the basic characteristics of the data collection.

Table 4.1 Descriptive Statistical Test Results

	N	Minimum	Minimum	Mean	Std.Deviation
GDP	32	2,70E+11	1,07E+12	5,9426E+11	2,51773E+11
FDI	32	-5969238278	2,51E+10	8761974451	9631797389
CO2	32	0,85	2,40	1,5983	0,42690
RNE	32	19,9	59,2	39,6531	11,75547

Source: SPSS 26 output, processed data (2025)

The results of descriptive statistical analysis can be explained as follows:

a. The GDP variable has a minimum value of 269915108922.00, a maximum value of 1065709127435.00, an average value (mean) of 594261345440.5000 and a standard deviation of 251773388406.74643
b. The Foreign Direct Investment variable has a minimum value of -5969238278, a maximum value of 25120732060.00, an average value (mean) of 8761974451 and a standard deviation of 9631797389
c. The Carbon Emission variable has a minimum value of 0,85, a maximum value of 2,40 an average value (mean) of 1,59 and a standard deviation of 0,42.
d. The Renewable Energy Consumption variable has a minimum value of 19,8 , a maximum value of 59,2, an average value (mean) of 39,6531, and a standard deviation of 11,75547

4.2 Classical Assumtion Test

4.2.1 *Normality Test*

Normality tests are used to test whether the residual values obtained in regression are normally distributed or not. The following are the results of the normality test using the Kolmogorov-Smirnov test

Table 4.2 Kolmogorov-Smirnov *Test*

	Unstandardized Residual
N	32
Asymp. Sig. (2-tailed)	0.178[c,d]

Source: SPSS 26 output, processed data (2025)

Based on Table 4.2 above, it shows that the Asymp. Sig. value obtained is 0.178 > 0.05. This result indicates that the residuals in the regression model are normally distributed, thus fulfilling the assumption of data normality.

4.2.2 *Multicollinearity Test*

The multicollinearity test is carried out to detect whether there is a correlation or relationship between fellow independent variables in a regression model using the multicollinearity test. Symptoms of multicollinearity can be identified by the VIF value of 0.1. The multicollinearity test results are listed in the following table:

Table 4.3 Multicollinearity Test *Collinearity Statistics*

Model	*Tolerance*	VIF
FDI	0,334	2,998
CO2	0,021	47,949
RNE	0,022	45,123

Source: SPSS 26 output, processed data (2025)

The results of the multicollinearity test presented in Table 4.3 show that there are variables that indicate multicollinearity between the independent variables in the regression model used in the study. The FDI variable has a tolerance value of 0.334 > 0.1 and a VIF value of 2.998 < 10. The CO2 variable has a tolerance value of 0.021 < 0.1 and a VIF value of 47.949 > 10. The RNE variable has a tolerance value of 0.022 < 0.1 and a VIF value of 45.123 > 10. These results indicate that the FDI variable does not exhibit multicollinearity, but the CO2 and RNE variables do exhibit multicollinearity.

4.2.3 *Autocorrelation Test*

The purpose of this test is to check whether there is a correlation between the residuals in period t from the residuals in the previous period (t-1) in a linear regression model. This study uses the Durbin-Watson test (DW test) to test for autocorrelation. The model is considered free from autocorrelation if the Durbin-Watson (dW) value is in the range dU < dW < 4-dU. The results of the autocorrelation test can be found in the following table:

Table 4.4 Autocorrelation Test

Model	Durbin-Watson
1	0,517

Source: SPSS 26 output, processed data (2025)

Based on Table 4.4, the autocorrelation test results obtained a dw value of 0.517. Based on the Durbin-Watson table with a significance level of 0.05, with the number of data (n) being 32 and the number of independent variables (k) being 3, the dU value obtained was 1.6505 and the dL value was 1.2437. With the testing criteria being dU < d < (4-dU), the autocorrelation test results indicate that the dw value (0.517) is not between the dU value (1.6505) and the 4-dU value (2.3495). Based on these results, it can be interpreted that autocorrelation is present.

4.2.4 Heteroscedasticity Test

The purpose of this test is to determine whether there is a difference in variance from one observation to another, as indicated by a heteroscedasticity regression model (variance and residuals are constant). In this study, the *Glejser* Test is used by regressing the absolute residuals. The model is considered free from heteroscedasticity if the significance value produced is greater than 0.05 (> 0.05). The results of the heteroscedasticity test can be found in the following table:

Table 4.5 Heteroscedasticity Test

Model	Sig.
FDI	0,407
CO_2	0,122
RNE	0,205

Source: SPSS 26 output, processed data (2025)

The output results of the Glejser test in Table 4.5 above show that the three variables from the proposed regression model have a significance value > 0.05 in the Glejser test. This proves that there are no symptoms of heteroscedasticity.

4.3 Multiple Linear Regression

The purpose of this study is to test and determine the effect of the relationship between the independent variables, namely Foreign Direct Investment and Carbon Emission,with the dependent variable, namely Economic Development.. The following presents the output results of the multiple linear regression test that has been carried out:

Table 4.6 Multiple Linear Regression

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std.Error	Beta		
(Constant)	-2,771E+11	6.016E+10		-3.776	0,001
FDI	4.318	2.015	0,165	2.143	0,041
CO_2	4,903E+11	4.546E+10	0,831	10.784	0,000

a.Dependent variable : GDP

Source: SPSS 26 output, processed data (2025)

GDP = -27163841933.753 + 4.318 FDI + 490262633388.257 CO2 + e

From the regression equation, it can be interpreted as follows:

1. The Constant (α) value is -27163841933.753, which means that if the variables of foreign direct investment and carbon emissions are considered zero, then the value of economic development is -27163841933.753 billion.
2. The regression coefficient of Foreign Direct Investment value of 4.318 indicates that every increase in foreign direct investment (FDI) of 1 billion USD will contribute to an increase in economic growth of 4.318 billion , assuming that other variables in the model are held constant.
3. The regression coefficient of Carbon Emission value is 490262633388.257, indicating that if the carbon emissions variable increases by 1 metric ton, the value will increase economic development by 490262633388.257 billion, assuming other variables in the model are held constant.

4.4 Hypothesis Test

4.4.1 Determination Coefficient Test

This test serves to determine and predict how much the influence of variable X simultaneously contributes to variable Y. The value of R^2 ranges from 0 to 1 which is usually expressed in percentage form. The following table presents the results of the R^2 test.

Table 4.7 Determinant Coefficient Test

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.971ᵃ	.942	.938	62465236883.14701

a. Predictors: (Constant),FDI, CO2,

Source: SPSS 26 output, processed data (2025)

The R-Square value in Table 4. 6 shows the magnitude of the influence of independent variables on economic development, which is 0.942 or 94.2%, meaning that the ability of Foreign Direct Investment (FDI) and Carbon Emissions (CO2) variables to influence economic development is 94.2%, while the remaining 5.8% is influenced by other variables not included in this study.

4.4.2 Partial Test

The t-test was conducted to determine the effect of each independent variable on the dependent variable. This t-test can be seen in the comparison between the calculated t and the table t, as well as by looking at the significance of each variable in the SPSS output results with a significance level of 0.05 (a = 5%).

Table 4.8 Partial Test

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	**Std.Error**	**Beta**		
(Constant)	-2,771E+11	6.016E+10		-3.776	0,001
FDI	4.318	2.015	0,165	2.143	0,041
CO2	4,903E+11	4.546E+10	0,831	10.784	0,000

a.Dependent variable : GDP

Source: SPSS 26 output, processed data (2025)

Based on Table 4.9 above, it can be seen that:

1. The t-test for the Foreign Direct Investment (X1) variable yielded a t-value of 2.143 with a significance level of 0.041. Since the calculated t-value is greater than the critical t-value (2.143 > 1.699) or the significance level is less than 5% (0.041 < 0.05), the Foreign Direct Investment (X1) variable has a positive and significant effect on economic development (Y).

2. The t-test for the Carbon Emissions variable (X2) yielded a calculated t-value of 10.784 with a significance level of 0.000. Since the calculated t-value is greater than the critical t-value (10.784 > 1.699) or a significance level of less than 5% (0.000 < 0.05), then the Carbon Emissions variable (X2) has a positive and significant effect on economic development (Y).

4.4.3 Simultaneous Test

The F test is useful in detecting whether the independent variables simultaneously have a significant effect on the dependent variable. If the sig value F table value, it means that the independent variable simultaneously affects the dependent variable.

Table 4.9 Simultaneous Test

T	Sum of Squares	df	Mean Sqaure	F	Sig.
Regression	1.852E+24	2	9.260E+23	237.311	0.000[b]
Residual	1.132E+23	29	3.902E+21		
Total	1.965E+24	31			

a.Dependent variable : GDP

Source: SPSS 26 output, processed data (2025)

Based on the table above, it can be seen that the F-count has a value of 237.311, which is greater than the F-table value of 3.32, and a significance value of 0.000 ($p < 0.05$). Thus, it can be said that Foreign Direct Investment and Carbon Emissions have a simultaneous effect on Economic Development.

4.5 Moderate Regression Analysis

Table 4.10 Moderate Regression Analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std.Error	Beta		
(Constant)	7.371E+11	2,650E+11		2.782	0,010
FDI	-17.031	5.097	-0,652	-3.341	0,003
CO2	5.241E+11	1.124E+11	-0,889	4.664	0,000
RNE	-2371740375	3637259775	-0,111	-0,625	0,520
FDIRNE	0.518	0.136	0,547	3.825	0,001
CO2RNE	-1.488E+10	2031364567	-0,341	-7.327	0,000

a.Dependent variable : GDP

Source: SPSS 26 output, processed data (2025)

GDP = 737082606084.726 - 17.031 FDI + 524127123214.447 CO2 – 2371740375 RNE + 0,518 FDI*RNE – 14882931931.604 CO2*RNE + e

From the regression equation, it can be interpreted as follows:

1. The constant value is 737082606084.726. This indicates that economic growth has a value of 737082606084.726 billion if the independent and moderating variables are considered zero.
2. The coefficient value of the foreign direct investment variable (X1) has an effect of -17.031, meaning that if foreign direct investment increases by 1 billion, it will reduce economic development (Y) by 17.031 billion. The coefficient is

negative. If renewable energy consumption is added as a moderating variable (Z), it results in an increase of 0.518 billion in economic development.

3. The coefficient value of carbon emissions (X2) has an impact of 524127123214.447, which means that if carbon emissions increase by 1 metric ton, economic development (Y) will increase by 524127123214.447 billion. The coefficient is positive. When renewable energy consumption is added as a moderating variable (Z), it results in a decrease of -148,829,319,316,040 billion in economic development.

4. The regression coefficient value for Renewable Energy Consumption (Z) is – 2371740375, meaning that if renewable energy consumption increases by 1 percent, economic growth (Y) will decrease by 2371740375 billion.

4.5.1   *Phase I Moderated Regression Test*

In the first stage of the moderation regression test, two testing steps were carried out. The first tested the effect of FDI (X1) and RNE (Z) on GDP (Y), and the second tested the effect of X1, Z, and X1*Z on Y.

Step I

Table 4.11 Moderating Effect Regression Results

Variable	Std. Coefficients Beta	t	Sig.
Constant		19.113	0,000
FDI	0,173	2.747	0,010
RNE	-0,835	-13.294	0,000

Source: SPSS 26 outp, processed data (2025)

Step II

Table 4.12 Moderating Effect Regression Results

Variable	Std. Coefficients Beta	t	Sig.
Constant		15.152	0,000
FDI	0,533	2.901	0,007
RNE	-0,737	-9,657	0,000
FDI*RNE	-0,269	-2,073	0,047

Source: SPSS 26 output, processed data (2025)

Based on the table above, it can be seen that the beta produced is -0.269, which is negative with a significance of 0.047 < 0.05, meaning that the moderating variable of renewable energy consumption can moderate and weaken the effect of FDI (X1) on Economic Development (Y). In this case, the renewable energy consumption variable acts as a quasi-moderator, as renewable energy consumption is significant in both the first and second steps of the test

4.5.2   Phase II Moderated Regression Test

In the second stage of the moderation regression test, two testing steps were carried out. The first tested the effect of CO2 (X2) and RNE (Z) on GDP (Y), and the second tested the effect of X2, Z, and X2* Z on Y

Step I

Table 4.13 Moderating Effect Regression Results

Variable	Std. Coefficients Beta	t	Sig.
Cinstant		2,365	0,025
CO2	0,131	0,466	0,645
RNE	-0,844	-3,005	0,005

Source: SPSS 26 output, processed data (2025)

Step II

Table 4.14 Moderating Effect Regression Results

Variable	Std. Coefficients Beta	t	Sig.
Constant		2,197	0,036
CO2	0,659	3,369	0,002
RNE	-0,223	-1,107	0,278
CO2*RNE	-0,217	-6,621	0,000

Source: SPSS 26 output, processed data (2025)

Based on the table above, it can be seen that the beta produced, which is -0.217, is negative with a significance of 0.000 < 0.005, which means that the moderating variable of renewable energy consumption can moderate but weaken the effect of CO2 (X2) on Economic Development (Y). In this case, the renewable energy consumption variable acts as a quasi-moderator, as renewable energy consumption is significant in both the first and second steps of the test.

4.6 Discussion

1. Foreign Direct Invesment has a positive and significant effect on economic development Indonesian.

   The results of this study indicate that foreign direct investment has a positive and significant effect on economic development. These results mean that if foreign direct investment increases, economic development will also increase. FDI can provide various benefits, such as creating new jobs, increasing technology transfer, and promoting domestic operational efficiency.

   The results of this study are also consistent with the neoclassical Solow-Swan economic theory, which states that FDI can increase capital accumulation and accelerate economic growth and development by bringing new technologies that can improve production efficiency. These results are also consistent with the Harrod-Domar theory, which emphasizes the importance of savings and investment in driving economic growth. According to this theory, foreign direct investment can increase capital accumulation in a country, which in turn drives increased production capacity and economic development

2. Carbon Emission has a positive and significant effect on economic development Indonesian

   The results of this study shows that carbon emissions have a positive and significant effect on economic growth in Indonesia. Increased carbon emissions reflect increased industrial activity and energy consumption, which drive productivity and economic expansion. Sectors such as manufacturing, mining, and natural resource processing are heavily dependent on fossil fuels, contributing to increased CO_2 emissions. Although these industrial activities have a negative impact on the environment, they also create jobs and increase GDP. Thus, Indonesia's high consumption of fossil-based energy reflects rapid economic growth, albeit accompanied by an increase in carbon emissions..

   Although there is a positive correlation between CO_2 emissions and economic development, increased emissions in the long term can have a negative impact on the environment and health, which ultimately reduces productivity. Therefore, a transition to clean energy is necessary to ensure that economic development remains sustainable without causing adverse effects in the future.

3. Renewable Energy Consumption Moderating the Relationship Between Foreign Direct Investment and
    Economic Development
    The results of this study indicate that renewable energy consumption can moderate the relationship between foreign direct investment and economic development, but with a weakening effect. Foreign direct investment (FDI) is often considered a key driver of economic development because it brings capital, technology, and improved workforce skills to the recipient country. However, the effect of FDI on economic development is highly dependent on external factors, including the energy policies implemented in the recipient country. In the context of transitioning to renewable energy, stringent regulations and technological adaptation requirements can increase production costs and reduce short-term efficiency. In Indonesia, the challenges of the energy transition remain significant due to high dependence on coal, while renewable energy sources such as solar and wind power have yet to match the efficiency of fossil fuels for large-scale industrial needs. As a result, the role of renewable energy tends to weaken the positive impact of FDI on economic growth.
4. Renewable Energy Consumption Moderating the Relationship Between Carbon Emission and
    Economic Development
    The results of the study show that increased consumption of renewable energy can weaken the impact of carbon emissions on economic development. Although the direction of the moderation is negative, the impact is actually positive for long-term development. This shows that as dependence on fossil fuels begins to decline, the contribution of carbon emissions to economic growth also decreases. This reflects a shift towards a more sustainable and environmentally friendly economic system. In other words, the larger the share of renewable energy in the national energy mix, the more successful the transition to a green economy, where economic growth no longer depends on increased carbon emissions. In Indonesia, although the transition to renewable energy still faces various challenges, such as uneven infrastructure and high dependence on coal, the government has shown a strong commitment to accelerating the use of clean energy. Through the National Energy General Plan (RUEN), Indonesia targets a renewable energy mix of 23% by 2025. This policy is reinforced by the implementation of instruments such as carbon taxes and incentives for companies adopting clean energy. The implementation of these policies encourages companies to reduce emissions and invest in environmentally friendly technologies. Thus, while energy consumption increases alongside economic growth, the rate of carbon emissions can be mitigated. This is in line with the Environmental Kuznets Curve (EKC) theory, which states that in the early stages of development, carbon emissions increase in line with economic development, but the adoption of clean energy in the later stages helps reduce emissions, creating more sustainable economic development.

5. Conclusions

Based on the research results, it can be concluded that Foreign Direct Investment (FDI) and carbon emissions have a positive and significant influence on economic development, especially in developing countries such as Indonesia. FDI drives development through job creation, technology transfer, and increased operational efficiency. Meanwhile, increased carbon emissions often reflect increased industrial activity that drives economic growth, especially in the early stages of industrialization. However, renewable energy consumption has been shown to moderate the relationship between FDI and carbon emissions on economic growth, although with a weakening effect. In the context of FDI, Indonesia's dependence on fossil fuels and the unstable supply of renewable energy reduce the effectiveness of foreign investment in driving the economy. For this reason, gradual policies, incentives for investors, and strengthening of green energy infrastructure are needed. In the context of carbon emissions, the greater the consumption of renewable energy, the smaller the contribution of emissions to economic growth. This is in line with the Environmental Kuznets Curve (EKC) [6]. theory, which explains that emissions increase at the beginning of development, but decrease with the adoption of clean energy in later stages. Policies such as RUEN and carbon taxes demonstrate Indonesia's commitment to reducing emissions without hindering sustainable economic growth.

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