

## IMPACT OF RENEWABLE ENERGY, FDI, AND INFLATION ON INDONESIA'S ECONOMIC GROWTH

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### Abstract

The study aims to analyze the impact of renewable energy consumption, foreign direct investment (FDI), and inflation on economic growth in Indonesia. The data in this study is a time series on the World Bank from 1990-2022. The analysis technique used is the Autoregressive Distributed Lag Model (ARDL). According to the ARDL test, renewable energy consumption has no impact on economic growth, FDI has a significant positive effect on economic growth, and inflation has a negative impact on economic growth. In the short term, only renewable energy consumption does not affect economic growth. In the long term, all independent variables significantly impact economic growth. The implications are that the high potential of renewable energy in Indonesia must be optimally exploited to enhance economic growth and minimize the use of non-renewable energies. The government's active role in organizing the FDI that enters Indonesia is also essential. As a potential country for investment, the Indonesian FDI should be labor-intensive to drive economic activity and create inclusive economic growth. Furthermore, the government's inflation controls must be continuously monitored to ensure stable prices.

**Keywords:** ARDL, renewable energy, FDI, inflation, economic growth

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### INTRODUCTION

The economic growth of a country in ASEAN is the primary key to global economic growth because the economy of the ASEAN country is ranked the fifth best economy with the fourth largest exporter in the world. The ASEAN economy has grown by an average of 4%–5% in the last decade, and by 2022, its growth will reach 5.7%, driven by an increase in industry, investment, and international trade. Economic growth is the element that shows the increase or decrease in the quantity of goods and services produced by a country in a given period. Indonesia has become one of the ASEAN countries with a strong economic growth rate. This condition is demonstrated by the strong growth of Indonesian economic activity amid the global economic slowdown. (Ministry of Finance, 2023; Coordinating Ministry of Economic Affairs of Indonesia, 2023; Tsalsalaila et al., 2022)

High economic growth is often associated with excessive energy use. Various natural resources, including non-renewable and renewable, are used as primary energy to boost economic growth. Energy has become an essential element in driving the development of the country's economy. Energy is often used to operate machinery in factories, power plants, transportation, and industrial activities. (Arista & Amar, 2019; Setiawan et al., 2020).

According to the Ministry of Energy and Resources (2022), The use of energy in Indonesia is still supported by non-renewable resources. Figure 1 shows data on energy demand in Indonesia in 2021. Based on Figure 1, it is known that Indonesia still has a high dependence on Coal, petroleum, and Natural Gas. If done continuously, it will cause new problems related to energy availability. Figure 1 shows that the use of new renewable energy (EBT) is low, accounting for only 11% of total energy consumption. Indonesia still has a lot of new and renewable energy potential that is not optimally exploited (Ministry of Energy and Resources, 2022, 2022).

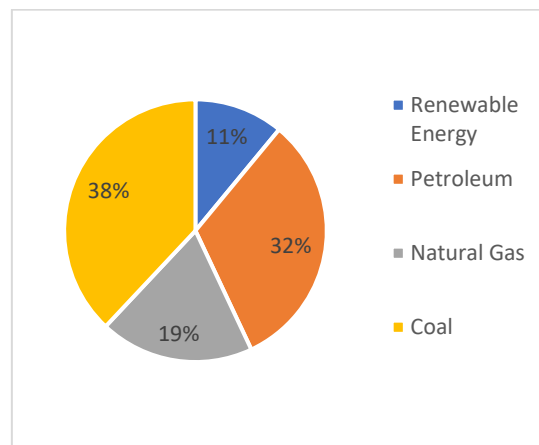


Figure 1. Energy consumption in Indonesia, 2021  
Source: Ministry of Energy and Resources, 2022

Excessive energy use can have a negative impact on environmental quality because its use will increase the production of carbon emissions as well as environmental pollution. Therefore, the use of renewable energy is an important element in supporting economic growth in addition to the non-renewable use of energy. This condition is because renewable energy is more environmentally friendly so that it can minimize environmental damage. In addition, renewable energy can also be an alternative to using non-renewable energies, whose numbers are decreasing (Patra, 2022; Rusdi et al., 2021).

In addition to energy use, economic growth is also largely determined by foreign direct investment (FDI) activities. According to the World Bank report (2023), the amount of FDI coming into Indonesia has grown in recent years. Figure 2 shows foreign direct investment data in Indonesia from 2018-2022.

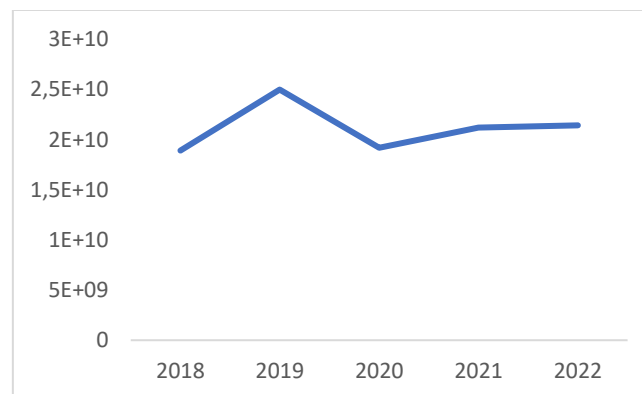


Figure 2. Foreign Direct Investment (US\$)  
Source: World Bank (2023)

Based on Figure 2, the flow of foreign direct investment in Indonesia from 2018 to 2022 fluctuated. The most significant decline will occur in 2020, along with the decrease in economic growth due to the COVID-19 pandemic. Foreign direct investment flows into Indonesia increased in 2021–2022 as national and global economic conditions improved.

FDI is widely used to buy capital goods to boost production activities. In addition, foreign direct investment can improve labor capacity, capital investment, job creation, or technology transfer in economic activities. FDI is a key to industrial activities in various sectors, enhancing a country's ability

to produce goods and services. The higher the production of goods and services, the greater the economic growth (Nguyen, 2022; Wati & Khoiriawati, 2023).

Every country must also pay attention to its inflation rate to maintain economic growth. According to data on the World Bank (2023b), Indonesia's inflation rate has been relatively low in recent years. Figure 3 shows inflation data in Indonesia from 2017 to 2022.

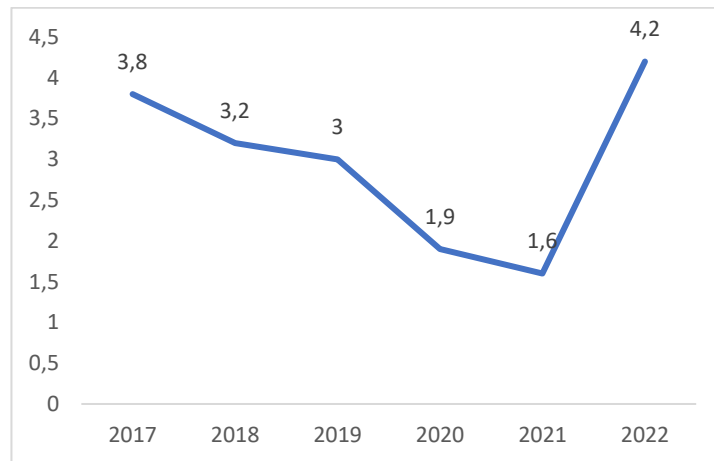


Figure 3. Inflation  
Source: World Bank (2023)

According to Figure 3, it is known that from 2017-2022, the inflation rate in Indonesia will be in the low inflation category and will have a declining trend. The highest inflation was in 2022 at 4.2% due to increased global price pressure, oil fuel adjustment policies, disruption of food supply, and increased public demand with the improvement of pandemic conditions. Fiscal Policy Agency, 2023). Related to economic growth, inflation is used to measure economic stability. This condition is because inflation is a reflection of price stability that plays a vital role in economic activity (Simanungkalit, 2020).

Several studies have been conducted linking energy consumption to economic growth by Shahbaz (2018), Gozgor (2018), Bekun, (2019); (Rahman et al., 2019); (Talha et al., 2021) so based on the explanation above, this study specifically aims to find out the impact of renewable energy consumption, foreign direct investment, and inflation on economic growth in Indonesia. The independent variable of renewable energy consumption becomes the novelty variable in this study, which is supported by the ARDL analysis technique.

## LITERATURE REVIEW AND HYPOTHESIS FORMULATION

### Economic Growth

According to Mankiw (2020), economic growth is increased goods and services used for economic activity. The more goods and services produced, the more economic growth will be driven. The Sollow theory explains that in order to promote a high rate of economic growth, it is necessary to accumulate a high level of capital. This is because capital is the accelerator of production activity. The higher the capital used in economic activity, the higher the economic growth can be achieved (Mankiw, 2016). In addition to the Sollow theory, the Harrod-Domar theory also explains that capital investment positively impacts a country's economic growth performance (Todaro & Smith, 2014).

### Foreign Direct Investment

The Harrod-Domar theory explains that a country needs to increase its savings and investment to support economic growth. The higher savings and investment, the higher the level of economic growth that a country can achieve, and the impact will be on reducing poverty levels. The investment is an important thing that must continue to be added in order to increase capital stock. The increase in inventory capital allows companies to carry out higher production activities of goods and services. This condition has implications for economic activity and growth (Todaro & Smith, 2012).

According to Undang-Undang, number 25 of 2007, investment in Indonesia is divided into foreign and domestic. Foreign investment is the activity of investing capital to conduct business in the territory of the Republic of Indonesia carried out by foreign investors, either using foreign capital entirely or jointly with domestic investors. Furthermore, domestic investment is the activity of investing capital to conduct business in the territory of the Republic of Indonesia which is carried out by domestic investors using domestic capital.

### **Inflation**

Inflation is a continuous increase in the prices of goods in general. Inflation is also defined as a condition of decreasing currency value caused by the rise in the amount of money circulating in a country. Keynes' theory explains that inflation is an increase in the average price level and price is the level or amount of money that must be spent to obtain a number of goods and services.

(Mankiw, 2020). Inflation in a country is caused by two factors, namely:

a. Demand-Pull Inflation

Demand-pull inflation occurs due to increased demand for goods and services. This condition can occur due to increasing incomes, the intensity of people's needs, and the country's population. If public demand continues to increase while the supply of goods and services remains constant, it will impact the price of goods in general over a certain period.

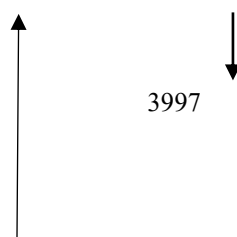
b. Cost-Push Inflation

Cost-Push inflation occurs when the supply of goods and services decreases. This condition can be caused by increasing production costs, such as labor wages, fuel prices, and raw material prices. If public demand remains constant while the supply of goods and services decreases, this will impact the cost of goods or services over a certain period.

### **Renewable Energy Consumption and Economic Growth**

Energy consumption has a positive impact on economic growth. Energy is widely used for industrial or other economic activities, thus accelerating the cycle of the economy. On the other hand, excessive energy consumption has a negative impact on the quality of the environment. This is because increasing energy use will cause pollution or environmental contamination. Based on this explanation, high economic growth has a negative impact on the quality of the environment. The Kuznet Curve (Figure 4) explains the relationship between economic growth and the decline in environmental quality. Based on Figure 4, the curve demonstrates that in the beginning, environmental damage increased as industrial activity increased. In this case, when industrial activity is at its peak, it means that economic growth has reached a peak and per capita income has also reached a peak. After the peak, industrial activity and economic growth will decline. This is also followed by a decrease in environmental degradation caused by a country's increasing concern for environmental quality. (Chang & Asari, 2023).

peak industrial activity &



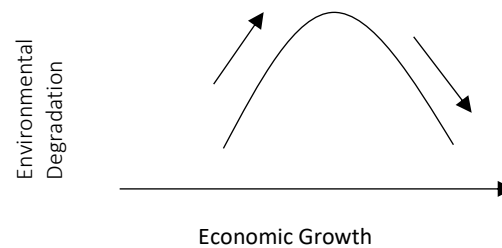


Figure 4. Environmental Kuznet Curve

Source: Permana, (2021)

Based on the explanation, it is known that there is a negative relationship between economic growth and the quality of the environment. It is known that when the economy is at the peak of industrial activity (maximum economic growth), environmental degradation also reaches its peak. This is because the maximum industrial activity is followed by high energy consumption, which increases pollution levels and can reduce the quality of the environment.

Therefore, to maintain economic growth and also the quality of the environment, it is necessary to consume renewable energy. This is because the use of renewables is more environmentally friendly, so it can minimize the negative impact of environmentally damaging industrial activities. In addition, the use of renewable energy has also been shown to have a positive effect on economic growth (Kasperowicz et al., 2020; Ntanos et al., 2018; Wang et al., 2021)

***H1: Renewable energy has a positive impact on economic growth***

### Foreign Direct Investment and Economic Growth

According to the Law of the Republic of Indonesia No. 25 of 2007 on capital investment, foreign direct investment is defined as capital investment activities in the territory of the United States of the Republic of Indonesia that are used to carry out business activities. Harrod-Domar's theory explains that capital accumulation can enhance economic growth (Todaro & Smith, 2014). This is because higher capital accumulation can increase the amount of goods and services produced. In running the economy's wheel, governments need large funding that is not enough if it comes only from domestic capital. Foreign direct investment is available and used to raise domestic capital. Foreign direct investment is also one of the key components that can stimulate the growth of the private and household sectors. Thus, foreign direct investment can accelerate economic growth (Mukamad & Sarda Ardyan, 2017; Purwaningsih, 2021).

Foreign direct investment has a positive effect on the economic growth of a country. The high level of foreign direct investment can also drive economic activity in the long term. With more foreign direct investment, it will be possible to increase the profits of a nation. Moreover, the increase in economic growth can be higher with higher foreign direct investment in a country (Acquah & Ibrahim, 2020; Iamsiraroj & Ulubaşoğlu, 2015).

***H2: Foreign direct investment has a positive impact on economic growth***

### Inflation and Economic Growth

Inflation is a phenomenon of rising commodity prices in general. According to Mankiw (2016), high inflation, often called hyperinflation, is inflation that reaches 50 percent per month. However, inflation does not have a negative impact on the economy. Mild inflation of less than ten percent can actually boost economic activity. Inflation reflects the purchasing power of the people, so it will motivate the business world to increase its production (Simanungkalit, 2020).

In developing countries, excessive inflation has a negative impact on economic growth. This is because high inflation hinders investment and speculative capital cultivation. In addition, higher inflation also causes instability in economic activity, thereby affecting the level of well-being of the population (Akinsola & Odhiambo, 2017; Ambarwati et al., 2021; Tien, 2021).

**H3: Inflation has a negative impact on economic growth**

**RESEARCH METHODS**

This research is quantitative. The analysis technique used in this research is the Autoregressive Distribution Lag (ARDL) analysis technique. ARDL analysis technique is a data analysis technique that uses lag. The advantage of data testing with the ARDL model is that it will give the data analysis results in the short and long term. The data used are on economic growth, renewable energy consumption, foreign direct investment, and inflation in Indonesia from 1990-2022 with World Bank sources. Here's a regression equation for this study:

$$EG_t = \alpha + \beta_1 RE_t + \beta_2 FDI_t + \beta_3 INF_t + e_t \dots \dots \dots (1)$$

Information :

- EG: Economic Growth (%)
- RE: Renewable Energy Consumption (%)
- FDI: Foreign Direct Investment (US\$)
- INF: Inflation (%)
- e*: Error Term
- $\alpha$ : Constanta
- $\beta$ : Coefficient

**RESULTS AND DISCUSSION**

**Result Analysis**

**a) Stationarity Test**

Table 1. Stationarity Test

Variable	Root Unit	p-value	Information
Economic Growth	Level	0,0027	Stationary
Renewable Energy	Level	0,7690	Not Stationary
	First Different	0,0001	Stationary
Foreign Direct Investment	Level	0,5477	Not Stationary
	First Different	0,0000	Stationary
Inflasi	Level	0,7640	Not Stationary
	First Different	0,0000	Stationary

Source: Data Processed, 2024

Table 1 shows that economic growth variables (EG) are stationary at levels with confidence levels of 1%, 5%, and 10%. P-value values on economic growth variables demonstrate this with critical values at various confidence levels (1%, 5%, and 10%). This study's entire independent variable (renewable energy consumption, foreign direct investment, and inflation) is stationary at first different 1. These results suggest that the ARDL model is suitable for this study.

**b) Cointegration Test with Johansen Test**

Table 2. Cointegration Test with Johansen Test

Hypothesized No.of CE (s)	Prob**
None	0,0566
At Most 1	0,1611
At Most 2	0,4512
At Most 3	0,3540

Source: Data Processed, 2024

Table 2 shows that the p-value of the cointegration test exceeds the total value  $> 0.05$ , which means the data is cointegrated and is compatible using the ARDL model.

c) Cointegration Test with Bound Test

Table 3. Cointegration Test with Bound Test

Test Stat.	Value	k
F-Stat.	8,261033	3
<b>Critical Value Bonds</b>		
Sign.	I0 Bound	I1 Bound
10%	2,72	3,77
5%	3,23	4,35
2,5%	3,69	4,89
1%	4,29	5,61

Source: Data Processed, 2024

Based on Table 3. the cointegration results with the Bound-test approach show a value of F-stat.  $> I1$  ( $8.26 > 4.89$ ) means there is a short- and long-term cointegration relationship.

d) Lag Optimum

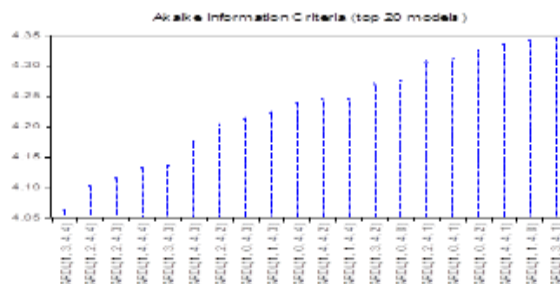


Figure 5. Lag Optimum

Source: Data Processed, 2024

Based on the optimum lag test in Figure 5, the optimal rate of lag of the economic growth variable is 1, while the optimal lag on the independent variable is 4.

e) ARDL Regression

Table 4. ARDL Result

Variable	Coefficient	P-value
C	1,172866	0,2959
Economic Growth(-1)	0,668626	0,0012
D(Renewable Energy)	0,355184	0,3774
D(Renewable Energy (-1))	-0,509581	0,1285
D(Renewable Energy (-2))	0,334047	0,2162

D(Renewable Energy (-3))	0,424025	0,1664
D(Renewable Energy (-4))	-0,387412	0,1984
D(Foreign Direct Investment)	2,07E-10	0,0165
D(Foreign Direct Investment (-1))	2,04E-11	0,7877
D(Foreign Direct Investment (-2))	6,88E-12	0,9290
D(Foreign Direct Investment (-3))	3,49E-11	0,7196
D(Foreign Direct Investment (-4))	2,98E-10	0,0043
D(Inflation)	-0,315849	0,0000
D(Inflation (-1))	-0,047418	0,4292
D(Inflation (-2))	-0,097765	0,0542
D(Inflation (-3))	-0,046876	0,2601
Adjusted R-Square		0,833895
Prob(F-statistic)		0,000135

Source: Data Processed, 2024

$$EG_{it} = 1,172866 + 0,355184RE_{it} + 0,0000000207FDI_{it} - 0,315849INF_{it} \dots \dots \dots (2)$$

Based on Table 4. it is known that :

1. The constant value is 1,172866, meaning that when renewable energy consumption, foreign direct investment, and inflation are zero, economic growth is 1,17,2866 percent (low economic growth).
2. Renewable energy consumption does not impact economic growth because the p-value is 0,3774 > 0,05.
3. The coefficient value of foreign direct investment is 2.07E-10. This means increasing foreign direct investment by one dollar will increase economic growth by 0.0000000207 percent.
4. The coefficient value of inflation is -0,315849. This means that once inflation increases by one percent, economic growth decreases by 0.315849 percent.
5. The p-value of the F-Test is 0,000135 < 0.05, which means renewable energy consumption, foreign direct investment, and inflation significantly impact economic growth.
6. The value of *adjusted R-Square* is 0,833895, This means that the ability of dependent variables to explain the variation of independent variable changes is 83.895 percent, while the rest is explained by variables outside the research model.

#### f) Short-term Analysis

Table 5. Short-term Analysis

Variable	Coefficient	P-value
D(Inflation)	-0,331678	0,0000
D(Foreign Direct Investment)	0,000000	0,0158
D(Renewable Energy)	0,072510	0,7866
D(Renewable Energy (-1))	-0,261213	0,3820
D(Renewable Energy (-2))	-0,109575	0,7072
D(Renewable Energy (-3))	0,526512	0,0532
CointEq(-1)	-0,962974	0,0000

Source: Data Processed, 2024

Table 5 shows that in the short term, the independent variables that influence economic growth are inflation and foreign direct investment. This is because the p-value of each variable is 0,0000 and 0,0158. Both values are < 0,05.

## g) Long-term Analysis

Table 6. Long-term Analysis

Variable	Coefficient	P-value
Constanta	-4,164972	0,1545
Renewable Energy	0,291971	0,0003
Foreign Direct Investment	0,000000	0,0111
Inflation	-0,344431	0,0000

Source: Data Processed, 2024

Table 6 shows that the entire independent variable in the long term has a significant impact on economic growth. Inflation has a significant negative impact on economic growth, while GDP and renewable energy consumption have a significant positive impact on economic growth.

## h) Normality Test

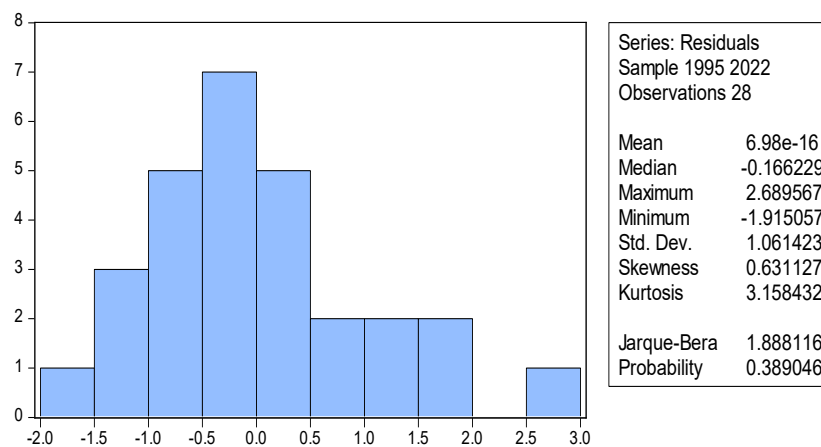


Figure 6. Normality Test

Source: Data Processed, 2024

Based on the normality test in Figure 6. the p-value of Jarque-Bera is  $0,389046 > 0,05$  so it is known that the data is distributed normally.

## i) Heteroskedasticity Test

Table 7. Heteroskedasticity Test

F-statistic	0,7343
Obs*R-squared	0,5863
Scaled explained SS	0,9998

Source: Data Processed, 2024

Based on the heteroskedasticity test carried out in Table 7, all independent variables in this study pass the heteroskedasticity test. This is because the p-value of the entire independent variable is  $> 0,05$ .

## j) Autocorrelation Test

Table 8. Autocorrelation Test

Prob. F(2,10)	0,5627
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Prob. Chi-Square(2)	0,2185
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Source: Data Processed, 2024

From the autocorrelation test above, it is known that this study passed autocorrelation tests because of the p-value F and Chi-Square > 0,05.

## k) Stability Test

### 1.1. Cusum Test

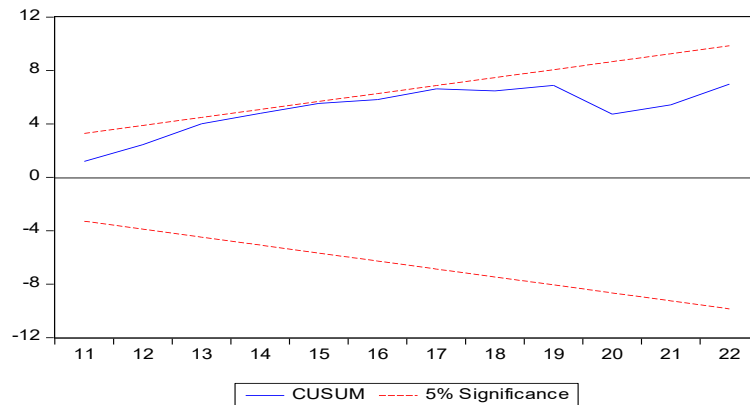


Figure 7. Cusum Test

Source: Data Processed, 2024

### 1.2. Cusum Of Square Test

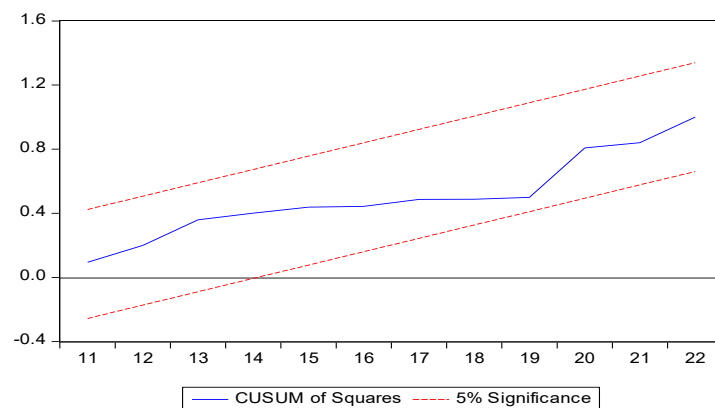


Figure 8. Cusum of Square Test

Source: Data Processed, 2024

Based on Figure 7 and Figure 8, which are related to the stability test, it is known that the data in this study reached stable conditions. It is seen from the blue lines in Figures 7 and 8, which do not exceed the red lines as the upper and lower boundaries.

## DISCUSSION

**a. Impacts of Renewable Energy Consumption on Economic Growth in the Short and Long Term**

Based on the results of data processing using e-views, the variables of renewable energy consumption have no impact on economic growth. In the short term, renewables do not affect economic development. In Indonesia, this is because renewable energy consumption is still low in economic activity, so it has not positively impacted economic growth. Furthermore, in the long term, renewables will positively affect Indonesia's economic growth. This means that when the consumption of renewable energy increases by one percent, it will enhance economic growth in the long term.

The Kuznetz curve explains that the higher energy consumption of a country will boost economic growth and decrease environmental degradation (Chang & Asari, 2023). This will have a negative impact on the environment despite the high rate of economic growth achieved. The unfriendly consumption of energy in production activities creates environmental pollution in a country. Therefore, renewable energy consumption becomes essential for a country's economic activities.

The results of this study are in line with the research carried out by Wang et al. (2021) & (Apergis & Danuletiu 2014), which explains that renewable energy consumption can enhance economic growth. The use of renewable energy boosts the economy more than continuing to hang economic activity on non-renewable natural resources. This is due to the availability of unlimited and easier-to-obtain renewable energy consumption. In European countries, renewable energy consumption has become one of the key components of the national economy. The more renewable energy consumed, the more it will significantly impact per capita income (Kasperowicz et al., 2020; Ntanos et al., 2018).

**b. Impacts of Foreign Direct Investment on Economic Growth in the Short and Long Term**

Based on the data processing results using e-views, the variable of foreign capital planting has a significant positive impact on economic growth. This study's results align with Harrod-Domar's theory that boosting economic growth requires sufficient capital (Todaro & Smith, 2014). The results of this study are in line with the research carried out by (Onafowora & Owoye, 2019) (Ibhagui, 2020) (Tahir et al., 2020); (Okwu et al., 2020) that explains that foreign direct investment has a positive impact on economic growth.

In the short and long term, the p-value value of foreign direct investments is  $< 0.05$  with a positive coefficient value, which means that increased foreign direct investment in the short term and the long term will be able to enhance Indonesian economic growth. The results of this study are consistent with (Mohanty & Sethi, 2019) which explains in the short and long term, foreign direct investment can enhance economic growth. Foreign direct investment that enters a country can be used to enhance the labor force's skills and thus accelerate economic growth. In Indonesia, high levels of foreign direct investment improve economic activity. Inclusive economic activity can be created with increasing capital circulation in the economy.

**c. Impacts of Foreign Direct Investment on Economic Growth in the Short and Long Term**

Based on the results of data processing using e-views, it is possible to identify inflation variables that have a negative and significant impact on economic growth. The results of this study are in line with the research carried out by Ho & Iyke, (2020); (Mandeya & Ho, 2021); (Sequeira, 2021); (Saungweme1 & Odhiambo, 2021); (Talha et al., 2021) explain that inflation has a significant negative impact on economic growth. This means that rising inflation in a country will slow economic growth.

In the short and long term, inflation variables also proved to have a significant negative impact on economic growth in Indonesia. This is because the p-value in both short- and long-term tests is  $< 0.05$ . Inflation is a general and continuous rise in the price of goods or services. Overly high inflation will reduce the purchasing power of the people, which can then affect the

side of the production of goods and services as well, which, in the end, will affect the decline in economic growth. Governments must continue to strive to maintain price stability so that there is no rise in inflation or lowest inflation. It's because the lowest inflation will lead to demotivation for producers, so it doesn't have a good impact on economic performance.

## CONCLUSION

Economic growth is an important aspect of macroeconomics. Every country, especially developing countries, is constantly trying to accelerate economic activity so that it can enhance economic growth. Some macro variables influenced economic growth, such as renewable energy consumption, foreign direct investment, and inflation. During the 1990 and 2022, renewables did not have an impact on economic growth. Foreign direct investment has been shown to have a positive and significant impact on economic growth, and inflation has a significant negative impact on economic growth. The combination of these three variables has an impact on economic growth in Indonesia.

This research implies that Indonesia, with a high renewable energy potential, must be able to leverage the availability of such renewable energy to enhance economic growth. If done massively and optimally, renewable energy can minimize the use of non-renewable sources of energy. While in the short term, the use of renewable energy does not have an impact on economic growth, renewables affect long-term economic growth. The use of petroleum, gas, and coal must be suppressed as its availability decreases every year. Governments also need to explore and develop the potential of renewable energy sources based on biomass, solar, and wind energy to enhance economic activity.

In connection with the increased absorption of foreign direct investment, the government needs to organize foreign direct investment flow into Indonesia actively. This is because foreign direct investment in Indonesia positively impacts economic growth in the short and long term. Indonesia is a potential country in terms of investment; foreign direct investment must always focus on labor absorption to move economic activity more massively and create inclusive economic growth. The development of the investment climate also needs to be continuously promoted so that it can stimulate economic growth.

Inflation, rising and falling prices need to be continuously monitored to stabilize inflation and economic growth. This is because inflation has a negative impact on economic growth in the short and long term. Too high inflation impacts people's purchasing power, so it can decrease the rate of economic growth.

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