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Causal Analysis of Inflation and Interest Rates in Post-COVID Indonesia (2020.1-2024.9)

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Abstract: *This study, titled "Causality Analysis of Inflation and Interest Rates in Indonesia Post-COVID-19 (2020.1-2024.9)," aims to examine the long-term equilibrium between inflation and interest rate variables and to explore their causal relationship during the post-pandemic period. The research utilizes secondary data in the form of monthly time series from January 2020 to September 2024, sourced from Bank Indonesia publications. The cointegration test results indicate no long-term equilibrium between inflation and interest rates. However, the Granger causality test reveals a bidirectional relationship between the two variables, meaning that inflation influences interest rates, and interest rates, in turn, affect inflation. Specifically, high inflation tends to drive up interest rates, while an increase in interest rates can suppress inflation. Therefore, Bank Indonesia must carefully consider this dynamic. Any changes in interest rates should not only be assessed based on their impact on inflation but also on how inflation itself may influence future interest rate decisions. This creates a complex cycle of interdependence between the two variables, particularly in the context of a volatile economic environment. This study provides insights into the interaction of these key economic indicators within the framework of Indonesia's post-pandemic economic recovery.*

Keywords: Inflation; Interest Rate; Granger Causality Test; Cointegration Test; Bi-directional

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INTRODUCTION

According to Nasution, Erlina, & Muda (2020), the spread of the coronavirus has reached all corners of the world and has a wide-ranging impact (Dekha Dwi Harianja, 2021). Furthermore, based on Ayu & Lahmi (2020), this includes key sectors such as trade, investment, and tourism (Dekha Dwi Harianja, 2021). One of the main challenges faced by the economies of developing countries is the effort to maintain macroeconomic stability, particularly in controlling inflation. Offers Sir (2012) stated that inflation arises from various causes, which can be viewed from the perspective of both demand and supply (Rangkuty & Lubis, 2021). Inflation can be a destabilizing factor for a country's economy. According to Fajarwati & Setiawina (2018), Indonesia, which remains highly dependent on the monetary system and global economic conditions, cannot escape the issue of inflation (Rangkuty & Lubis, 2021). Feranika & Haryati (2020) described inflation as an event where the prices of goods and services continuously increase over a long period due to an imbalance between money and the available goods (Rangkuty & Lubis, 2021).

On the other hand, Interest rate denotes the amount received over the money borrowed or lent. In an economic context, interest rates are defined as the cost of obtaining credit. The determination of interest rates in a free market is influenced by the laws of supply and demand. However, interest rates are not only influenced by market

forces, but also by other social factors. Several economists, including Adam Smith, Frederic Bastiat, Irving Fisher, and John Maynard Keynes, have developed theoretical frameworks to explain the concept of interest rates, noting that interest rates can fluctuate (rise or fall) due to variations in monetary policy, fiscal policy, fluctuation rate, maturity period, supply and demand of money, and other factors. The Fed's rate cut is a reasonable response to the global stock market impact caused by COVID-19.

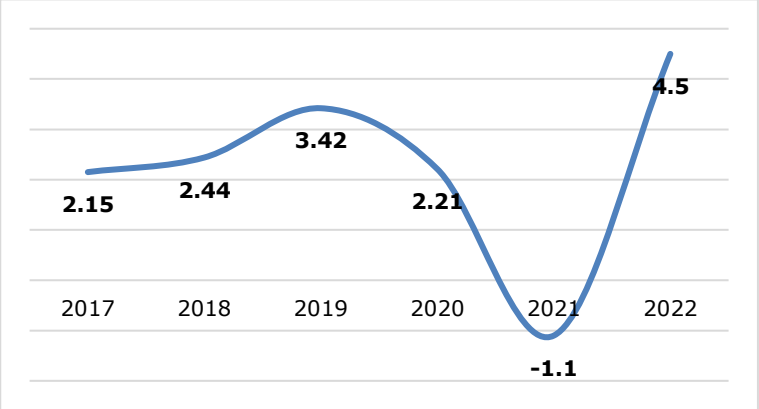

Figure 1. Federal Reserve Interest Rate Trends from 2017 to 2022
Source: Processed from World Bank Data

In 2022, the Fed funds rate increased by 3.4%, reaching 4.5%. In response to the inflation caused by COVID-19, on September 21, 2022, the Fed raised its interest rate by 75 basis points, bringing the total interest rate to 3.25% (US Congress, 2021). Global stock markets were also affected by the Fed's 75 basis points rate hike, and the Fed is expected to maintain an aggressive policy for a long period of time due to the strengthening trend of the US dollar (Bank Indonesia, 2022). The Fed's interest rate decision affects Bank Indonesia's (BI) policy in raising the benchmark interest rate.

Therefore, Bank Indonesia (BI) continues to strive to maintain Indonesia's economic stability amid global economic uncertainty. Following the significant impact of the COVID-19 pandemic that caused a 5% economic contraction, the government responded with various policies. One of the measures taken was the reduction of the BI7DRR benchmark interest rate by 25 basis points to 4.75%, accompanied by a 25 basis points reduction in the deposit facility rate to 4.00% and a 25 basis points reduction in the lending rate to 5.50%. Inflation will depend on the flexibility of prices in the market. Although the Federal Reserve (Fed) believes that inflation can be controlled without significant interest rate hikes, inflation often has stronger momentum than projected. The Fed can address inflation without changing fiscal policy, but it faces challenges in determining the ideal level of interest rates. While the Fed can control inflation in the short term, this is often followed by an increase in inflation in the long term.

This study was conducted because inflation and interest rates are two crucial elements in maintaining a country's economic stability. The impact of the COVID-19 pandemic and global monetary policies, particularly those from the Federal Reserve (The Fed), posed significant challenges to Indonesia's economy, including managing inflation and interest rates. Understanding the relationship between inflation and interest rates, both in the context of Bank Indonesia's policies and the influence of global policies, is essential to support macroeconomic stability in Indonesia.

Based on the explanation above, this research focuses on the following issues: (1) What is the long-term relationship between inflation and interest rates in Indonesia post-COVID-19? (2) What is the causal relationship between inflation and interest rates in Indonesia post-COVID-19? (3) To what extent has Bank Indonesia's effort contributed to maintaining Indonesia's economic stability amidst global uncertainties after the COVID-19 pandemic?

The primary objective of this study is to obtain information on the long-term equilibrium between the inflation variable and the interest rate variable and to provide insights into the causal relationship between inflation and interest rates in Indonesia post-COVID-19 using the Johansen Cointegration Test and the Granger Causality Method.

METHODOLOGY

In this study, we will examine the long-term equilibrium and causal relationship between inflation and interest rates in Indonesia from January 2020 to September 2024, a period that follows the COVID-19 pandemic. The long-term equilibrium will be assessed using the Johansen cointegration test, while the Granger causality test will analyze the causal relationship. The steps involved in this study are as follows:

1. Unit Root Test

The first step in conducting the Granger causality test is to evaluate stationarity through a unit root test (Juliansyah et al., 2020). The Augmented Dickey-Fuller (ADF) test is a commonly used method for this purpose. The formula for the ADF test is as follows:

$$\Delta Y = \beta 1 + \beta 2 + \delta Y_t - 1 + \sum_{i=1}^{m} \alpha i \Delta Y t - 1 + \varepsilon t$$

The ADF test formula designated for the variables inflation (INF) and interest rate (INT) is as follows:

$$\Delta INFt = \beta 1 + \beta 2 + \delta INFt - 1 + \sum_{i=1}^{m} \alpha i \Delta INFt - 1 + \varepsilon t$$

$$\Delta INTt = \beta 1 + \beta 2t + \delta INTt - 1 + \sum_{i=1}^{m} \alpha i \Delta INTt - 1 + \varepsilon t$$

2. Determining the Optimum Lag

The method for determining the optimum lag can be done by observing the changes in the Akaike Into Criterion (AIC) values between lags (Fidelia Febriani Roman, 2020). If the AIC value increases from lag 1 to lag 2, the optimum lag is lag 1. However, if the AIC value decreases, the process can continue with lag 3, and so on, until the minimum AIC value is found.

3. Cointegration Test

The purpose of the cointegration test is to examine the independent and dependent variables to ensure that there is a long-term equilibrium between the variables (Hutagalung et al., 2020). The test identifies cointegration equations, which indicate long-term equilibrium, if the probability value is < 0.05. The Johansen cointegration test method is used to conduct this test.

4. Granger Causality Test

The Granger causality test is used to determine the direction of the relationship between two variables. This arises due to the concept of duality between the variables. One theory suggests that variable X may influence Y, while another theory posits that Y may influence X (Hutagalung et al., 2020). This study employs the Granger Causality Test, with the formula for the model as follows (Wardani, 2018):

$$INF_t = \sum_{i=1}^{m} \lambda_i INF_{t-i} + \sum_{j=1}^{m} \delta_i INT_{t-j} + \varepsilon_{1t}$$

$$INT_t = \sum_{i=1}^{m} \alpha_i INT_{t-i} + \sum_{j=1}^{m} \beta_i INF_{t-j} + \varepsilon_{2t}$$

If the probability value of both variables is < 0.05, then H0 is rejected. This means that the variables of inflation and interest rate influence each other and have a bidirectional causality. However, if the probability in the test is > 0.05 for one of the variables, there is only a unidirectional causality.

To determine the results of the Granger causality analysis, the F-statistic value can also be observed. If the F-statistic value is greater than the F-table value, H0 is rejected. Conversely, if the F-statistic value is lower than the F-Table value, H0 is accepted.

Types and Sources of Data

EViews version 12 is the statistical software used in this research to process the data. The secondary data consists of time series data, primarily the latest macroeconomic data of Indonesia, such as inflation and interest rates. This data is sourced from Bank Indonesia publications, covering the period from January 2020 to September 2024.

RESULTS

Unit Root Test Results

1. Unit Root Test of Inflation

The unit root test aims to determine whether the data is stationary or not. Another purpose is to transform non-stationary data into stationary data. In this first stage, data stationarity is identified, and the analysis is conducted at the level stage. The results can be seen in Table 1.

Table 1. ADF Unit Root Test Results for the Inflation Variable

Variable	t- Statistic	Prob.
INF	-2.339909	0.1637

Source: Processed from BI data

From Table 1, it can be observed that the significance or T-Statistic probability has a value of 0.1637 (> 0.05), meaning that H0: $\delta = 0$ (data is non-stationary) is accepted. Thus, the INF variable is non-stationary at the level stage.

2. Unit Root Test for Difference Variable d(INF)

The first stage involves performing the 1st difference. The results can be seen in Table 2.

Table 2. ADF Unit Root Test Results for the Inflation Variable

Variable	t- Statistic	Prob.
INF	-1.985413	0.2922

Source: Processed from BI data

From Table 2, it can be observed that the significance or T-Statistic probability has a value of 0.2922 (> 0.05), meaning that H0: $\delta = 0$ (data is non-stationary) is accepted. Thus, the INF variable is non-stationary at the 1st difference.

3. Unit Root Test for Difference Variable d(INF)

The second stage involves performing the 2nd difference. The results can be seen in Table 3.

Table 3. ADF Unit Root Test Results for the Inflation Variable

Variable	t- Statistic	Prob.
INF	-11.50156	0.0000

Source: Processed from BI data

From Table 3, it can be observed that the significance or T-Statistic probability has a value of 0.0000 (< 0.05), meaning that H0: $\delta = 0$ (data is not stationary) is rejected, and the INF variable is stationary at the 2nd difference.

4. Unit Root Test for Interest Rates

Table 4. ADF Unit Root Test for Interest Rate Variable

Variable	t- Statistic	Prob.
INT	-1.079396	0.7178

Source: Processed from BI data

From Table 4, it can be observed that the significance or T-Statistic probability has a value of 0.7178 (> 0.05), meaning that H0: $\delta = 0$ (data is non-stationary) is accepted. Thus, the INT variable is non-stationary at the level stage.

5. Unit Root Test for Difference Variable d(INT)

Since the INT Variable is not stationary at the level, the variable must be differenced to achieve stationarity. The

first step is applying the 1st difference.

Table 5. ADF Unit Root Test for Interest Rate Variable

Variable	t- Statistic	Prob.
INT	-3.381031	0.0159

Source: Processed from BI data

From Table 5, it can be observed that the significance or probability of the t-statistic is 0.0159 (< 0.05), meaning H0: $\delta = 0$ (data is not stationary) is rejected, and the INT variable is stationary.

Determination of Optimum Lag

The results of the optimum lag determination can be seen in Table 6.

Table 6. Result of Optimum Lag Determination

AIC	Lag 1	0.83
	Lag 2	0.84

Source: Processed from BI data

From Table 6, it can be seen that there is an increase in the AIC value from lag 1 to lag 2. This means that lag 1 is optimum. Therefore, lag 1 is used in the cointegration test and the Granger causality test.

Cointegration Test

To determine whether one variable has a long-term equilibrium relationship with another, the cointegration test is used. The results can be seen in Table 7.

Table 7. Results of Cointegration Test Using the Johansen Method

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.
None	0.177658	11.88214	12.32090	0.0591
At most 1	0.020232	11.124188	4.129906	0.3365
Trace test indicates no cointegration at the 0.05 level				
*denotes rejection of the hypothesis at the 0.05 level				

Source: Processed from BI data

From Table 7, it can be observed that the probability value is > 0.05, which means there is no cointegration equation. Thus, there is no long-term equilibrium between inflation and interest rate variables.

Granger Causality Test

If both datasets in the pair are either stationary or non-stationary but cointegrated, a Granger causality test must be conducted. In this study, the variables INF and INT are unstable. Therefore, differentiation must be applied to make these variables stationary.

Table 8. Granger Causality Test

Null Hypothesis	*Obs*	*F- Statistic*	*Prob.*
D(INT) does not Granger cause D(INF)	56	8.12688	0.0062
D(INF) does not Granger cause D(INT)		30.9770	9.E-07

Source: Processed from BI data

From Table 8, it can be observed that the F-statistic 8.126 > F Table 4.019541, then H0 is rejected, meaning INF influences the INT. And F-statistic 30.9770 > F-table 4.019541, then H0 is rejected, meaning INT influences the INF.

DISCUSSION

There is a bidirectional relationship between interest rates and inflation. This means that when inflation is high, interest rates will rise. Conversely, when interest rates increase, inflation will decrease (Fund, n.d.). Interest rates influence investment decisions, borrowing costs, and aggregate economic growth. The general opinion of economists is that high interest rates decrease inflation. This phenomenon is due that high interest rates increase the cost of borrowing, therefore decreasing aggregate demand in the economy. Bank Indonesia (BI) is capable of controlling inflation in Indonesia. BI implements strict monetary policies, such as raising interest rates, reducing the money supply, and selling government securities. It also conducts open market operations and utilizes other monetary policy instruments.

BI and the government collaborate to manage inflation by strengthening policy coordination, maintaining macroeconomic stability, and taking other strategic measures. These include controlling inflation in the Volatile Food category, ensuring food supply availability, and facilitating smooth distribution. They also work to strengthen food security and improve the availability of food supply data. Additionally, BI enhances communication to manage inflation expectations that could negatively affect the welfare of the population, particularly those with fixed incomes.

Furthermore, Bank Indonesia plays a crucial role in maintaining the stability of the Rupiah while supporting sustainable economic growth. The monetary policies implemented include strategies and the execution of monetary measures. One of the primary responsibilities of Bank Indonesia (BI) is to ensure price stability. When inflation is low and stable, people can hold their money without concern that the money will lose its purchasing power due to high inflation. An increase in prices may lead to higher interest rates.

BI uses historical data to inform its monetary policy decisions, which impact the economy. Historical data is also utilized to determine the best course of action based on various economic indicators, including employment trends, prices, wages, consumer spending, and business investment. This data helps to understand how the economy evolves. For example, historical data can be used to analyze how the international gold market and European central bank policies were affected by the global crisis.

When interest rates rise, newly issued bonds offer higher yields, making existing lower-yielding bonds less attractive, which decreases their prices. Bank Indonesia (BI) and the government need to use historical data to analyze the relationship between inflation and interest rates. This historical data provides valuable insights into the relationship between these two variables under various economic conditions. By understanding past patterns that have occurred, policymakers can anticipate the potential impact of their decisions, both in the short and long term. Consistent use of historical data enables BI and the government to make more targeted decisions that support economic stability.

CONCLUSION

Based on the findings from the analysis in the previous chapter, it can be concluded that a bi-directional relationship occurred during the study period. This means that inflation affects interest rates, and interest rates also influence inflation. Bank Indonesia (BI) is capable of controlling inflation in Indonesia and plays a significant role in maintaining the stability of the Rupiah while supporting sustainable economic growth. BI achieves this by utilizing historical data to inform its monetary policy decisions, which have a broad impact on the economy. Bank Indonesia's monetary policy needs to be formulated with careful consideration. Any changes in interest rates should not only be evaluated based on their impact on inflation but also on how inflation itself might influence future interest rate decisions. This creates a complex cycle of interdependence between these two variables, particularly in the context of an unstable economic environment.

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