

Inflation and policy response: A case study of Indonesia during the Covid-19 pandemic

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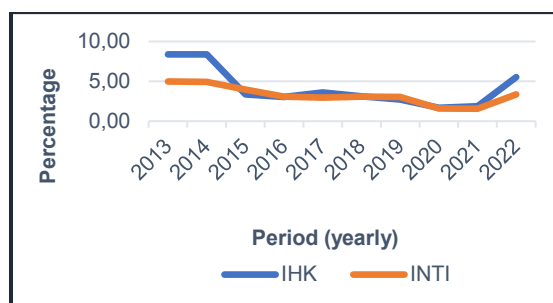
Abstract. Through the responses and contributions generated during the COVID-19 pandemic from March 2020 to April 2023, this research aims to analyse the monetary determinants of inflation in Indonesia. The dependent variables in this research include consumer price index inflation (CPI) and core inflation. In contrast, the independent variables are variables on the monetary side, which include interest rate policy, money supply (M2), and the exchange rate of the United States dollar against the rupiah. This research uses a quantitative approach with the Vector Error Correction Model (VECM) as the analysis method. According to the research findings, CPI and core inflation responded negatively to shocks in policy interest rates. Both CPI and core inflation responded positively to shocks or changes in the money supply. CPI and core inflation respond positively to money supply shocks. CPI and core inflation respond negatively to exchange rate shocks. Overall, core inflation responded better to the magnitude of changes in monetary side variables during the COVID-19 pandemic than consumer price index (CPI) inflation. The interest rate policy variable contributes more to consumer price index (CPI) inflation and core inflation than the money supply and exchange rate variables.

1 Introduction

The government initially declared that the COVID-19 pandemic would reach Indonesia on March 2, 2020. COVID-19 cases have shown an increase since it was first announced, with 4,262,720 confirmed cases and 4,292 active cases until the end of 2021 (Ministry of Health of the Republic of Indonesia, 2022). The increase in COVID-19 cases has led the government to implement a Large-Scale Social Restrictions (PSBB) policy to overcome the health crisis quite effectively. However, it affects economic performance. Inhibitions in human mobility and activities for goods and services reduce people's purchasing power and ultimately, economic growth experiences a sharp decline, overall, in 2020 amounting to -2.07 percent. The implementation of PSBB by more than 31 regional governments has hampered economic growth in several regions, causing weak domestic demand and driving low inflation (Bank Indonesia, 2021).

Inflation plays an important role in looking at the stability of a country's economy. A growing economy means that economic activity continues to experience growth in various sectors, as long as inflation is within the normal range (Silaban et al., 2021). Figure 1 shows that the growth rates of the Consumer Price Index (CPI) and Core Inflation are relatively the same, decreasing and growing below Bank Indonesia's inflation target of 3 ± 1 percent in 2020–2021, which is also the lowest inflation in the last ten years. Due to the government's implementation of mobility policies as well as the

decline in global commodity prices during the COVID-19 pandemic, domestic demand that year was unstable, which had an impact on the low level of inflation (Bank Indonesia, 2021).



Source: Bank Indonesia, 2023 (Data processed).

Fig.1. Inflation in Indonesia in 2013 – 2022.

The problem of inflation in Indonesia has been the government's focus since 2000, it cannot be completely eliminated but can only be controlled. According to Özen et al., (2020), maintaining price stability by ensuring that the inflation rate is controlled and as low as possible is one of the main goals of a country's central bank, because price stability indicators are believed to be able to predict the future. Afonso et al., (2019) revealed that inflation has a major impact on the monetary authority's response in analyzing the interaction of monetary and fiscal policy. Bank Indonesia has the authority to determine and implement monetary policy by taking into account the inflation rate

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target, as stated in Law no. 3 of 2004. The ultimate goal of the policy focus is to maintain the stability of the rupiah exchange rate.

The implementation of Bank Indonesia's monetary policy develops based on economic developments and the political climate of the Indonesian nation (Warijiyo & Solikin, 2003). During the Covid - 19 pandemic, Bank Indonesia coordinated with the government and the Financial System Stability Committee (KSSK) to maintain macroeconomic stability, the financial system, and support National Economic Recovery (PEN). Bank Indonesia funds and shares burdens in the 2020 APBN through the purchase of Government Securities (SBN) to implement Law no. 02 of 2020, through market mechanisms regulated in the Joint Decree of the Minister of Finance and the Governor of Bank Indonesia dated 16 April 2020 amounting to 75.86 trillion rupiah (Bank Indonesia, 2021).

Stock and Watson (2015) states that monetary policy has more influence Core Inflation than Consumer Price Index (CPI) Inflation. The statement is based on the fact that Core Inflation reflects a more stable long-term inflation trend, while CPI Inflation is more influenced by temporary factors such as fluctuations in commodity prices and changes in prices of certain goods.

Sertiartiti and Hapsari (2019) in their analysis stated that inflation is determined by demand pull and cost push, but the central bank is only able to control inflation from the monetary aspect. According to Amaefula (2016) interest rates and inflation are macroeconomic indicators that are often linked to maintaining economic balance. Makhrus and Priyadi (2022) reveal that interest rates influence inflation positive and significant in the short and long term. Bank Indonesia issued the BI - 7 Days Reverse Repo Rate (BI7DRR) as a new interest rate policy which took effect on 19 August 2016 to strengthen the effectiveness of monetary policy transmission and function as a policy response to reduce inflation according to target (Bank Indonesia, 2023). During the Covid-19 pandemic in 2020, the policy interest rate was reduced five times with a total reduction of 125 bps to 3.75 percent and was reduced again in 2021 by 25 bps to 3.50 percent (Bank Indonesia, 2021).

According to quantity theory, the amount of money circulating in society determines the value of money and the growth of the money supply determines the inflation rate (Mankiw, 2021). In 2020 the amount of money in circulation was 6,900,050 billion rupiah, an increase of 7,870,453 billion rupiah in 2021. The increase in the amount of money in circulation in 2020 - 2021 when associated with the reduction in Bank Indonesia's policy interest rate in that year is something consistent, because of this decrease, the increase in interest rates is expected to respond to people's desire to take advantage of bank loans, which will then trigger growth in the money supply. Amankwah and Atta (2019) stated that growth in the money supply has a short-term and long-term relationship with the inflation rate. This assumption is in line with the research results of Osman et al., (2019); Esprance and Fuling (2020); and Cheti and Ilembo (2021). In general, an increase in the money supply

which tends to be high is always accompanied by a high level of inflation. However, the money supply (M2) increased in 2020 to 2021, the inflation rate showed a downward trend in that year in Figure 1.1.

In addition to policy interest rates and the money supply, exchange rate is one of the most important prices in an open economy has a very large influence on the current account and other macroeconomic variables (Amhimmid *et al.*, 2021). Dornbusch (1976) states that inflation and exchange rates have a vital importance in developing countries. Exchange rate fluctuations significantly affect the general price level and changes in exchange rates will affect production costs, such as the price of imported goods.

Fetai *et al.*, (2016) explains that exchange rate changes have a strong impact on inflation. Devia dan Fadli (2022) states that the exchange rate has a negative and significant effect on inflation in Indonesia for the period 2004 - 2017. An increase in the Rupiah exchange rate against the US Dollar makes the US Dollar currency weaken or depreciate and reduce inflation. Monfared and Akin (2017) analyzed the relationship between the exchange rate and inflation in the Iranian case, revealing that the exchange rate had a positive effect on inflation.

Several studies in analyzing the determinants of inflation were carried out by reviewing the application of monetary policy. Oktori (2019), the case of Nigeria for the period 2009 - 2017 with the Error Correction Model (ECM) model reveals that the money supply, exchange rates, monetary policy interest rates, securities and liquidity ratios are not only significant, but have an influence on the inflation rate. Researchers argue that the central bank needs to conduct periodic research to determine the dynamics of changing relationships so that policy interventions are far more effective and have traction on the economy. Assa *et al.*, (2020), explained that the policy interest rate has a positive and significant effect on the inflation rate, while the money supply shows a negative and insignificant effect on inflation in the case of Indonesia for the period 2006 - 2019. Angelina and Nugraha (2020), examining inflation in the Indonesian case using the Two Stage Least Squared (TSLS) method state that inflation is positively and significantly influenced by the money supply and exchange rate, negatively and significantly influenced by the SBI interest rate. Salih and Kabasakal (2021) examine the case of Iraq inflation for the period 2014-2020 using the Autoregressive Distributed Lagged (ARDL) model, explaining that the money supply and exchange rates have a positive and significant effect on the inflation rate. An Increase in the money and exchange rate high inflation, while the interest rate has a contradictory and significant relationship with the inflation rate. An increase in interest rates causes a decrease in the inflation rate. Gabisa et al., (2022) examined inflation in the Ethiopian case for the period 1980 - 2021 using Auto - Regressive Distributed Lag (ARDL). The results reveal that inflation expectations, real Gross Domestic Product (GDP), money supply and real interest rates are the main determinants of inflation both in the short and long term.

Inflation is a major problem affecting various aspects of macro-level economic activity, which is important for a controlled and planned rate of economic growth. Research on the factors that influence the inflation rate needs to be carried out, so that the empirical results obtained can be used as views by policy makers. Based on the description of the background above and the importance of the problem of inflation, the authors are interested in conducting research entitled "Determinants of Inflation in Indonesia From The Monetary Side During the Covid-19 Pandemic". This study makes a significant contribution to the understanding of the factors influencing inflation in Indonesia, particularly in the context of the COVID-19 pandemic.

2 Research method

This study uses a quantitative approach method. Creswell (2018) explains that a quantitative approach is used to test objective theories. The quantitative approach aims to prove, upload or give credence to existing theories. This approach involves measuring variables and examining the relationships between variables to uncover patterns, correlations or causal relationships, using a linear data collection and analysis method that produces statistical data (Leavy, 2023). Research data analysis techniques use the Vector Error Correction Model (VECM) method. The basic model used, as follows:

$$IHK_t = \alpha + \beta_1(IR)_t + \beta_2 Ln(MS)_t + \beta_3 Ln(ER)_t + e_t \quad (1)$$

$$INTI_t = \alpha + \beta_1(IR)_t + \beta_2 Ln(MS)_t + \beta_3 Ln(ER)_t + e_t \quad (2)$$

IHK_t is Consumer Price Index (CPI) Inflation in the first model, $INTI_t$ is Core Inflation in the second model. IR is the policy interest rate, MS is the money supply in a broad sense (M2) and ER is the exchange rate of the US Dollar against the Indonesian Rupiah as a variable on the monetary side of both models. α is a constant and e_t is error term.

Stationarity test of research data or unit root test is an initial stage that must be carried out before estimating VECM, aims to determine whether the variable data used is stationary or non-stationary. The stationarity test was developed by Dickey-Fuller and is known as the Augmented Dickey-Fuller (ADF) test through the following equation (Gujarati & Porter, 2008):

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + u_t + \sum_{i=1}^m \alpha_i \Delta Y_{t-i} + \varepsilon_t \quad (3)$$

Information:

ε_t = pure white noise error

$\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2}), \Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$ etc.

Optimal lag testing is needed in VECM modeling, aims to ensure that the estimated model is able to interpret dynamically, efficiency and comprehensive. Lutkepohl (2005) explained that the optimal lag test was

seen based on the recommended information, through the following approach:

$$AIC = \ln(|\Sigma_u|) + \frac{2pK^2}{T} \quad (4)$$

$$SBIC = \ln(|\Sigma_u|) + \frac{\ln(T)}{T} pK^2 \quad (5)$$

$$HQIC = \ln(|\Sigma_u|) + \frac{2 \ln \{ \ln(T) \}}{T} pK^2 \quad (6)$$

$$SBIC = |\Sigma_u| \left(\frac{T + Kp + 1}{T - Kp - 1} \right)^K \quad (7)$$

Stability test in the estimation of Vector Error Correction Model (VECM) is performed for analysis of Impulse Response Function (IRF) and Variance Decomposition (VD) is valid to perform. Knowing the stability level of the model by looking at the characteristics of the Polynomial Inverse Root through the modulus value in the table. A model is said to be stable if all of its roots or roots have a modulus smaller than one (Damayanti & Jalunggono, 2022).

The cointegration test identifies whether the model in the study indicates a long-term relationship between variables, and integrates with each other in the same order (Gujarati & Porter, 2008). The cointegration test in the study was carried out using the Johansen approach, based on the two tests suggested by Johansen (1988) and Osterwald-Lenum (1992), namely the statistical trace test and the maximum eigenvalue, which is written in the following equation (Bedada et al., 2020):

$$Trace\ Statistic: \lambda_{trace} = -T \sum_{t=1}^T \log(1 - \lambda_t^1) \quad (8)$$

$$= r + 1, \dots, p$$

$$Maximum\ eigen\ value\ statistic: \lambda_{max}(r, r + 1) \quad (9)$$

$$= -T \log(1 - \lambda_{r+1}^1)$$

Where $\lambda_{r+1}^1, \dots, \lambda_p^1$ is $(p - r)$ the sum of the estimated eigenvalues and "r" implements the cointegration relationship. Detecting the existence of cointegration in the model is carried out with the following hypothesis conditions:

H_0 : no cointegration ($r = 0$)

H_1 : there is cointegration ($r > 0$)

Criteria for decision making, as follows:

- The results of the trace statistic value and eigenvalue $> 0,05$, then H_0 is rejected, meaning that there is cointegration between the variables in the research model, then the estimation of the Vector Error Correction Model (VECM) can be done (Laksahmanasany, 2022).
- The results of the trace statistical value of the eigenvalue $< 0,05$, then H_0 is accepted, meaning that there is no cointegration between the variables in the research model, so the Vector Autoregression (VAR) method can be used (Laksahmanasany, 2022).

Vector Error Correction Model (VECM) has advantages in explaining short-term and long-term economic phenomena, as well as being a solution to the problem of non-stationary time series variables at the

level. The assumptions that must be met in the VECM analysis are that all variables in the study must be stationary in the first derivative and cointegrated.

The Vector Error Correction Model (VECM) is used due to its ability to capture both short-term dynamics and long-term relationships among the variables. This is marked with an average value of zero, constant variance and between the dependent variables there is no correlation. In general, the Vector Error Correction Model (VECM) model is as follows:

$$\Delta y_t = \mu_0 x + \mu_1 x_t + \pi x y_{t-1} + \sum_{j=1}^{K-1} rix + \Delta y_{t-1} + \varepsilon_t \quad (10)$$

Information:

- y_t = The vector that contains the variables analyzed in the study
- $\mu_0 x$ = Interception vector
- $\mu_1 x$ = Regression coefficient vector
- t = Time trend
- πx = $\alpha x \beta y$, where b contains the long-run cointegration equation
- y_{t-1} = In-level variables
- rix = Regression coefficient matrix
- $k - 1$ = The VECM and VAR orders
- εt = error term

The specifications of the VECM equation model used in the research are as follows:

$$\Delta IHK_t = \alpha + \sum_{i=1}^{K-1} \beta_1 \Delta IHK_{t-i} + \sum_{j=1}^{K-1} \beta_2 \Delta IR_{t-j} + \sum_{m=1}^{K-1} \beta_3 \Delta \ln MS_{t-m} + \sum_{n=1}^{K-1} \beta_4 \Delta \ln EX_{t-n} + \gamma ECT_{t-1} + u_t \quad (11)$$

$$\Delta INTI_t = \alpha + \sum_{i=1}^{K-1} \beta_1 \Delta INTI_{t-i} + \sum_{j=1}^{K-1} \beta_2 \Delta IR_{t-j} + \sum_{m=1}^{K-1} \beta_3 \Delta \ln MS_{t-m} + \sum_{n=1}^{K-1} \beta_4 \Delta \ln EX_{t-n} + \gamma ECT_{t-1} + u_t \quad (12)$$

Information:

- IHK_t = Consumer Price Index (CPI) Inflation
- $INTI_t$ = Core Inflation
- IR = Interest Rate Policy
- MS = Money Supply
- EX = Exchange Rate
- α = constant
- $\beta_1 \dots \beta_4$ = long run coefficient
- γ = Speed of adjustment parameter with a negative sign
- ECT_{t-1} = error corection term
- u_t = error term

Impulse Response Function (IRF) describes the rate of shock of one variable to another over a certain period of time, so that the duration of the shock effect of

a variable on other variables is obtained until the effect returns to the balance point (Enders, 2015). IRF analysis tracks the reactions of endogenous variables in the VECM system to shocks or one-off changes to any of the current and future value innovations. IRF can be determined through the equation (Laksahmanasany, 2022), as follows:

$$y_t = \alpha + \omega_0 \varepsilon_t + \omega_1 \varepsilon_{t-1} + \omega_2 \varepsilon_{t-2} + \dots + \omega_p \varepsilon_{t-p} \quad (13)$$

y_i s the endogenous dependent variable vector, α s the endogenous dependent variable vector, ε_i is the innovation vector and ω_i is the parameter vector that measures the dependent variable's reaction to innovation in all variables including those included in the VECM model.

Variance decomposition or error variant decomposition reveals the relationship between variables in the system by providing an estimate of the proportion of movement in the sequence due to shocks from one variable to another (Enders, 2015).

3 Results and discussion

3.1 Results

In this study, there are two models analyzed, the first model uses Consumer Price Index (CPI) Inflation and the second model uses Core Inflation as the dependent variable. The independent variables in both models include the policy interest rate, the money supply (M2) and the exchange rate of the United States Dollar against the Indonesian Rupiah. Both models were analyzed using the Vector Error Correction Model (VECM) method, which was carried out with the help of the Eviews-12 computer program, to obtain the best research results.

Descriptive statistics show the true nature of the research data, based on table 1 CPI inflation has a mean value of 2.84 with a standard deviation of 1.585351421. The Core Inflation variable has a mean value of 2.20 with a standard deviation of 0.719222996. The policy interest rate variable has a mean value of 4.07 with a standard deviation of 0.76236347. The money supply variable has a mean value of 7,395,945.19 with a standard deviation of 654669.58. The exchange rate variable has a mean of 14,706 with a standard deviation of 509.8504703.

Table 1. Variable descriptive statistics.

Variable	N	Max	Min	Mean	Standard Deviation
CPI Inflation (%)	38	5,95	1,32	2,84	1,585351421
Core Inflation (%)	38	3,36	1,18	2,20	0,719222996
Policy Interest Rate (%)	38	5,75	3,50	4,07	0,76236347
Money Supply M2 (Billion Rupiah)	38	8.528.022,31	6.238.267,00	7,395,945.19	654669,58
USD/IDR Exchange Rate (Thousand rupiah)	38	16.367	14.084	14.706	509,8504703

Source: processed data, 2023

Table 2 is the result of stationarity test of research variable data. At the level level it can be seen that all the variables in the study are not stationary, the ADF probability values produced by all variables are greater than the significance level of 1 percent, 5 percent and 10 percent, so it is necessary to test the stationarity of the data on the first derivative or 1st difference.

Table 2. Data stationarity test results.

Variabel	Tingkat Level I(0)		Tingkat 1st Difference I(1)	
	T-statistic	Prob.	T-statistic	Prob.
IHK	-2.065294	0.5458	-5.390998	0.0017***
INTI	-2.929980	0.1655	-2.636919	0.0098***
BI7DRR	-1.770459	0.6980	-3.911335	0.0236**
LN_M2	-3.194886	0.1019	-9.197334	0.0000***
LN_KURS	-0.802812	0.3614	-6.040681	0.0000***

Note: *** and ** indicate significant at the 1% and 5% level
 Source: Results of Output Eviews-12, 2023 (Data processed)

The results of the research data stationarity test in the first difference in table 2, it is known that overall, the variables are stationary at the 1st difference level, having a probability value of ADF smaller than the significance level of 1 percent and 5 percent. After the overall data is stationary at the same level, then determine the optimal lag length.

Based on table 3 the results of examining the optimal lag length in the first model, it can be seen that the criterion information that has the smallest value is indicated by the LR, FPE, SC and HQ criteria with the most asterisks being in lag 1, so it is concluded that the optimal lag length is used in the first model is at lag 1.

Table 3. Optimal leg test result.

Model I							
Lag	LogL	LR	FPE	AIC	SC	HQ	
0	59.53265	NA	4.92e-07	-3.173294	-2.995540	-3.111934	
1	225.6740	284.8137*	9.32e-11*	-11.75280	-10.86403*	-11.44600*	
2	242.0707	24.36082	9.48e-11	-11.77547*	-10.17568	-11.22322	
3	252.4567	13.05674	1.45e-10	-11.45467	-9.143867	-10.65698	

Model II							
Lag	LogL	LR	FPE	AIC	SC	HQ	
0	78.73897	NA	1.64e-07	-4.270798	-4.093044	-4.209438	
1	264.4068	318.2877*	1.02e-11*	-13.96610*	-13.07733*	-13.65930*	
2	276.6662	18.21395	1.31e-11	-13.75235	-12.15257	-13.20011	
3	287.9672	14.20703	1.90e-11	-13.48384	-11.17304	-12.68615	

Source: Results of Output Eviews-12, 2023 (Data processed)

The results of examining the optimal lag length in the second model, it can be seen that the criterion information that has the smallest value is shown by the LR, PFE, AIC, SC and HQ criteria with the most asterisks being in lag 1, so it is concluded that the optimal lag length used in the second model is at lag 1.

Based on table 4 the results of stability testing in the first model and the second model are stable, this can be seen from the modulus range with an average value obtained in each model less than one, thus the results of the Impulse Response Function (IRF) and Variance analysis Decomposition (VD) of each model is valid. Next, do the Johansen cointegration test on each model.

Table 4. VAR stability test result.

Model I		Model II	
Root	Modulus	Root	Modulus
0.954055	0.954055	0.981625	0.981625
0.931038 - 0.177202i	0.947752	0.942466 - 0.148337i	0.954069
0.931038 + 0.177202i	0.947752	0.942466 + 0.148337i	0.954069
0.301785	0.301785	0.377930	0.377930

Source: Results of Output Eviews-12, 2023 (Data processed)

Based on the results of the cointegration test of the first model in table 5, it is known that all trace statistical values obtained are greater than the critical value of 5 percent, so reject H0. There are 4 cointegration or long-term relationships detected between the Consumer Price Index (CPI) Inflation variables, policy interest rates, money supply and exchange rates. This means that the first model can be continued using the Vector Error Correction Model (VECM) method.

Table 5. Johansen cointegration test result.

Rank	Model I			Rank	Model II		
	Trace Statistic	5% Critical Value	Prob.		Trace Statistic	5% Critical Value	Prob.
0*	86.95745	54.07904	0.0000	0*	74.77953	54.07904	0.0003
1*	56.38409	35.19275	0.0001	1*	40.95405	35.19275	0.0107
2*	31.10267	20.26184	0.0011	2*	20.35655	20.26184	0.0485
3*	9.926685	9.164546	0.0358	3	5.885157	9.164546	0.1998

Source: Results of Output Eviews-12, 2023 (Data processed)

The results of the second model cointegration test in table 3.5, it is known that the three trace statistics values at rank 0, 1 and 2 are greater than the critical value of 5 percent, so reject H0. There are 3 cointegration or long-term relationships detected between Core Inflation, policy interest rates, money supply and exchange rates. This means that the second model can be continued using the Vector Error Correction Model (VECM) method. The following is the result of representing the VECM estimation of the two models:

Model I

$$\begin{aligned}
 & D(IHK) \\
 = & 0.618179800759 * (IHK(-1)) \\
 & - 6.96477439584 * LN_M2(-1) \\
 & - 61.979864499 * LN_KURS(-1) \\
 & + 701.563501963) - 0.555467222131 \\
 & * (BI7DRR(-1) - 3.70115549907 \\
 & * LN_M2(-1) - 19.0477535821 \\
 & * LN_KURS(-1) + 236.96759351) \\
 & - 0.421476319427 * D(IHK(-1)) \\
 & - 0.107960798849 \\
 & * D(BI7DRR(-1))0.441341879441 \\
 & * D(LN_M2(-1)) - 0.856504244375 \\
 & * D(LN_KURS(-1))
 \end{aligned}
 \tag{14}$$

Model II

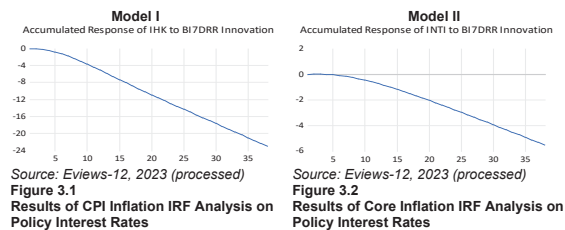
$$\begin{aligned}
 D(INTI) = & 0.03259008037617 * (INTI(-1)) \\
 & - 0.858299127253 \\
 & * LN_M2(-1) \\
 & - 51.6868366824 \\
 & * LN_KURS(-1) \\
 & + 507.085036362) \\
 & - 0.0402467051129 \\
 & * (BI7DRR(-1) \\
 & - 11.5383597313 \\
 & * LN_M2(-1) \\
 & - 11.9090260007 \\
 & * LN_KURS(-1) \\
 & + 293.320690786) \\
 & + 0.44374993191 \\
 & * D(INTI(-1)) \\
 & + 0.290354326274 \\
 & * D(BI7DRR(1)) \\
 & + 0.525091134463 \\
 & * D(LN_M2(-1)) \\
 & + 0.967400736339 \\
 & * D(LN_KURS(-1))
 \end{aligned}
 \tag{15}$$

3.2 Discussion

The results of the IRF analysis in this study are presented in graphical form showing positive or negative responses over 38 periods, according to the time span of observations during the Covid - 19 Pandemic. The horizontal axis describes the time in the next day after a shock occurs, while the vertical axis describes the response value. The response generated in the short term is usually quite significant and tends to change, while in the long term it is consistent and tends to shrink.

3.2.1 Interest rate

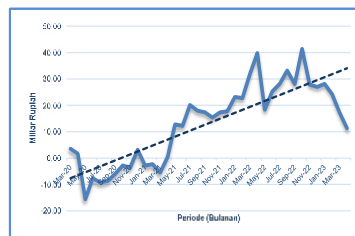
Figures 3.1 and 3.2 show that the variable policy interest rates on inflation Consumer Price Index (CPI) and Core Inflation show the same response. CPI inflation and core inflation tend to respond negative to shocks or changes in the policy interest rate variable. CPI inflation responded negative from the third period to the last period with the magnitude of the shock given -23.0 percent, while Core Inflation responded negative from the sixth period to the last period with a shock amount of -5.5 percent. The resulting negative response explained that the movement of the policy interest rate with CPI inflation and core inflation was not in the same direction, where an increase in the policy interest rate will reduce the CPI inflation rate and core inflation, conversely, a decrease in the policy interest rate will increase the CPI Inflation and Core Inflation rates. The results of the IRF analysis are supported by the results of research by Lelo et al., (2018); Esprance and Fuling (2020); Junaeldi and Sentosa (2022); Ratri and Munawar (2022).



Source: *Eviews-12, 2023 (processed)*
 Figure 3.1
 Results of CPI Inflation IRF Analysis on Policy Interest Rates

Source: *Eviews-12, 2023 (processed)*
 Figure 3.2
 Results of Core Inflation IRF Analysis on Policy Interest Rates

The contraction in economic growth in the second quarter of 2020 was -5.32 percent until the first quarter of 2021 was -0.69 percent due to the Covid-19 pandemic, encouraging Bank Indonesia to implement expansionary monetary policy in support of national economic recovery, one of which is lowering policy interest rates. In 2020 Bank Indonesia reduced the policy interest rate five times with a total reduction of 125 bps to 3.75 percent at the end of the year, in 2021 it will reduce the policy rate again by 25 bps to 3.50 percent. Changes in short-term interest rates are transmitted to long-term interest rates in the supply and demand side of the money market, which then affect the cost of investment capital. A decrease in interest rates makes the cost of new physical capital cheaper and investments made profitable, resulting in an increase in aggregate demand at a certain price level, thus shifting the AD curve to the right (Mishkin, 2019). Lower interest rates throughout 2020 and 2021 trigger an increase in CPI inflation in early 2022 until it grows by 5.95 percent in September 2022.



Source: *Indonesian Economic and Financial Statistics (SEKI), 2023. (Data processed)*
 Figure 4.7 Core Money Growth During the Covid-19 Pandemic

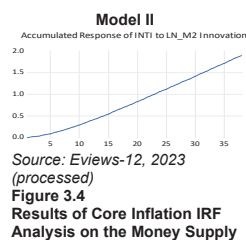
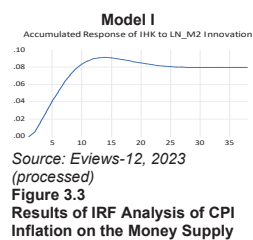
Stock and Watson (2015) explain that policy interest rates affect Core Inflation through the monetary policy transmission mechanism, when the policy interest rate is raised it will reduce aggregate demand in the economy, conversely when the policy interest rate is lowered it will encourage economic growth and increase the inflation rate. The policy interest rate does not always affect Core Inflation directly, but varies depending on economic conditions and monetary policy. The application of monetary policy influences the core money supply, through open market operations. Core money consists of currency circulating in the community and balances in demand deposits owned by commercial banks at Bank Indonesia. The central bank raises interest rates to attract money in the community, this will reduce the money supply and reduce inflation, and vice versa, low interest rates will increase the money supply and increase inflation (Tjahjono et al., 2000).

During the Covid - 19 Pandemic, the low monetary policy interest rate continued to drive a reduction in

bank lending rates as an effort to facilitate and increase financing (credit) for the business world. Asmadina et al., (2021) revealed that lending had a positive and significant effect on inflation in Indonesia during the Covid - 19 Pandemic. The reduction in bank lending rates has stimulated an increase in core money growth as shown in Figure 4.6, in March 2020 core money amounted to 1,031,285.12 billion rupiahs or grew by 3.56 percent to 1,544,963.73 billion rupiahs or grew by 28.13 percent at the beginning of 2023. This core money growth triggered an increase in inflation in early 2022 until January 2023 growing by 3.27 percent.

3.2.2 Money supply

Figures 4.3 and 4.4 show that the money supply variable (M2) has the same response to Consumer Price Index (CPI) Inflation and Core Inflation. CPI inflation and core inflation tend to respond positive to shocks or changes in the variable money supply (M2) from the beginning of the period to the last period. The magnitude of the shock given by the money supply variable was CPI Inflation of 0.8 percent and Core Inflation of 1.89 percent. The resulting positive response explains that the movement of the money supply (M2) with CPI Inflation and Core Inflation is one way, where an increase in the money supply (M2) will increase the level of CPI Inflation and Core Inflation, conversely, a decrease in the money supply (M2) will reduce the level of CPI inflation and core inflation. The results of the IRF analysis are supported by the research results of Bedada et al., (2019); Nigguse et al., (2019); Atil and Saouli (2020); Damayanti and Jalunggono (2022); Laksamanany (2022).

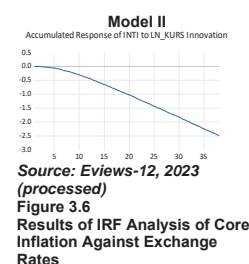
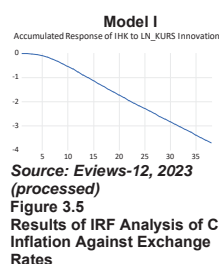


Based on empirical results, the relationship between the money supply (M2) and inflation is expected to be positive and unidirectional, but in fact the increase in the money supply (M2) during the Covid-19 Pandemic was not followed by high inflation rates, both Consumer Price Index (CPI) Inflation and Core Inflation grew below 3 percent in early 2020 until the end of 2021. This reveals that the increase in the money supply (M2) throughout 2020 to 2021, which was triggered by the injection of large amounts of liquidity by Bank Indonesia through the purchase of Government Securities (SBN) for funding the State Budget, has been considered for its impact on the inflation rate. An increase in the money supply (M2) from January 2022 to early 2023 triggered by an increase in savings and quasi-money in the community, as well as an increase in

bank credit, will increase the growth of CPI Inflation and Core Inflation in August 2022 until early 2023.

3.2.3 Exchange rate

Figures 3.5 and 3.6 show that the variable exchange rate to inflation Consumer Price Index (CPI) and Core Inflation show the same response. CPI inflation and core inflation tend to respond negative to shocks or changes in exchange rate variables. CPI inflation responded negative from the fourth to the last period with a shock of -3.7 percent, while Core Inflation responded negative from the third to the last period with a shock of -5.1 percent. The resulting negative response explains that exchange rate movements with CPI Inflation and Core Inflation are not in the same direction, where an increase in the exchange rate will reduce the CPI Inflation and Core Inflation rates, and conversely a decrease in the exchange rate will increase the CPI Inflation and Core Inflation rates. The results of the IRF analysis are supported by the results of research by Lelo et al., (2018); Esprance and Fuling (2020); Laksamanany (2022); Devia and Fadli (2022).



The relationship between the United States Dollar exchange rate and the Indonesian Rupiah is expected to be positive, but empirical results reveal different results, namely CPI Inflation and Core Inflation tend to respond negative to exchange rate variables, even though the exchange rate of the United States Dollar to the Indonesian Rupiah shows an increasing trend during the Covid-19 Pandemic. An increase in the exchange rate of the United States Dollar causes the value of the rupiah to weaken (depreciate). According to the Mundell Flemming Model, the depreciation of the value of the domestic currency makes domestic goods cheaper than goods abroad, thus stimulating net exports and total income (Mankiw, 2019). The indirect relationship between exchange rates and prices states that a decrease in imports and an increase in exports increases net external demand, which then increases total aggregate demand and the inflation rate (Simorangkir & Suseno, 2004). In 2022 the growth rate of CPI Inflation and Core Inflation will increase, in line with the weakening of the rupiah exchange rate caused by the strengthening of the United States Dollar.

The resulting negative response was due to Bank Indonesia continuing to strengthen Rupiah exchange rate stabilization measures to remain in line with its fundamentals, amidst global financial market uncertainties and efforts to control imported goods

inflation during the Covid-19 Pandemic. Exchange rate stabilization policies were carried out through triple intervention, both in the market spot, Domestic Non-Deliverable Forward (DNDF) market, as well as intensive communication with investors and domestic and foreign market players (Bank Indonesia, 2023).

Table 6. Variance decomposition test result.

Peri- Od	Model I				Model II			
	IHK	BI7DRR	LN_M2	LN_KURS	IHK	BI7DRR	LN_M2	LN_KURS
1	100.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00
2	97.10	2.96	0.01	0.03	99.58	0.03	0.39	0.00
4	83.97	15.77	0.05	0.21	98.95	0.11	0.67	0.26
6	70.73	28.68	0.04	0.55	97.06	1.13	0.98	0.83
8	61.87	37.28	0.03	0.82	94.23	3.09	1.25	1.43
10	56.44	42.53	0.02	1.02	91.01	5.53	1.47	1.98
12	53.13	45.73	0.01	1.13	87.81	8.07	1.66	2.46
14	51.09	47.69	0.01	1.21	84.84	10.48	1.82	2.85
16	49.82	48.91	0.01	1.26	82.20	12.66	1.96	3.18
18	49.04	49.66	0.01	1.29	79.89	14.59	2.07	3.45
20	48.55	50.12	0.01	1.31	77.89	16.26	2.17	3.68
22	48.24	50.43	0.01	1.33	76.16	17.72	2.45	3.87
24	48.03	50.63	0.00	1.34	74.67	18.98	2.32	4.03
26	47.89	50.78	0.00	1.34	73.37	20.08	2.37	4.17
28	47.77	50.88	0.00	1.35	72.25	21.04	2.43	4.29
30	47.68	50.97	0.00	1.35	71.26	21.88	2.47	4.39
32	47.59	51.05	0.00	1.35	70.39	22.62	2.51	4.48
34	47.51	51.12	0.00	1.36	69.63	23.27	2.54	4.56
36	47.44	51.19	0.00	1.36	68.95	23.85	2.57	4.63
38	47.38	51.26	0.00	1.36	68.34	24.36	2.60	4.69

Source: Results of Output Eviews-12, 2023 (Data processed)

In the first period, both Consumer Price Index (CPI) Inflation and Core Inflation were heavily influenced by the Inflation shock itself by 100 percent. Meanwhile, the variables of policy interest rates, money supply and exchange rates in the first period did not have any effect on CPI inflation and core inflation. The value of the proportion of the impact of the CPI Inflation shock and Core Inflation itself was quite large from the beginning of the period to the end of the period, but the CPI Inflation shock and Core Inflation gave the proportion of influence that decreased little by little until the last period of 47.38 percent and 68.34 percent. This is because both CPI Inflation and Core Inflation have been influenced by the variables of policy interest rates, money supply and exchange rates.

3.2.4 Interest rate

Based on the results of the Variance Decomposition test on both models, it can be seen that the value of the largest proportion of shocks to Consumer Price Index (CPI) Inflation and Core Inflation is given by the policy interest rate variable. Policy interest rates began to have an effect on CPI inflation in the second period of 2.96 percent and continued to show an increase in each period until the last period of 51.26 percent. The value of the shock proportion is greater than the money supply (M2) and the exchange rate. In Core Inflation, the policy interest rate begins to exert its influence in the 6th period, because in the 2nd to 4th periods a larger proportion of the influence is exerted by the money supply (M2). The effect of policy interest rates on Core Inflation continued to show an increase in each period until the last period of 24.36 percent. Based on the value of the proportion of shocks generated in each period up to the last period, the policy interest rate variable has a greater influence on CPI Inflation than Core Inflation.

3.2.5 Money supply

Based on the results of the Variance Decomposition test on both models, it can be seen that the shock proportion value of the money supply variable to Consumer Price Index (CPI) Inflation and Core Inflation shows a difference. The money supply (M2) began to have an effect on CPI inflation in the second period of 0.01 percent, increased in the 4th period, decreased until the 22nd period of 0.01 percent and in the following period until the end of the period the money supply does not affect CPI Inflation. In Core Inflation, the money supply (M2) began to have an impact in the second period of 0.39 percent and continued to show an increase in each period until the last period of 2.60 percent. Based on the value of the proportion of shocks generated in each period up to the last period, the money supply variable has a greater influence on Core Inflation than CPI Inflation. When compared to the policy interest rate and the exchange rate, the shock proportion is smaller.

3.2.6 Exchange rate

Based on the results of the Variance Decomposition test on both models, it can be seen that the value of the proportion of exchange rate variable shock to Consumer Price Index (CPI) Inflation and Core Inflation shows a difference. The exchange rate began to have an effect on CPI inflation in the second period of 0.03 percent and continued to show an increase in each period until the last period of 1.36 percent. In Core Inflation, the exchange rate began to have an effect in the third period of 0.26 percent and continued to show an increase in each period until the last period of 4.69 percent. Based on the value of the proportion of shocks generated in each period up to the last period, the exchange rate variable has a greater influence on Core Inflation than CPI Inflation. When compared to the interest rate policy, the proportion of exchange rate shocks is smaller and larger than the money supply (M2).

The main findings of this study show that interest rates have a negative impact on inflation, while money supply growth contributes positively to inflation, with a stronger core inflation response compared to CPI inflation. Compared to other studies, such as those conducted by Sertiartiti and Hapsari (2019) which examine the determinants of inflation in Indonesia, this study highlights the important role of monetary policy in crisis situations, providing a new perspective on how such policies can be adapted in uncertain conditions. The implications of these findings suggest that inflation control must consider the interaction between interest rates and money supply, as well as the importance of a quick and appropriate policy response in maintaining economic stability.

The strength of this study lies in the use of the VECM model which allows for the analysis of long-run and short-run relationships between macroeconomic variables. However, limitations of this study include the limited focus on a specific period during the pandemic, which may not fully reflect the dynamics of inflation in a broader context.

4 Conclusions

The main findings show that interest rates have a negative impact on inflation, while money supply growth contributes positively to inflation, with core inflation showing a stronger response than CPI inflation. The significance of these results lies in a deeper understanding of how monetary policy can be optimized to control inflation in a crisis situation. However, this study has limitations, including focusing on a specific period that may not fully reflect the dynamics of inflation in a broader context, as well as data limitations that may affect the results of the analysis. Therefore, future research prospects can include further analysis of the influence of external factors, such as fiscal policy and global conditions, on inflation in Indonesia. Longitudinal research covering the period before and after the pandemic will also provide more comprehensive insights.

This article contributes to new knowledge in the macroeconomic domain by highlighting the importance of responsive monetary policy management in maintaining inflation stability, especially in a crisis situation. To encourage further research, it is recommended that other researchers explore the relationship between inflation and other macroeconomic variables, as well as conduct more in-depth studies on the impact of different monetary policies in varying contexts. This study is expected to motivate other researchers to continue exploration in this field, so that they can produce more effective and responsive policies to the economic challenges faced.

Based on the research results showing the relationship between monetary policy, interest rates, and inflation in Indonesia during the COVID-19 pandemic, here are some policy recommendations that can be considered: (1) *Responsive Interest Rate Adjustment*: Bank Indonesia should consider making interest rate adjustments more flexibly and responsively to changes in inflation. Given that interest rates have a negative impact on inflation, interest rate cuts can be considered in situations where inflation tends to increase, to encourage economic growth. (2) *Monetary and Fiscal Policy Coordination (Policy Miix)*: Better coordination between monetary policy and fiscal policy is needed to achieve economic stability. The government and Bank Indonesia must work together in formulating policies that support each other, especially in terms of government spending and investment to encourage economic growth without triggering inflation.

Thank you to Bank Indonesia for providing research funding through the Research Assistance Program (Banlit).

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