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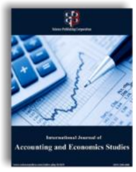

Exploring The Drivers of Inflation in Indonesia: A Quantitative Analysis

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Abstract

Inflation is a crucial macroeconomic indicator that affects various economic variables and requires effective policy responses. In Indonesia, Bank Indonesia plays a central role in maintaining price stability through monetary policy. This study examines the short- and long-term impacts of several macroeconomic variables on inflation using quarterly data from 2009 to 2023, employing the Vector Autoregression (VAR) and Vector Error Correction Model (VECM) approach-es. The results show that in the short term, money supply (M1) negatively affects inflation, while interest rates have a positive effect. Other variables, such as exchange rate, GDP, exports, and imports, also exhibit negative effects in the short term. In the long run, M1, GDP, exports, and imports significantly affect inflation, with exchange rate, interest rates, and imports showing a positive relationship. Granger causality indicates a bidirectional relationship between GDP and M1. These findings suggest the importance of controlling money supply, promoting exports, managing imports, and stabilizing the exchange rate. Overall, Indonesia's inflation control policies appear relatively effective, with the diminishing impact of inflation shocks over time. Further research is encouraged to deepen the understanding of causal relationships among these variables.

Keywords: *Inflation; Macroeconomic; Vector Autoregression (VAR); Vector Error Correction Model (VECM); Monetary Policy.*

1. Introduction

Inflation is a common economic phenomenon that occurs when the general price level of goods and services in an economy rises over time. Inflation can have a significant impact on the economy, as it reduces the purchasing power of money and can lead to decreased economic growth and stability. (Endri, 2009). Therefore, understanding the drivers of inflation is important for policymakers, economists, and businesses to develop effective strategies to mitigate its impact and promote economic stability and growth. (Mankiw, 2012).

North Sumatra is one of the provinces in Indonesia that has experienced inflation in recent years, which has raised concerns among policymakers and economists. Inflation in North Sumatra can be caused by a variety of factors, such as changes in the supply and demand of goods and services, fluctuations in the value of the Indonesian rupiah, and changes in government policies and regulations. (Setiartiti & Hapsari, 2019). Inflation in North Sumatra has been an ongoing concern for the government and the public. The inflation rate in North Sumatra reached 3.06% in 2020, which is slightly higher than the national inflation rate of 2.72% (Haryono, 2022). Although the inflation rate in North Sumatra is still considered moderate, it is crucial to understand the drivers of inflation to prevent it from becoming a bigger problem in the future.

One of the main drivers of inflation in North Sumatra is the supply and demand of goods and services. When the demand for goods and services exceeds the supply, prices tend to increase. In North Sumatra, the demand for goods and services is driven by the growing population, urbanization, and economic growth. The province has a population of over 14 million people, which is expected to increase in the future. As the population grows, the demand for goods and services will also increase, putting pressure on prices. (Damanik & Panjaitan, 2022). The supply of goods and services in North Sumatra is affected by various factors, such as weather conditions, transportation, and infrastructure. For example, the province is known for its agricultural products, such as rubber, palm oil, and coffee. If there is a drought or other weather-related problems, the supply of these products may decrease, leading to higher prices. Similarly, if the transportation infrastructure is inadequate, the cost of transporting goods to North Sumatra may increase, leading to higher prices. (Endri, 2009). Another factor that contributes to inflation in North Sumatra is the fluctuation in the value of the Indonesian rupiah. North Sumatra is highly dependent on imports, such as raw materials and consumer goods. If the value of the rupiah decreases, the cost of imports will increase, leading to higher prices of goods and services. The value of the rupiah is affected by various factors, such as global economic conditions, interest rates, and government policies. (Setiartiti & Hapsari, 2019).

Changes in government policies and regulations also play a role in driving inflation in North Sumatra. For example, the government may increase the minimum wage, which may lead to higher labor costs for businesses. Higher labor costs may lead to higher prices of goods and services to maintain the profit margin. Similarly, the government may increase taxes or reduce subsidies, leading to higher costs for businesses, which may be passed on to consumers in the form of higher prices (Setiartiti & Hapsari, 2019). In addition to these factors, inflation in North Sumatra may also be affected by external factors, such as global economic conditions, geopolitical tensions, and natural disasters. For example, if there is a global economic recession, demand for exports from North Sumatra may decrease, leading to lower prices for exports and a decrease in economic growth. Similarly, if there is a natural disaster, such as a flood or earthquake, the supply of goods and services may be disrupted, leading to higher prices (Irawan, Hartono, Irawan, & Yusuf, 2012). To manage inflation in North Sumatra, policymakers and businesses need to develop effective strategies to address the underlying drivers of inflation. For example, policymakers may implement measures to increase the supply of goods and services, such as improving transportation infrastructure and promoting investments in agriculture and industry. By increasing the supply of goods and services, policymakers can help alleviate the pressure on prices caused by high demand (Güneş, Mohanty, & Morley, 2021).

Another strategy that policymakers can use is to maintain stable monetary and fiscal policies. For example, the central bank can use monetary policy tools, such as adjusting interest rates, to manage inflation. Fiscal policies, such as taxes and subsidies, can also be used to regulate the supply and demand of goods and services. Businesses can also play a role in managing inflation by implementing cost-cutting measures and adopting efficient production methods. For example, businesses can reduce their labor costs by implementing automation and adopting new technologies. This can help reduce the cost of production, which may result in lower prices for consumers. Moreover, businesses can also consider sourcing raw materials locally to reduce their reliance on imports. This can help reduce the impact of fluctuations in the value of the Indonesian rupiah on their production costs, which can help stabilize prices for consumers. In addition to these strategies, policymakers and businesses need to work together to promote economic growth and stability in North Sumatra. This can be achieved by implementing policies and initiatives that promote investment, job creation, and entrepreneurship. By promoting economic growth, policymakers can help reduce poverty, increase the standard of living, and create opportunities for the people of North Sumatra. (Don Sama Lelo, Dwi Astuti, & Suharsih, 2018).

In conclusion, inflation is a complex economic phenomenon that can have a significant impact on the economy and the well-being of people. In North Sumatra, inflation is driven by a variety of factors, such as changes in the supply and demand of goods and services, fluctuations in the value of the Indonesian rupiah, and changes in government policies and regulations. (Rohimah, Tanjung, & Pulungan, 2020). To manage inflation in North Sumatra, policymakers and businesses need to develop effective strategies to address these underlying drivers of inflation. By promoting economic growth and stability, policymakers can help ensure a better future for the people of North Sumatra. (Don Sama Lelo et al., 2018).

2. Theoretical Framework

2.1. Quantity theory of money

The Quantity Theory of Money (QTM) posits a long-run relationship between money supply growth and inflation, emphasizing that persistent increases in money circulation ultimately translate into higher price levels. In empirical inflation modeling, QTM primarily motivates the inclusion of monetary aggregates and liquidity-related variables as long-run inflation determinants.

Recent literature suggests that while the short-run validity of QTM is debated, its relevance remains strong in explaining long-term inflation trends, particularly in emerging and developing economies where monetary expansion often accompanies fiscal dominance (Wouters, 2002; McLure, 2013). This is especially relevant for Indonesia, where monetary growth has historically interacted with administered prices and exchange rate dynamics.

However, contemporary critiques argue that QTM oversimplifies the role of money by treating it as exogenous. Cochrane (2023) emphasizes that modern financial systems transmit monetary effects through asset prices and expectations, rather than solely through transaction balances, while Fontana (2016) highlights the importance of institutional structures and policy regimes.

These critiques motivate the use of broader monetary indicators and control variables, rather than a mechanical one-to-one money–inflation relationship. Alternative approaches, such as Divisia monetary aggregates (Brill et al., 2021) and monetary regime frameworks (Mndebele et al., 2023), reinforce the view that the inflationary impact of money depends on policy credibility and institutional context.

In this study, QTM provides the foundational justification for including monetary variables, while recognizing that their effects are conditional on expectations, policy regimes, and structural characteristics of the economy.

2.2. Expectation theory

The expectation theory of inflation emphasizes that inflation is forward-looking, as current price-setting behavior depends on agents' expectations of future inflation. This theoretical perspective directly motivates the inclusion of inflation expectations or proxy variables in empirical inflation models.

Extensive empirical evidence shows that inflation expectations influence consumer spending, wage negotiations, asset prices, and interest rate dynamics (Evans & Honkapohja, 2006; Coibion & Gorodnichenko, 2015). In emerging economies such as Indonesia, expectation formation is particularly sensitive to central bank communication, exchange rate volatility, and food and energy price shocks, making expectation channels highly relevant.

Recent studies demonstrate that incorporating expectation measures improves inflation forecasting accuracy and policy effectiveness (Bonatti et al., 2022; Okuda & Tsuruga, 2021). These findings imply that a credible and transparent monetary policy framework can anchor expectations and dampen inflation persistence.

Accordingly, expectation theory underpins the hypothesis that higher expected inflation leads to higher realized inflation, reinforcing inflation inertia. This linkage is essential for interpreting estimated coefficients related to lagged inflation or expectation proxies in the empirical model.

2.3. Structural theory

Structural inflation theory argues that inflation dynamics are shaped by real-side characteristics of the economy, including market structure, wage-setting mechanisms, technological change, demographics, and supply shocks. Unlike purely monetary explanations, this framework emphasizes persistent and sector-specific sources of inflation.

Empirical studies show that market power and wage bargaining institutions can amplify inflationary pressures (Chirinko & Fazzari, 2000; Lombardi et al., 2020), while technological progress and demographic shifts alter cost structures and demand patterns (Campolmi & Faia, 2011; Duarte & Restuccia, 2010).

For developing economies, structural factors such as supply bottlenecks, labor market rigidity, and commodity dependence are particularly important. In Indonesia, food supply disruptions and administered prices frequently act as structural inflation drivers, justifying the inclusion of supply-side control variables.

Structural theory, therefore, motivates the inclusion of real-sector indicators and supply-shock variables, and supports the expectation that inflation is not solely a monetary phenomenon but also a function of economic structure.

2.4. Demand theory

Structural demand theory focuses on how changes in the composition and distribution of demand influence inflation dynamics. Shifts in income distribution, demographics, consumer heterogeneity, and global demand conditions can alter relative prices and aggregate inflation outcomes.

Empirical evidence shows that income inequality and demographic change significantly affect inflation through consumption patterns (Berriel et al., 2018; Yoon et al., 2014). In open emerging economies, global demand shocks and commodity price movements further transmit inflationary pressures through import prices and exchange rates (Finck & Tillmann, 2022).

For Indonesia, demand-side inflation is closely linked to household consumption dominance and sensitivity to income and price shocks, making demand indicators particularly relevant.

This theoretical perspective supports the inclusion of demand-related variables and implies that stronger aggregate demand exerts upward pressure on inflation, ceteris paribus.

3. Research Method

3.1. Data

This study utilized secondary data in the form of time series, sourced from various related agencies, including the Central Statistics Agency (BPS) and Bank Indonesia (BI), covering the period from 2009 quarter I to 2023 quarter IV. The investigated variables comprised Inflation (INF), Money Supply (M1), Exchange Rate (ER), Central Bank Interest Rate (IR), Gross Domestic Product (GDP), Exports (EXP), Imports (IMP) (Gujarati, 2004).

In order to explore the interdependence between the aforementioned variables, Vector Autoregression (VAR) analysis was employed, encompassing several stages of estimation. These included tests for data stationarity, degree of integration, cointegration, optimal lag determination, VAR model analysis, Granger causality, Impulse Response Function (IRF), and Variance Decomposition (VD) tests. (Gujarati, 2004).

The VAR model is a regression-based equation model utilizing time series data. Such data often poses issues related to stationarity and cointegration. To establish the VAR model, the first step is to test for data stationarity. If the data is stationary at the level, an ordinary VAR model (unrestricted VAR) is utilized. Conversely, if the data is not stationary at the level, but is stationary through the process of data differentiation, a cointegration test is conducted to determine whether a long-term relationship exists between the variables. If such a relationship is present, a Vector Error Correction Model (VECM) is utilized, which represents a restricted VAR model indicating a long-term relationship between the variables in the VAR system. If the data is stationary through the differentiation process, but the variables are not cointegrated, it is referred to as a VAR model with differentiated data (VAR indifference) (Gujarati, 2004).

3.2. Stationarity test

The Augmented Dickey-Fuller (ADF) method is one of the statistical techniques used to test the stationarity of data in time series analysis. The objective of the ADF test is to identify whether the time series data possesses a unit root or not. (Gujarati, 2004). Initially, the data is tested at the level, and if non-stationarity is detected, it is then tested at the first and second difference levels or tested for the degree of integration to determine the degree of integration at which the data is stationary. (Gujarati, 2004).

3.3. Optimum lag test

The Optimum Lag Test is utilized to determine the optimal lag length of the VAR model in the research. The optimal lag length is determined based on the Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quinn Information Criterion (HQ), which are identified as the values that yield the lowest AIC, SC, and HQ values from the first lag to the maximum lag. (Gujarati, 2004).

3.4. Stability test

The stability of the VAR model utilized is assessed through stability testing, as any instability in the estimated results of the VAR model combined with the error correction model can render the conclusions obtained from Impulse Responses and Variance Decomposition invalid. The stability of the VAR model can be determined by examining the inverse root characteristic of the AR polynomial, with a stable VAR model featuring AR root values < 1 (Gujarati, 2004).

3.5. Cointegration test

Cointegration testing is conducted when non-stationarity is detected in the data stationarity test. Cointegration testing is necessary to determine whether the data exhibits a long-term relationship (cointegration) and the influence of mutual relationships between the variables. This test determines the model to be estimated, whether using the ordinary VAR or the Vector Error Correction Model (VECM). If non-stationarity is present but is stationary through the data differentiation process, a cointegration test is conducted to determine whether a long-term relationship exists between the variables. If such a relationship is present, a Vector Error Correction Model (VECM) is utilized, which represents a restricted model (restricted VAR) due to the presence of cointegration, indicating a long-term relationship between the variables in the VAR system. (Gujarati, 2004).

3.6. Vector autoregressive models (VAR)

The VAR model is a multivariate time series model in which all variables are considered as endogenous variables without being differentiated into exogenous and endogenous variables. (Gujarati, 2004). The VAR model is an extension of the autoregressive (AR) model for multiple time series. The general formulation of the VAR model is expressed as:

$Yt = \beta_1 y_{1t-1} + \beta_2 y_{2.t-1} + \ldots.. + \beta_p y_{t-p} + e$

Where:
Y_t = vector of n endogenous variables
For this study, the VAR model equation is specified as follows:
Long-term VAR equation

$INF_t = \beta_1 + \beta_2\, M1_{(t-1)} + \beta_3 ER_{(t-1)} + \beta_4\, IR_{(t-1)} + \beta_5\, GDP_{(t-1)} + \beta_6\, EXP_{(t-1)} + \beta_7\, IMP_{(t-1)} + e$

Short-term VAR equation

$INF_t = \beta_1 + \beta_2\, D(M1_{(t-1)}) + \beta_2\, D(M1_{(t)}) + \beta_3\, D(ER_{(t-1)}) + \beta_4\, D(ER_{(t)}) + \beta_5\, D(IR_{(t-1)}) + \beta_6\, D(IR_{(t)}) + \beta_7\, D(GDP_{(t-1)}) + \beta_8\, D(GDP_{(t)}) + \beta_9\, D(EXP_{(t-1)}) + \beta_{10}\, D(EXP_{(t)}) + \beta_{11}\, D(IMP_{(t-1)}) + \beta_{12}\, D(IMP_{(t)}) + ECT$

Where:
INF= Inflation
M1= Money Supply
ER= Rupiah Exchange Rate
IR= Central Bank Interest Rate
EXP = Export
IMP = Import

3.7. Granger causality test

The Granger Causality Test is a statistical method used to assess the predictive power of one variable's lag values on another variable. Specifically, the causality test investigates the causal relationship between variables. This is particularly important in the context of Vector Autoregressive (VAR) models, which do not distinguish between endogenous and exogenous variables. As a result, the causality test can begin from a lack of knowledge regarding the interdependence between variables. This study employs the Granger's Causality method, which is commonly used to test the causal relationship between two variables, including one-way or two-way causation. (Gujarati, 2004).

3.8. Impulse response functions (IRF)

Impulse Response Functions (IRF) are mathematical tools that elucidate the dynamic structure of VAR models. These functions describe the influence of shocks among endogenous variables, as well as among themselves. More specifically, IRF showcases the response of the dependent variable to shocks in the error term, which are characterized by standard deviation values in the VAR system. (Gujarati, 2004).

3.9. Variance decomposition analysis

Variance Decomposition Analysis is a statistical technique used to determine the relative importance of each variable in explaining changes in both itself and other variables. Through an examination of exogenous variables, it is possible to identify the degree to which each variable's shock contributes to the variance of that variable and other variables. In essence, Variance Decomposition analysis can be leveraged to identify the variable shocks that most strongly influence changes in a given variable. (Gujarati, 2004).

4. Result and Discussion

4.1. Stationarity testing

In this study, stationarity tests were conducted at the level and first difference for all variables examined using the Augmented Dickey-Fuller (ADF) test. The purpose of this testing was to determine whether the data used was stationary or not, ensuring the validity of the analysis results. The ADF method was chosen because it is capable of identifying the presence of trends or patterns that could potentially cause non-stationarity in the data.

Table 1: Stationary Test with ADF Test at Level

Variable	ADF Statistics	Mackinon Critical Calue			Prob.	Results
		1%	5%	10%		
INF	-1.745560	-3.555023	-2.915522	-2.595565	0.4032	Non-stationer
M1	3.492559	-3.552666	-2.914517	-2.595033	1.0000	Non-stationer
ER	-1.101997	-3.546099	-2.911730	-2.593551	0.7095	Non-stationer
IR	-3.171889	-3.548208	-2.912631	-2.594027	0.0268	Stationer
GDP	2.259899	-3.562669	-2.918778	-2.597285	0.9999	Non-stationer
EXP	-2.755527	-3.546099	-2.911730	-2.593551	0.0710	Non-stationer
IMP	-2.580838	-3.546099	-2.911730	-2.593551	0.1026	Non-stationer

The results of the stationarity test in Table 1 indicate that the inflation (INF), money supply (M1), exchange rate (ER), Gross Domestic Product (GDP), exports (EXP), and imports (IMP) data are not stationary at the level. This is evident from the probability values that are

greater than 0.05. Only the Central Bank interest rate (IR) is found to be stationary at the level. Therefore, the VAR estimation at the level form is not used in this study because not all variables are stationary at the level.
As the next step, a stationarity test is conducted on the first difference. If the data is stationary in the first difference, a cointegration test is necessary to determine whether the model has a long-run relationship or not. If a long-run relationship is found, the model used is the Vector Error Correction Model (VECM).

Table 2: Stationary Test with ADF Test at 1st Difference

Variable	ADF Statistics	Mackinon Critical Value			Prob.	Result
		1%	5%	10%		
INF	-6.414687	-3.555023	-2.915522	-2.595565	0.0000	Stationer
M1	-12.60931	-3.548208	-2.912631	-2.594027	0.0000	Stationer
ER	-9.274602	-3.548208	-2.912631	-2.594027	0.0000	Stationer
IR	-4.634983	-3.548208	-2.912631	-2.594027	0.0000	Stationer
GDP	-5.557352	-3.562669	-2.918778	-2.597285	0.0000	Stationer
EXP	-9.229059	-3.548208	-2.912631	-2.594027	0.0000	Stationer
IMP	-7.406326	-3.550396	-2.913549	-2.594521	0.0000	Stationer

Based on the results of the stationary test in Table 2, it was found that all variables under study have been proven to be stationary. Therefore, the research can be continued to the next stage, which is determining the optimum lag.

4.2. Optimum lag testing

The determination of the optimal lag in a VAR model serves to address the issue of autocorrelation that may arise in the VAR system. If the chosen optimal lag is too short, the model's ability to capture the overall dynamics can be limited. However, if the lag is too long, the estimation of the model can become inefficient due to the reduced degrees of freedom. Furthermore, the selection of the optimal lag length also plays a crucial role in determining the duration of inter-variable dependence. The optimal lag is selected as the model that has the smallest value of LR, FPE, AIC, SC, and HQ.

Table 3: Optimum Lag Test Results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3309.601	NA	1.10e+41	114.3655	114.6142	114.4624
1	-2997.048	538.8845*	1.26e+37*	105.2775*	107.2669*	106.0524*
2	-2963.833	49.25012	2.33e+37	105.8218	109.5519	107.2748

Based on the results of the optimal lag test, it was found that the optimal lag length is one (1). However, Table 3 shows that the optimal lag for the data is at the second lag. Therefore, the next test needs to be conducted using the second lag.

4.3. VAR model stability test

The next step after selecting the optimal lag is to conduct stability tests on the VAR model. Stability tests are necessary before conducting impulse response and variance decomposition tests to ensure the validity of the results obtained. The results of the stability test in Table 4 show that the VAR model is stable and has passed the stability test. This can be seen from the modulus values that are less than one, indicating that the estimated VAR used for Impulse Response Function (IRF) analysis and Variance Decomposition (VD) analysis is stable and valid.

Table 4: Stability Test Results

Root	Modulus
1.012487	0.992487
0.796155 - 0.207494i	0.822749
0.796155 + 0.207494i	0.822749
0.556306 - 0.376184i	0.671559
0.556306 + 0.376184i	0.671559
0.557915 - 0.141632i	0.575612
0.557915 + 0.141632i	0.575612
-0.510638	0.510638
0.051950 - 0.377483i	0.381040
0.051950 + 0.377483i	0.381040
-0.290466	0.290466
-0.120513 - 0.135495i	0.181334
-0.120513 + 0.135495i	0.181334
-0.181047	0.181047

4.4. Cointegration test

After stability testing, the next step is to perform cointegration testing. The purpose of cointegration testing is to identify the existence of a long-term relationship or equilibrium between variables in the study, where this relationship can form a stable linear relationship. Cointegration testing is conducted using Johansen's Cointegration Test with data that has been stationary at the first difference level. The results of cointegration testing in Table 5 indicate indications of a long-term relationship between several variables, but there are no indications of cointegration in two other variables. According to the VAR model, if there is cointegration in the data, the model used in the next stage is the Vector Error Correction Model (VECM).

Table 5: Test Results of Johansen's Cointegration Rank Test

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.652395	185.8270	111.7805	0.0000
At most 1 *	0.586848	125.5957	83.93712	0.0000
At most 2 *	0.412923	75.21108	60.06141	0.0016
At most 3 *	0.275201	44.85291	40.17493	0.0157
At most 4 *	0.268232	26.50687	24.27596	0.0257
At most 5	0.141548	8.706249	12.32090	0.1869
At most 6	0.000117	0.006654	4.129906	0.9466

4.5. Vector error correction model (VECM) estimation

The estimation of the Vector Error Correction Model (VECM) is conducted to demonstrate the short-term and long-term relationships among variables. Based on the results presented in Table 6, it is known that in the short-term there are two variables that influence inflation, namely $M1_{t-1}$ and IR_{t-1}. In addition, in the long-term three variables affect inflation, namely M1, GDP, and EXP.

Table 6: VECM Estimation Result

Variable	Coefficient	t-value	t-table	Intepretation
Short-term				
CointEq1	[-0.565363]	[-4.54215]		
D (INF (-1))	[0.067607]	[0.42300]	2.00100	Not-Significant
D (INF (-2))	[0.261192]	[1.67177]	2.00100	Not-Significant
D (M1 (-1))	[-0.494190]	[-3.13123]	2.00100	Significant
D (M1 (-2))	[-0.027185]	[0.20117]	2.00100	Not-Significant
D (ER (-1))	[-0.236507]	[-1.46562]	2.00100	Not-Significant
D (ER (-2))	[-0.111142]	[-0.66444]	2.00100	Not-Significant
D (IR (-1))	[0.395179]	[2.25539]	2.00100	Significant
D (IR (-2))	[0.207657]	[1.15969]	2.00100	Not-Significant
D (GDP (-1))	[0.065206]	[0.39028]	2.00100	Not-Significant
D (GDP (-2))	[-0.130191]	[-0.87075]	2.00100	Not-Significant
D (EKS (-1))	[-0.258210]	[-0.96946]	2.00100	Not-Significant
D (EKS (-2))	[0.165926]	[0.65973]	2.00100	Not-Significant
D (IMP (-1))	[-0.066282]	[-0.31145]	2.00100	Not-Significant
D (IMP (-2))	[-0.370063]	[-1.70392]	2.00100	Not-Significant
C	[-0.237778]	[-0.79208]		
Long-term				
INF (-1)	1.000000	-	-	-
M1 (-1)	[-1.27E-05]	[-4.83553]	2.00100	Significant
ER (-1)	[-0.001196]	[-2.57796]	2.00100	Not-Significant
IR (-1)	[0.074491]	[0.31028]	2.00100	Not-Significant
GDP (-1)	[2.53E-05]	[5.64638]	2.00100	Significant
EKS (-1)	[-0.001089]	[-2.99053]	2.00100	Significant
IMP (-1)	[0.000280]	[1.06903]	2.00100	Not-Significant
C	[3.856914]	-	-	-

The estimation results of VECM are at lag-2 for the observation period from the first quarter of 2009 to the fourth quarter of 2023, as follows:

$D(INF) = -0.474013 + 0.067607\ INF_{(t-1)} + 0.261192\ INF_{(t-2)} - 0.494190\ M1_{(t-1)} - 0.027185\ M1_{(t-2)} - 0.236507\ ER_{(t-1)} - 0.111142\ ER_{(t-2)} + 0.395179\ IR_{(t-1)} - 0.207657\ IR_{(t-2)} + 0.065206\ GDP_{(t-1)} - 0.130191\ GDP_{(t-2)} - 0.258210\ EXP_{(t-1)} + 0.165926\ EXP_{(t-12} - 0.066282\ IMP_{(t-1)} - 0.370063\ IMP_{(t-2)} - 0.565363\ ECT$

Furthermore, the long-run VECM equation is as follows:

$INF = 3.856914 - 1.27E\text{-}05\ M1_{(t-1)} - 0.001196\ ER_{(t-1)} - 0.074491\ IR_{(t-1)} + 2.53E\text{-}05\ GDP_{(t-1)} - 0.001089\ EXP_{(t-1)} + 0.000280\ IMP_{t-1)} + e$

4.6. Granger causality test

This study employs the Granger causality test to examine the directional relationships among variables within the VAR/VECM framework. The use of Granger causality is motivated by the absence of a priori assumptions regarding endogenous and exogenous relationships among variables in the VAR system. Consequently, this test allows for an empirical assessment of whether past values of one variable contain predictive information for another variable.

Granger causality is applied to identify both unidirectional and bidirectional causal relationships, with statistical significance evaluated at conventional levels. It is important to emphasize that Granger causality reflects predictive causality in the short run rather than true structural or long-run causality.

Table 7: Granger's Causality Results

Null Hypothesis:	Obs	F-Statistic	Prob.	Keterangan
JUB does not Granger-cause INFLASI	58	2.96407	0.0602	There is no causal relationship.
INFLASI does not Granger-cause JUB		0.86598	0.4265	
KURS does not Granger-cause INFLASI	59	3.59293	0.0344*	There is a one-way relationship.
INFLASI does not Granger-cause KURS		2.10713	0.1317	
BIRATE does not Granger-cause INFLASI	59	3.16432	0.0503	There is no causal relationship.
INFLASI does not Granger-cause BIRATE		0.31997	0.7276	
GDP does not Granger Cause INFLASI	59	2.94516	0.0613	There is no causal relationship.

Null Hypothesis:	Obs	F-Statistic	Prob.	Keterangan
INFLASI does not Granger-cause GDP		0.60694	0.5488	
EKS does not Granger-cause INFLASI	59	0.59510	0.5552	There is no causal relationship.
INFLASI does not Granger-cause EKS		2.60632	0.0832	
IMP does not Granger-cause INFLASI	59	1.49184	0.2343	There is no causal relationship.
INFLASI does not Granger-cause IMP		3.03930	0.0563	
KURS does not Granger-cause JUB	59	0.74725	0.4786	There is a one-way relationship.
JUB does not Granger-cause KURS		3.37778	0.0416*	
BIRATE does not Granger-cause JUB	59	0.18887	0.8284	There is a one-way relationship.
JUB does not Granger-cause BIRATE		3.32081	0.0438*	
GDP does not Granger-cause JUB	59	4.13946	0.0214*	There is a two-way relationship.
JUB does not Granger-cause GDP		3.83815	0.0278*	
EKS does not Granger-cause JUB	59	1.81830	0.1723	There is no causal relationship.
JUB does not Granger-cause EKS		0.27482	0.7608	
IMP does not Granger-cause JUB	59	3.23866	0.0471*	There is a one-way relationship.
JUB does not Granger-cause IMP		0.53048	0.5914	
BIRATE does not Granger-cause KURS	59	3.72730	0.0306*	There is a one-way relationship.
KURS does not Granger-cause BIRATE		2.49002	0.0926	
GDP does not Granger-cause KURS	59	2.40255	0.1003	There is no causal relationship.
KURS does not Granger-cause GDP		0.06214	0.9398	
EKS does not Granger-cause KURS	59	4.15333	0.0211*	There is a one-way relationship.
KURS does not Granger-cause EKS		0.65152	0.5254	
IMP does not Granger-cause KURS	59	4.26292	0.0192*	There is a one-way relationship.
KURS does not Granger-cause IMP		0.27973	0.7571	
GDP does not Granger-cause BIRATE	59	3.81781	0.0283*	There is a one-way relationship.
BIRATE does not Granger-cause GDP		1.16968	0.3184	
EKS does not Granger-cause BIRATE	59	2.37094	0.1032	There is no causal relationship.
BIRATE does not Granger-cause EKS		2.71986	0.0751	
IMP does not Granger-cause BIRATE	59	2.50447	0.0913	There is a one-way relationship.
BIRATE does not Granger-cause IMP		3.58067	0.0348*	
EKS does not Granger-cause GDP	59	0.10459	0.9009	There is no causal relationship.
GDP does not Granger-cause EKS		0.46353	0.6316	
IMP does not Granger-cause GDP	59	0.14135	0.8685	There is no causal relationship.
GDP does not Granger-cause IMP		0.60617	0.5492	
IMP does not Granger-cause EKS	59	0.63771	0.5325	There is no causal relationship.
EKS does not Granger-cause IMP		2.94112	0.0615	

Based on Table 7, several significant unidirectional and bidirectional causal relationships are identified. Notably, the exchange rate Granger-causes inflation, indicating that short-run movements in the exchange rate contain predictive information for inflation dynamics. A bidirectional causality is observed between GDP and money supply (JUB), suggesting feedback effects between real economic activity and monetary expansion.

Overall, the Granger causality results highlight short-run predictive linkages among macroeconomic variables, which are further explored through dynamic analysis using IRF and Variance Decomposition.

4.7. Impulse response function (IRF)

The Impulse Response Function (IRF) analysis is employed to examine the dynamic effects of a one-standard-deviation shock to one variable on the current and future values of other variables in the system. Unlike Granger causality, IRF captures the magnitude and persistence of responses over time, allowing for a clearer distinction between short-run and medium-run dynamics.

Table 8: Impulse Response Function (IRF) Test Results for Inflation

Response of INFLATION:							
Period	INF	M1	ER	IR	GDP	EXP	IMP
1	1.440874	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	1.228305	0.350438	-0.257983	0.384640	-0.449723	0.149990	0.148177
3	1.335161	0.612998	-0.322790	0.294857	-0.506995	0.334232	0.006630
4	0.989833	0.711498	-0.270322	0.138586	-0.747464	0.281025	-0.104432
5	0.861749	0.693639	-0.282194	-0.132797	-0.618558	0.206513	-0.176975
6	0.731709	0.656729	-0.252923	-0.304235	-0.548032	0.089856	-0.103576
7	0.751029	0.518817	-0.276076	-0.372348	-0.416718	0.002140	-0.135299
8	0.809019	0.503348	-0.265818	-0.324763	-0.409251	-0.011940	-0.116727
9	0.897362	0.479820	-0.264702	-0.238985	-0.431678	0.030157	-0.089984
10	0.920054	0.515718	-0.269070	-0.172833	-0.450883	0.063362	-0.070984

The IRF results indicate that inflation responds most strongly to its own shock, reflecting inflation persistence. The response gradually stabilizes at approximately 0.92 by the tenth period. The second-largest positive response comes from money supply (M1) shocks, suggesting that monetary expansion exerts a sustained inflationary effect over time.

Conversely, exchange rate (ER), interest rate (IR), GDP, and imports (IMP) exhibit negative responses, indicating that appreciation, monetary tightening, higher output, and increased imports tend to dampen inflationary pressures. Although the exchange rate shows Granger causality with inflation in the short run, its IRF magnitude is moderate, suggesting that its effect is transitory rather than dominant over the medium term.

4.8. Variance decompositions (VD)

Variance Decomposition analysis complements the IRF by quantifying the proportion of forecast error variance in inflation attributable to shocks from each variable over time. This approach provides insight into the relative importance of different macroeconomic drivers beyond short-run causality.

Table 9: Variance Decompositions (VD) Test Results from Inflation

Period	S.E.	INF	M1	ER	IR	GDP	EXP	IMP
1	1.440874	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	2.041780	85.99105	2.945812	1.596483	3.548873	4.851464	0.539645	0.526675
3	2.624351	77.93429	7.239107	2.479212	3.410496	6.668804	1.948655	0.319437
4	3.018954	69.64251	11.02473	2.675233	2.787930	11.16950	2.339050	0.361050
5	3.300255	65.09452	13.64287	2.969758	2.494834	12.85946	2.348863	0.589686
6	3.511985	61.82309	15.54422	3.141116	2.953518	13.79070	2.139645	0.607706
7	3.684302	60.33063	16.10718	3.415660	3.705083	13.81018	1.944215	0.687049
8	3.852186	59.59728	16.44118	3.600590	4.099926	13.76133	1.779405	0.720286
9	4.024594	59.57207	16.48410	3.731293	4.108792	13.75803	1.635831	0.709887
10	4.198147	59.55140	16.65842	3.839950	3.945583	13.79750	1.526154	0.680995

The variance decomposition results show that inflation shocks remain the dominant source of inflation variability, accounting for approximately 59.55 percent in the tenth period. However, money supply (16.66 percent) and GDP (13.80 percent) emerge as the most influential external contributors to inflation variability over time.

Exchange rate and interest rate shocks contribute modest but non-negligible shares (around 4 percent each), reinforcing their role as secondary transmission channels rather than primary inflation drivers. Exports and imports play relatively minor roles, although the contribution of imports increases gradually over time.

5. Conclusion and Recommendations

The short-term Vector Error Correction Model (VECM) estimation indicates that the Central Bank Interest Rate (IR) and imports (IMP) emerge as the primary short-run drivers of inflation in Indonesia, both exerting a statistically significant and positive effect. In contrast, money supply (M1), exchange rate (ER), Gross Domestic Product (GDP), and exports (EXP) show a negative short-run association with inflation, suggesting that these variables may act as inflation-dampening factors in the adjustment process. In the long run, the results reveal a different configuration of inflation determinants. The exchange rate (ER), Gross Domestic Product (GDP), and imports (IMP) exhibit a positive long-term relationship with inflation, indicating that structural factors related to external prices and real economic expansion play a more prominent role over time. Meanwhile, money supply (M1), Central Bank Interest Rate (IR), and exports (EXP) demonstrate a negative long-run association with inflation, reflecting the stabilizing role of monetary policy and external competitiveness. The Granger causality test results reinforce the distinction between short-run predictive relationships and long-run equilibrium dynamics. Most macroeconomic variables do not exhibit direct causal links with inflation, underscoring that inflation dynamics in Indonesia are not driven by a single dominant factor. Nevertheless, several one-way causal relationships are identified, most notably from the exchange rate (ER), exports (EXP), and imports (IMP) to inflation (INF), as well as from imports (IMP) to the Central Bank Interest Rate (IR). A bidirectional causal relationship between GDP and money supply (M1) highlights the feedback mechanism between real economic activity and monetary expansion. The dynamic evidence from Impulse Response Function (IRF) and Variance Decomposition (VD) analyses complements these findings. Variance decomposition results indicate that inflation shocks remain the dominant source of inflation variability, although their contribution declines over time, suggesting gradual stabilization. Among external drivers, the exchange rate and interest rate contribute more to inflation variability than other macroeconomic variables, while exports, imports, GDP, and money supply exhibit relatively smaller but persistent roles. Taken together, the empirical results suggest that inflation in Indonesia is influenced primarily by monetary policy conditions and external sector dynamics, particularly exchange rate movements and import-related pressures. Other variables, such as output growth and trade flows, play supporting roles that become more relevant in the long run. From a policy perspective, these findings highlight the importance of coordinated policy actions. Monetary authorities should prioritize exchange rate stabilization and prudent interest rate management, given their relatively larger contribution to inflation dynamics. Trade policies aimed at reducing excessive import dependence and strengthening export competitiveness can further mitigate inflationary pressures. At the same time, growth-oriented policies should be carefully aligned with monetary objectives, especially in light of the bidirectional relationship between GDP and money supply. Overall, the declining contribution of inflation shocks over time indicates increasing effectiveness of macroeconomic stabilization efforts. However, sustained price stability requires continuous policy coordination across monetary, trade, and growth strategies, supported by ongoing empirical monitoring and refinement of policy instruments.

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