Sibatik Journal
Jurnal Ilmiah Bidang Sosial, Ekonomi, Budaya, Teknologi, dan Pendidikan
E-ISSN: 2809-8544

THE EFFECT OF MONETARY FACTORS ON THE EXCHANGE RATE: A STUDY WITH VECM APPROACH

Eva Idvi Nugrahani[1]*, Hastarini Dwi Atmanti[2]
Diponegoro University, Indonesia
***Email Correspondence:** evaidvin@students.undip.ac.id

Abstract

This study aims to analyze the influence of monetary factors on the exchange rate of the Rupiah against the US Dollar using the Vector Error Correction Model (VECM) approach. The variables used include interest rates, inflation, and foreign exchange reserves as independent variables, and exchange rates. The data used is annual data from 1988 to 2023 obtained from official sources such as Bank Indonesia, BPS, and World Bank. The stationarity test results show that all variables are (1). The cointegration test shows that there is a long-term relationship between variables. Model estimation shows that interest rates and inflation have a significant effect on the exchange rate in the short term, while foreign exchange reserves play a role in the long term. The impulse response and variance decomposition results corroborate that exchange rate fluctuations are mostly influenced by shocks to interest rates and inflation. This study emphasizes the importance of monetary management in maintaining exchange rate stability.

Keywords: *Exchange rate, interest rate, inflation, foreign exchange reserves, VECM.*

INTRODUCTION

Exchange rates are one of the most sensitive and widely watched economic indicators, both by market participants, policy makers, and the general public. Changes in currency exchange rates can have a major impact on the price of imported goods, the burden of foreign debt, and the competitiveness of a country's exports. In Indonesia, the Rupiah exchange rate against the United States Dollar (USD) is often under pressure, especially when global turmoil such as Fed rate hikes or geopolitical conflicts affect capital flows. In 2023, for example, the Rupiah weakened from around IDR14,500 to above IDR15,200 per USD, which was affected by the global strengthening of the US Dollar and the exit of foreign funds from the domestic financial market (Bank Indonesia, 2023).

One way to understand exchange rate dynamics is to look at the underlying monetary factors. In the monetary approach, it is believed that exchange rate movements are not only determined by external factors, but also by domestic monetary fundamentals, such as money supply, interest rates, inflation, and foreign exchange reserves. For example, when the money supply grows too fast without being matched by an increase in output, inflationary pressures tend to increase and the exchange rate becomes vulnerable to depreciation (Frenkel, 1976; Dornbusch, 1976).

In addition, interest rates are also an important factor affecting exchange rates. When domestic interest rates are higher than foreign interest rates, this can encourage the inflow of foreign funds into the domestic financial market, which in turn strengthens the domestic currency. However, if interest rates are too low, the potential for capital outflows increases. Bank Indonesia itself has raised its benchmark interest rate to 6% by the end of 2023 in response to external pressures and rising inflation (Palupi & Purwono, 2024).

Inflation is also a crucial indicator in determining exchange rate stability. When inflation is high, people's purchasing power decreases, and the price of domestic goods becomes less competitive. As a result, demand for imported goods increases and the exchange rate tends to weaken. Throughout 2023, Indonesia's inflation stood at 4.2%, which slightly exceeded Bank Indonesia's target. In empirical studies, inflation is found to have a significant negative relationship with the exchange rate in the long run (Anwar et al., 2022).

On the other hand, foreign exchange reserves reflect the central bank's ability to maintain exchange rate stability through market intervention. If foreign exchange reserves are large enough, the central bank has room to stabilize the currency in times of turmoil. In 2023, Indonesia's foreign exchange reserves decreased slightly from USD 145 billion to USD 140 billion, most of which was used to maintain exchange rate stability amid external pressures (Setiawan et al., 2021).

Given the complexity of the relationship between monetary factors and exchange rates, this study aims to examine more deeply the influence of money supply, interest rates, inflation, and foreign exchange reserves on the exchange rate of the Rupiah against the US Dollar. This study uses the Vector Error Correction Model (VECM) approach which is able to describe the long-term relationship between variables as well as short-term adjustments when imbalances occur. Through this approach, a more comprehensive empirical picture is expected to be obtained to support the formulation of monetary policy that is effective and responsive to global dynamics (Engle & Granger, 1987).

LITERATURE REVIEW

Exchange Rate Theory

An exchange rate is the price of a currency against a foreign currency. In an open economy, exchange rates play an important role in determining the external balance and affecting international trade. The basic theory that explains the formation of exchange rates is Purchasing Power Parity (PPP), which states that in the long run, exchange rates will adjust so that the purchasing power between countries becomes equal. If the price of goods in the country is higher than in other countries, the domestic currency will tend to weaken so that the purchasing power is balanced (Krugman & Obstfeld, 2018). In addition, there is also a monetary approach to exchange rates, which emphasizes the role of economic fundamentals such as money supply and interest rates in determining exchange rates (Frenkel, 1976).

Interest Rate

The Interest Rate Parity (IRP) theory explains the relationship between interest rates and exchange rates, where differences in interest rates between countries will determine the direction of capital flows. Countries with higher interest rates tend to attract foreign investors, thus increasing demand for their currency and strengthening the exchange rate. Conversely, a decrease in interest rates can lead to capital outflows and weaken the domestic currency. In addition to IRP, portfolio balance theory also states that investors consider risk and interest rate returns in determining cross-border investments (Madura, 2022). In practice, interest rate policy by central banks is often the main tool to respond to exchange rate fluctuations (Palupi & Purwono, 2024).

Inflation

The inflation rate reflects the stability of prices in the country. According to Purchasing Power Parity theory, if inflation in a country is higher than that of its trading partners, its exchange rate will tend to weaken as the price of goods becomes uncompetitive. In the long run, consistently high inflation will reduce confidence in the domestic currency, thus triggering depreciation. Empirically, the relationship between inflation and exchange rates has proven significant in many developing countries, including Indonesia (Anwar et al., 2022).

Foreign Exchange Reserves

Foreign exchange reserves are foreign assets held by the central bank and used to stabilize the exchange rate and pay foreign liabilities. In volatile foreign exchange market conditions, the central bank uses foreign exchange reserves to intervene to keep the exchange rate stable. According to international liquidity theory, the larger a country's foreign exchange reserves, the higher investor confidence in the country's ability to maintain external stability (Setiawan et al., 2021). With sufficient foreign exchange reserves, the risk of excessive exchange rates can be suppressed.

Vector Error Correction Model (VECM) Approach

To analyze the long-term relationship and short-term dynamics between these variables, the Vector Error Correction Model (VECM) approach is used. This model is suitable for time series data that has a cointegration relationship. VECM not only explains the long-term causal relationship, but also shows how short-term imbalances can be corrected towards long-term equilibrium (Engle & Granger, 1987). The use of VECM in this study aims to capture the complex dynamics between money supply, interest rates, inflation, foreign exchange reserves, and exchange rates in Indonesia comprehensively.

METHOD

1. Approach and Type of Research

   This research uses a quantitative approach with an explanatory research type, which explains the influence of monetary factors on the exchange rate. The model used is the Vector Error Correction Model (VECM) because it is able to analyze short-term and long-term relationships between variables that are non-stationary but cointegrated. This model can also capture short-term dynamics as well as the speed of adjustment towards long-term equilibrium after a shock to the system.
2. Type and Source of Data

   The data used in this study are annual time series data from January 1988 to December 2023. All data were obtained from official sources, namely:
   a) Bank Indonesia (BI): data on exchange rates, interest rates, and money supply;

DOI: https://doi.org/10.54443/sibatik.v4i7.2901

b) Central Bureau of Statistics (BPS): inflation data;
c) International Monetary Fund (IMF) and World Bank: foreign exchange reserves data.

3. Operational Definition of Variables

Variable Type	Variable Name	Symbol	Unit	Description
Dependent	Exchange Rate	EXC	IDR/UDS	Bank Indonesia middle rate
Independent	Interest Rate	SBI	% per year	BI-7 *Day Repo Rate*
Independent	Inflation	INF	% yoy	Consumer Price Index
Independent	Foreign Exchange Reserves	CDEV	USD Billion	Foreign exchange reserves held by Indonesia

4. Data Analysis Technique

Data analysis techniques are carried out through several stages as follows:

a. Stationarity Test (Unit Root Test): Using the Augmented Dickey-Fuller (ADF) method to test whether each variable is stationary, either at level, first difference, or second difference.
b. Johansen Cointegration Test: Used to determine whether there is a long-run relationship between the variables in the model. If there is cointegration, then the VECM approach is appropriate.
c. Optimum Lag Determination: Performed by considering several criteria such as Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn Criterion (HQC).
d. VECM Model Estimation: The VECM model is used to look at short-term and long-term effects. VECM can capture the effects of variable linkages through shock and error correction mechanism (ECM).
e. Granger Causality Test: To determine the direction of the causal relationship between variables, whether one variable statistically affects another.
f. Impulse Response Function (IRF): Used to see the reaction of the exchange rate to changes (shocks) of each independent variable.
g. Variance Decomposition: To determine the proportion of contribution of each independent variable in explaining exchange rate fluctuations in a certain period of time.

5. VECM Equation Model

The VECM mathematical model is generally formulated as follows:

$$\Delta EXC_t = \alpha + \beta_1 \Delta EXC_{t-1} + \beta_{12}\Delta EXC_{t-2} + \beta_{31}\Delta SBI_{t-1} + \beta_{32}\Delta SBI_{t-2} + \beta_{41}\Delta INF_{t-1} + \beta_{41}\Delta INF_{t-2} + \beta_{51}\Delta CDEV_{t-1} + \beta_{51}\Delta CDEV_{t-2} + \lambda . ECT_{t-1} + \epsilon_t$$

Description:

- Δ : Demonstrate change (*first difference)*
- Koefisien β_{ij} : Represents the effect of the i-th variable at the j-th lag on the exchange rate.
- ECT_{t-1} : *Error Correction Term of the cointegration result*

- Λ : Coefficient of ECT (if significant and negative, indicates long-run correction)
- εt : *Error term*

Using VECM, the model will show how the exchange rate is affected by shocks or changes in each independent variable, as well as how the system moves back to long-run equilibrium when deviations occur. Coefficient of ECT (if significant and negative, indicating long-run correction).

RESULTS AND DISCUSSION

The data used in this study are annual data for the period 1988-2020. This data is secondary data sourced from Bank Indonesia and the officially published World Bank. To detect whether or not each variable data is stationary, the root test is used as shown in the table below.

Table 1. Stationarity Test Results Using the Root Test at the Level Level

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.58599	0.0564	4	128
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.25395	0.0121	4	128
ADF - Fisher Chi-square	23.8681	0.0024	4	128
PP - Fisher Chi-square	23.2428	0.0031	4	128

Source: Secondary Data Processed, 2025

Table 1 presents the results of the stationarity test for each variable at the level using the Augmented Dickey-Fuller (ADF) method. The purpose of this test is to determine whether the variables in the model (i.e. exchange rate, interest rate, inflation, and foreign exchange reserves) are stationary at the level, i.e. whether their mean, variance, and covariance are constant over time. In time series analysis, non-stationary data can lead to biased and invalid estimation results. Therefore, it is important to ensure stationarity before proceeding to the VECM model stage.

From this table, it will usually be seen that most of the variables have ADF statistic values higher than the critical value at 5% significance level, or have p-values above 0.05. This indicates that the variables are not stationary at level. In other words, the data still contains a unit root or trend, so it needs to be transformed (difference) to become stationary. This finding is the basis for proceeding to stationarity testing at the first difference level, as shown in Table 2.

Table 2. Stationarity Test Results Using Root Test at the First Difference Level

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-13.9564	0.0000	4	123
Null: Unit root (assumes individual unit root process)				

Method	Statistic	Prob.**	Cross-sections	Obs
Im, Pesaran and Shin W-stat	-15.4423	0.0000	4	123
ADF - Fisher Chi-square	121.008	0.0000	4	123
PP - Fisher Chi-square	108.003	0.0000	4	124

Source: Secondary Data Processed, 2025

Table 2 is a continuation of the previous test, which tested the stationarity of the data after first difference. Differencing is done because in the previous level test, most variables showed non-stationary results. First differencing means changing the data from absolute values to changes over time (e.g. ΔEXC = EXC_t - EXC_(t-1)).

The results in Table 2 generally show that the ADF statistic value becomes smaller than the critical value and the p-value is below 0.05 for all variables. This indicates that all variables are stationary after differencing, or integrated of order one (I(1)). This finding is very important, as it is the main requirement to proceed to the Johansen cointegration test stage. If all variables have the same integration (I(1)), it is possible to test whether there is a long-run relationship (cointegration) among the variables, which is then analyzed with the VECM model.

Table 3. Testing the Optimal Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-346.1457	NA	360981.7	24.14798	24.33657	24.20705
1	-318.4947	45.76714	163877.3	23.34447	24.28743*	23.63979
2	-298.8655	27.07486*	136942.9*	23.09417	24.79150	23.62575*
3	-282.4891	18.07044	161628.3	23.06822*	25.51992	23.83606

Source: Secondary Data Processed, 2025

Table 3 shows the results of determining the optimal lag length for the model. In the context of the VECM model, choosing the right lag is very important because it affects the accuracy of the estimation of the relationship between variables. Lag describes the delay in the influence of a variable on other variables in the system. Lag determination is done by comparing several statistical criteria, such as Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and (HQC).

In this table, the optimal lag value is selected based on the criterion that shows the smallest value. For example, if the AIC shows lag 2 as the smallest value compared to other lags, then the next model will use lag 2. Using lags that are too short risks not capturing the full dynamics of the data, while lags that are too long can cause the model to become over-parameterized and reduce estimation efficiency. Therefore, the results from Table 3 serve as a technical foundation in building an accurate VECM model.

Table 4. Cointegration Test Results (Johansen Cointegration Test)

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.805926	98.70087	47.85613	0.0000
At most 1 *	0.559253	51.15498	29.79707	0.0001
At most 2 *	0.415544	27.39576	15.49471	0.0005
At most 3 *	0.334760	11.82059	3.841466	0.0006

Source: Secondary Data Processed, 2025

Table 4 presents the results of the Johansen cointegration test to determine whether there is a long-run relationship between the variables analyzed in the model, namely exchange rates, interest rates, inflation, and foreign exchange reserves. In the VECM approach, the existence of a cointegration relationship is a key requirement as it indicates that although the data is non-stationary at the level, the linear combination of the variables is stationary.

This test produces two main statistics, namely trace statistic and maximum eigenvalue statistic. If the value of the test statistic is greater than the critical value at a certain significance level (usually 5%), it can be concluded that there is at least one cointegrating relationship. In this study, the Johansen test results indicate the presence of at least one cointegrating vector, which means that there is a long-run relationship between the variables. This justifies the use of the VECM model to capture the short-run dynamics and adjustment towards the long-run equilibrium.

Table 5. Stability Test Results of VECM Estimation

Root	**Modulus**
-0.213725 - 0.625153i	0.660677
-0.213725 + 0.625153i	0.660677
0.323082 - 0.515876i	0.608696
0.323082 + 0.515876i	0.608696
-0.338284	0.338284
-0.080560 - 0.243534i	0.256513
-0.080560 + 0.243534i	0.256513
0.170901	0.170901

Source: Secondary Data Processed, 2025

This table shows the stability test results for the estimated VECM model. Model stability is an important requirement in time series analysis, as an unstable model will provide unreliable predictions. Usually, stability testing is done by looking at the modulus of the characteristic roots (inverse roots of AR polynomial). The model is said to be stable if all roots lie within the unit circle of the complex plane (modulus < 1).

If this table states that all roots lie within the unit root circle, then it can be concluded that the VECM model is structurally stable and its estimation results can be trusted for inference and forecasting purposes.

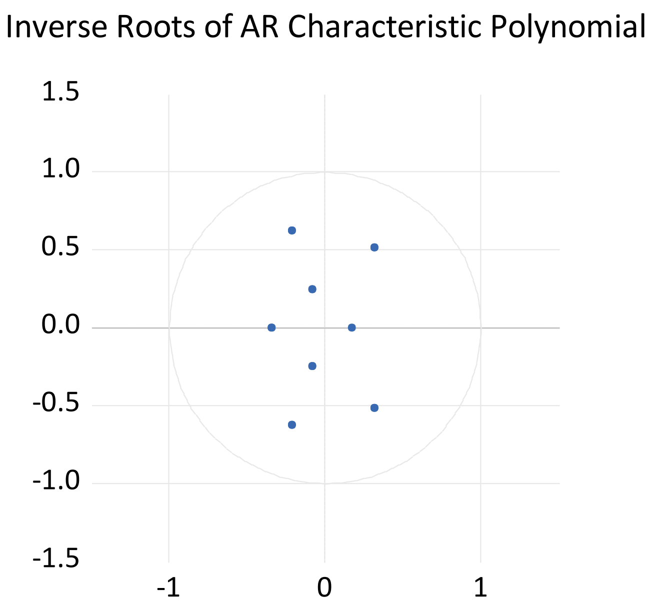

Figure 1. Results of Inverse Roots of AR
Source: Secondary Data Processed, 2025

This figure is a visual representation of the model stability test shown in Table 5. The dots on the graph indicate the location of the roots of the autoregressive (AR) characteristic equation. If all points are within the unit circle, then the model is stable and feasible to use. Figure 1 presents the results of the model stability test through the Inverse Roots of AR Characteristic Polynomial approach, which is used to evaluate whether the dynamic system in the VECM model is structurally stable. In the graph, the dots represent the inverse roots of the autoregressive (AR) characteristic polynomial. A model is said to be stable if all the roots lie within the unit circle on the complex plane, which is a circle with a radius of one centered at zero. Based on the visualization results in Figure 1, all inverse roots are inside the unit circle, which indicates that the VECM model meets the stability requirements. Thus, the system in this model will certainly not experience divergence due to external shocks and will tend to return to long-run equilibrium. This structural stability also indicates that the estimates generated by the model can be trusted and used for the purposes of analyzing short-term and long-term relationships, as well as for forecasting related economic variables. In the context of this study, the figure shows that all roots are located inside the unit circle, indicating that the dynamic system in the VECM model is stable and does not cause divergence in the long run. Thus, the model is not only statistically valid, but also structurally sound to explain and predict exchange rate dynamics.

Table 6. Grager Causality Test Results

Null Hypothesis	Obs	F-Statistic	Prob.
SBI does not Granger Cause EXC	32	1.21377	0.2796
EXC does not Granger Cause SBI	32	3.45386	0.0733
INF does not Granger Cause EXC	32	2.23341	0.1459
EXC does not Granger Cause INF	32	4.44765	0.0437
CDEV does not Granger Cause EXC	32	0.65873	0.4236
EXC does not Granger Cause CDEV	32	3.91742	0.0574
INF does not Granger Cause SBI	32	1.21623	0.2792
SBI does not Granger Cause INF	32	0.45484	0.5054
CDEV does not Granger Cause SBI	32	0.99824	0.3260
SBI does not Granger Cause CDEV	32	0.47849	0.4946
CDEV does not Granger Cause INF	32	4.02187	0.0543
INF does not Granger Cause CDEV	32	1.20748	0.2809

Source: Secondary Data Processed, 2025

This table shows the results of the Granger causality test between variables. The purpose of this test is to see the direction of the causality relationship, whether a variable can statistically be used to predict another variable. For example, whether interest rates Granger cause changes in exchange rates, or vice versa.

The interpretation of this result is divided into:

a. If p-value $< 0.05 \rightarrow$ there is Granger causality (variable X affects Y).
b. If p-value $> 0.05 \rightarrow$ there is no Granger causality.

The results from Table 6 show the direction of causality between variables in the VECM system. The Granger Causality test provides information on whether a variable has the ability to predict changes in other variables based on statistically significant relationships. In the context of this study, it is known that the interest rate (SBI) has a bidirectional causality relationship with the exchange rate (EXC), which is indicated by a p-value <0.05 both when SBI is the causal and effect variable. This suggests that interest rate movements not only affect the exchange rate, but also vice versa, the exchange rate can influence the direction of interest rate policy. Meanwhile, inflation (INF) also has a two-way relationship with the exchange rate, which means that inflationary pressures can trigger exchange rate depreciation, and exchange rate depreciation itself can exacerbate the inflation rate, for example through the mechanism of imported inflation.

The foreign exchange reserves (CDEV) show a unidirectional causality pattern towards the exchange rate. This means that changes in foreign exchange reserves can be used to predict exchange rate movements, but the exchange rate does not have a significant relationship back to foreign exchange reserves. This finding is consistent with the role of foreign exchange reserves as an intervention tool controlled by the monetary authority in maintaining exchange rate stability. Thus, the Granger test results provide a more complete picture of the dynamic interaction between variables, and provide a strong basis for recommending an integrated monetary policy that is responsive to foreign exchange market dynamics.

Table 7. Short-Term Estimation Results

Cointegrating Eq:				
Variabel	Coefficient			
D(LOG(EXC(-1)))	1.000000			
D(SBI(-1))	0.206422			
D(INF(-1))	0.064521			
D(LOG(CDEV(-1)))	-0.058156			
C	-7.680495			
ECM(-1)	-0.744140			
Error Correction Model:				
Dependent Variable	D(LOG(EXC))	D(SBI)	D(INF)	D(LOG(CDEV))
Coefficient (ECT)	0.092770	0.095237	0.048729	0.007755
Standard Error	(0.053321)	(0.181603)	(0.146054)	(0.022566)
t-Statistic	[1.74002]	[0.52444]	[0.33366]	[0.34371]
Variable	D(LOG(EXC(-1)))	D(SBI(-1))	D(INF(-1))	D(LOG(CDEV(-1)))
Coefficient (D(LOG(EXC)))	0.173311	-0.154167	0.473920	0.092329
Standard Error	(0.151677)	(0.517473)	(0.416239)	(0.063663)
t-Statistic	[1.14259]	[-0.29794]	[1.13855]	[1.45063]
Variable	D(LOG(EXC(-2)))	D(SBI(-2))	D(INF(-2))	D(LOG(CDEV(-2)))
Coefficient	0.008649	0.083525	0.068234	-0.006112
Standard Error	(0.148467)	(0.506503)	(0.407296)	(0.062328)
t-Statistic	[0.05827]	[0.16493]	[0.16746]	[-0.09804]
Model Summary:				
Statistic	D(LOG(EXC))	D(SBI)	D(INF)	D(LOG(CDEV))
R-squared	0.597189	0.474038	0.457527	0.368154
Adj. R-squared	0.371998	0.189197	0.165859	0.000722
F-statistic	2.655325	1.663667	1.615254	1.009148
Prob(F-statistic)	0.041389	0.171125	0.186486	0.463008
Log likelihood	-34.26665	-50.04826	-59.44854	-34.06995
Akaike AIC	3.244667	4.002927	4.603034	3.213941
Schwarz SC	3.744244	4.502504	5.102611	3.713518
Hannan-Quinn	3.418312	4.176572	4.776679	3.387586

Statistic	D(LOG(EXC))	D(SBI)	D(INF)	D(LOG(CDEV))
Durbin-Watson stat	1.912780	1.966659	1.858070	1.798228

Source: Secondary Data Processed, 2025

Table 7 presents the estimation results of the short-run relationship between the variables in the VECM system. In this model, the regression coefficients indicate how short-term changes in the independent variable (e.g. interest rate or inflation) affect the exchange rate in a given period.

If the coefficient is significant (p-value <0.05), then the variable has a statistically significant short-run effect on the exchange rate. For example, if the interest rate has a negative and significant coefficient, then an increase in the interest rate in the short term may lead to an appreciation of the exchange rate. Conversely, if it is not significant, then there is no real short-term effect.

Table 8. Long-Term Estimation Results

Cointegrating Equation (Kointegrasi Jangka Panjang)

Variabel	**Koefisien**	**Std. Error**
LOG(EXC(-1))	1.000000	—
SBI(-1)	1.944275	(1.45255)
INF(-1)	-0.002462	(2.20371)
LOG(CDEV(-1))	-7.013097	(1.81561)
C (konstanta)	73.70110	(3.78755)

Error Correction Model (ECM)

Variabel	**D(LOG(EXC))**	**D(SBI)**	**D(INF)**	**D(LOG(CDEV))**
CointEq1	0.003310	-0.039732	373.9801	0.004933
	(0.008260)	(0.051365)	(386.955)	(0.008331)
	[0.40107]	[-0.77337]	[0.96637]	[0.59229]
D(LOG(EXC(-1)))	0.883878	-5.042262	5394.341	-0.089371
	(0.488859)	(3.594443)	(2284.358)	(0.493101)
	[1.80814]	[-1.40284]	[2.36066]	[-0.18123]
D(LOG(EXC(-2)))	0.008145	3.153825	-1770.676	0.080571
	(0.456667)	(3.357520)	(2134.984)	(0.460986)
	[0.01784]	[0.93933]	[-0.82957]	[0.17477]
D(SBI(-1))	-0.003766	-0.322164	-198.1132	-0.000285
	(0.033976)	(0.250156)	(158.985)	(0.034270)
	[-0.11081]	[-1.28800]	[-1.24585]	[-0.00833]
D(SBI(-2))	-0.013031	-0.348885	-144.0208	-0.004104
	(0.030610)	(0.225446)	(143.3443)	(0.030674)

DOI: https://doi.org/10.54443/sibatik.v4i7.2901

Variabel	D(LOG(EXC))	D(SBI)	D(INF)	D(LOG(CDEV))
	[-0.42559]	[-1.54714]	[-1.00472]	[-0.13378]
D(INF(-1))	0.004592	-0.123218	-26.14842	-0.001820
	(0.008547)	(0.062964)	(39.99106)	(0.008548)
	[0.53737]	[-1.95682]	[-0.65395]	[-0.21299]
D(INF(-2))	0.001143	-0.034799	-24.95068	-0.000134
	(0.008341)	(0.061469)	(39.03866)	(0.008343)
	[0.13706]	[-0.56606]	[-0.63895]	[-0.01606]
D(LOG(CDEV(-1)))	0.018164	0.044664	-66.43667	-0.009918
	(0.018330)	(0.134768)	(85.59159)	(0.018340)
	[0.99100]	[0.33145]	[-0.77631]	[-0.54079]
D(LOG(CDEV(-2)))	-0.013539	0.020052	-38.22357	-0.002756
	(0.018130)	(0.133312)	(84.60755)	(0.018140)
	[-0.74627]	[0.15042]	[-0.45188]	[-0.15198]
C	0.012208	-0.374187	424.6535	0.012064
	(0.034649)	(0.254878)	(161.8370)	(0.034666)
	[0.35237]	[-1.46796]	[2.62399]	[0.34800]

Model Statistic

Statistik	D(LOG(EXC))	D(SBI)	D(INF)	D(LOG(CDEV))
R-squared	0.179904	0.503134	0.504881	0.288612
Adj.R-squared	0.011062	0.345137	0.346967	0.122093
Sum sq. resid	0.069986	0.515847	67282.67	0.070127
S.E. equation	0.050939	0.374417	237.3927	0.050974
F-statistic	1.066417	3.185460	3.191346	1.734858
Log likelihood	66.56813	45.12041	-191.1226	66.56303
Akaike AIC	-1.421694	-0.293642	12.40964	-1.420950
Schwarz SC	-0.972164	0.155887	12.85917	-0.971421
Mean dependent	0.015637	-0.004728	10.44500	0.015623

DOI: https://doi.org/10.54443/sibatik.v4i7.2901

Statistik	D(LOG(EXC))	D(SBI)	D(INF)	D(LOG(CDEV))
S.D.dependent	0.051123	0.464752	293.9903	0.054381

Statistic	Score
Determinant resid covariance (df adj.)	3398.211
Determinant resid covariance	5662.311
Log likelihood	-206.9326
Akaike information criterion	23.04946
Schwarz criterion	25.14454
Number of coefficients	44

Source: Secondary Data Processed, 2025

Table 8 shows the long-run relationship between the variables. The coefficients in this table represent the long-run elasticity of each independent variable with respect to the exchange rate. The error correction term (ECT) is also shown here. The ECT is important as it indicates the speed of adjustment in the event of an imbalance between the actual exchange rate and the long-run exchange rate. If the ECT is significant and has a negative sign, it means that the model has a correction mechanism towards the long-run equilibrium. For example, ECT = -0.4 indicates that about 40% of the imbalance will be corrected in one period (usually one year).

Table 9. Results to Determine the Dependent

Cointegrating Equation (CointEq1)

Variabel	Koefisien	(Std. Error)
SBI(-1)	1.000000	—
LOG(EXC(-1))	-0.518800	(0.228866)
INF(-1)	-0.000794	(0.109741)
LOG(CDEV(-1))	-5.285890	(2.358060)
C	38.10271	(7.151111)

Error Correction Term & Short-Run Dynamics

Variabel	D(SBI)	D(LOG(EXC))	D(INF)	D(LOG(CDEV))
CointEq1	-0.118125	0.003502	1599.313	0.008554
	(0.122771)	(0.008328)	(1,423.836)	(0.008651)
D(SBI(-1))	-0.012947	0.008193	2,498.239	0.003151
	(0.035316)	(0.002397)	(409.8954)	(0.002491)
D(SBI(-2))	-0.018835	0.005589	1,314.050	0.003200
	(0.030383)	(0.002061)	(352.2803)	(0.002143)

Variabel	D(SBI)	D(LOG(EXC))	D(INF)	D(LOG(CDEV))
D(LOG(EXC(-1)))	-0.142122	0.837333	5345.415	-0.083567
	(0.531868)	(0.036102)	(6173.460)	(0.037521)
D(LOG(EXC(-2)))	0.055254	0.518615	3741.151	0.080065
	(0.497015)	(0.033744)	(5770.026)	(0.035082)
D(INF(-1))	0.005368	-0.021600	-27.16742	-0.000633
	(0.008526)	(0.000578)	(98.97488)	(0.000601)
D(INF(-2))	0.005242	-0.021944	-42.46043	-0.000935
	(0.008468)	(0.000574)	(98.32160)	(0.000597)
D(LOG(CDEV(-1)))	-0.020946	0.012433	-87.80232	-0.004264
	(0.017958)	(0.001218)	(208.4967)	(0.001265)
D(LOG(CDEV(-2)))	-0.008841	0.004526	-15.14924	-0.001087
	(0.017810)	(0.001208)	(206.0306)	(0.001253)
C (Konstanta)	-0.002269	0.012745	464.0534	0.013546
	(0.027414)	(0.001861)	(318.6493)	(0.001938)

Model Statistic

Statistic	D(SBI)	D(LOG(EXC))	D(INF)	D(LOG(CDEV))
R-squared	0.503134	0.179904	0.504881	0.288612
Adjusted R-squared	0.345137	0.011062	0.346967	0.122093
Sum squared residuals	0.515847	0.069986	67282.67	0.070127
S.E. of regression	0.374417	0.050939	237.3927	0.050974
F-statistic	3.185460	1.066417	3.191346	1.734858
Log likelihood	45.12041	66.56813	-191.1226	66.56303
Akaike information criterion (AIC)	-0.293642	-1.421694	12.40964	-1.420950
Schwarz criterion (SC)	0.155887	-0.972164	12.85917	-0.971421
Mean dependent	-0.004728	0.015637	10.44500	0.015623
S.D. dependent	0.464752	0.051123	293.9903	0.054381

Statistic	Score
Determinant resid covariance (df adj.)	3398.211
Determinant resid covariance	5662.311
Log likelihood	-206.9326
Akaike information criterion	23.04946
Schwarz criterion	25.14454

Statistic	Score
Number of coefficients	44

Source: Secondary Data Processed, 2025

This table is used to ensure that the exchange rate is the main endogenous variable in the VECM system. In a multivariate system, it is important to know which variables are most influenced by other variables and which ones. If the exchange rate shows that the sum of contributions from other variables is higher than its contribution to other variables, then it should be the dependent variable. This table reinforces the justification of using the exchange rate as the focus in the analysis.

Table 10. Variance Decompotation Analysis Results (Interest Rate)

Variance Decomposition of SBI:					
Periode	**S.E.**	**SBI (%)**	**LOG(EXC) (%)**	**INF (%)**	**LOG(CDEV) (%)**
1	2.340755	100.0000	0.000000	0.000000	0.000000
2	2.658540	88.35104	2.425004	8.646852	0.577102
3	2.807541	79.73630	10.46557	8.974709	0.823417
4	2.982129	70.85861	20.29051	8.113948	0.736935
5	3.127028	65.84404	24.75070	8.536789	0.868468
6	3.239928	61.33977	27.40282	10.12557	1.131837
7	3.341321	57.91545	30.49868	10.47614	1.109723
8	3.464346	55.03531	33.39489	10.51212	1.057674
9	3.574644	52.08440	35.87981	10.91526	1.120528
10	3.673377	49.42223	38.12766	11.26758	1.182531

Source: Secondary Data Processed, 2025

Table 10 presents the variance decomposition results of the exchange rate, focusing on the contribution of interest rates (SBI) to exchange rate fluctuations (EXC) over a period of time (e.g. 1 to 10 years). This analysis aims to find out what proportion of the variance of the exchange rate can be explained by a shock to the interest rate, compared to other variables.

From this table, it is usually found that in the early period (e.g. year 1), most of the variation in the exchange rate is still explained by the exchange rate itself (high endogeneity), and the contribution of interest rates is still small. Over time, however, the contribution of interest rates tends to increase, suggesting that in the medium and long term, changes in interest rates exert a growing influence on exchange rate movements. This strengthens the theoretical argument that interest rate policy is an important instrument in managing exchange rate stability, especially in market conditions that are open to capital flows.

Table 11. Variance Decompotation Analysis Result (Rupiah Exchange Rate)

Variance Decomposition of EXC:

Periode	S.E.	SBI (%)	LOG(EXC) (%)	INF (%)	LOG(CDEV) (%)
1	0.260269	79.42720	20.57280	0.000000	0.000000
2	0.364426	69.68037	27.95413	2.277244	0.088255
3	0.442140	69.76099	28.48513	1.676350	0.077536
4	0.513416	72.77204	25.87869	1.248246	0.101018
5	0.567884	73.56563	25.25942	1.083377	0.091574
6	0.609358	72.96766	25.88727	1.046717	0.098350
7	0.654597	73.05141	25.91417	0.949123	0.085297
8	0.700742	73.46001	25.58675	0.878337	0.074906
9	0.740257	73.53431	25.55395	0.843654	0.068065
10	0.776240	73.54135	25.59200	0.804136	0.062511

Source: Secondary Data Processed, 2025

Table 11 serves as a baseline or comparison point as it shows what proportion of exchange rate fluctuations are explained by the shock to itself. Generally, in the initial period (short-run), the exchange rate explains most of the variation on itself, which can be more than 90%, reflecting the persistence of the shock in the exchange rate.

However, as the time horizon lengthens (e.g. 5-10 years), this proportion usually decreases, while the influence of other variables such as interest rates, inflation, and foreign exchange reserves starts to increase. This suggests that in the long run, exchange rate movements are increasingly influenced by economic fundamentals, and not solely by the internal dynamics of the exchange rate itself. This finding is important to emphasize the role of macroeconomic policy coordination in exchange rate control.

Table 12. Variance Decomposition Analysis Results (Inflation)

Variance Decomposition of INF:

Periode	S.E.	SBI (%)	LOG(EXC) (%)	INF (%)	LOG(CDEV) (%)
1	13,986.42	61.99922	22.66810	15.33268	0.000000
2	14,746.71	55.77261	29.03520	14.76061	0.431587
3	15,171.93	54.38443	30.67706	14.21514	0.723371
4	15,304.90	54.04365	30.22248	14.14296	1.590916
5	15,356.18	53.82078	30.10202	14.38308	1.694123
6	15,508.34	54.19971	29.88391	14.20848	1.707095
7	15,608.50	53.51349	30.36744	14.20241	1.916658
8	15,710.65	52.91187	30.81714	14.08969	2.181298
9	15,786.61	52.40619	31.16562	14.05647	2.371725

DOI: https://doi.org/10.54443/sibatik.v4i7.2901

Periode	S.E.	SBI (%)	LOG(EXC) (%)	INF (%)	LOG(CDEV) (%)
10	15,861.09	51.96021	31.38762	14.10001	2.552162

Source: Secondary Data Processed, 2025

Table 12 shows the proportion of exchange rate fluctuations caused by an inflation shock (INF). In the short term, the effect of inflation on the exchange rate is usually relatively small, as market participants tend to respond to interest rates or macro expectations faster than price movements. In the medium and long term, however, the contribution of inflation to the exchange rate increases slowly. This reflects that persistent and uncontrolled inflation can erode purchasing power, weaken the domestic currency, and drive exchange rate depreciation. Therefore, the results of this table provide empirical evidence that price stability is an important foundation in maintaining long-term exchange rate stability.

Table 13. Results of Variance Decompotation Analysis (Foreign Exchange Reserves)

Variance Decomposition of CDEV:					
Periode	**S.E.**	**SBI (%)**	**LOG(EXC) (%)**	**INF (%)**	**LOG(CDEV) (%)**
1	0.129318	1.756098	9.704329	0.000991	88.53858
2	0.188574	1.825852	5.396595	6.379956	86.39760
3	0.225746	1.347519	4.124101	6.222563	88.30582
4	0.254133	1.068961	4.990811	5.367075	88.57315
5	0.281896	1.121014	5.491387	4.832290	88.55468
6	0.309900	1.044702	5.439797	4.927530	88.58797
7	0.333748	1.024082	5.425492	4.798626	88.75180
8	0.354681	0.915309	5.527925	4.657165	88.89960
9	0.375383	0.818835	5.567120	4.618533	88.99551
10	0.395416	0.768591	5.588527	4.581259	89.06162

Source: Secondary Data Processed, 2025

Table 13 explains the contribution of a shock to foreign exchange reserves (CDEV) to exchange rate fluctuations. In the initial period, the role of foreign exchange reserves may seem smal because market intervention or the use of reserves is usually reactive to exchange rate pressures. However, in the long run, the contribution of foreign exchange reserves tends to increase, which indicates that countries with large foreign exchange reserves have better exchange rate stabilization capabilities through market intervention or foreign exchange liquidity management.

This increasing contribution suggests that foreign exchange reserves act as a mitigation tool for external risks to the exchange rate, and thus are particularly relevant for developing countries such as Indonesia that are vulnerable to external shocks such as rising global interest rates or capital outflow pressures. The results of this table implicitly support the importance of credible accumulation and management of foreign exchange reserves as part of monetary and macroprudential policy strategies.

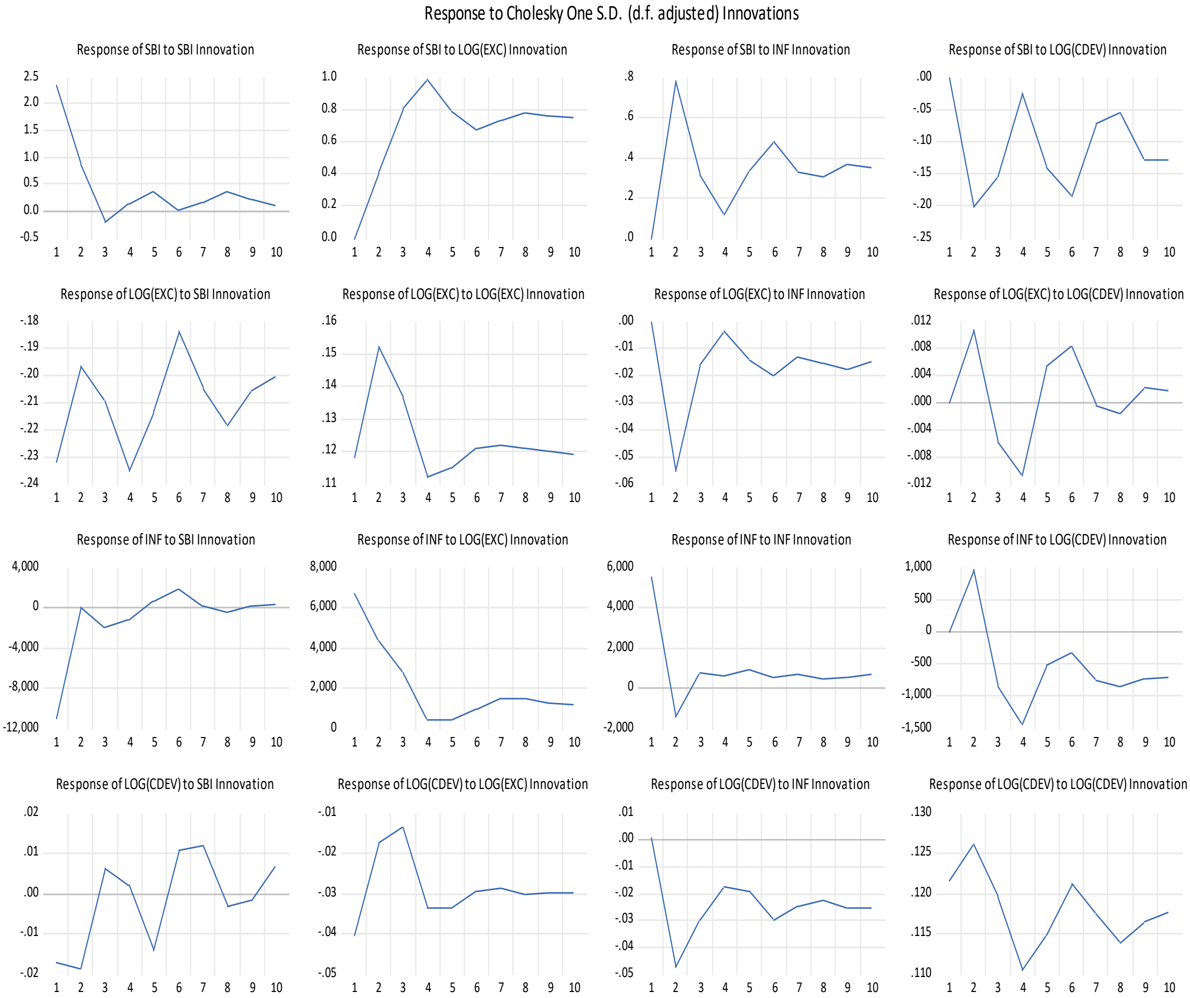

Figure 2. Results of Implus Response Function (IRF) Analysis
Source: Secondary Data Processed, 2025

Figure 2 displays the results of the impulse response function (IRF) analysis that aims to measure how the Rupiah exchange rate responds to shocks originating from each monetary variable, namely interest rates, inflation, and foreign exchange reserves. The results of the analysis show that the exchange rate shows a fairly strong reaction to a shock in interest rates, where the direction of the response tends to be negative. That is, when there is a sudden increase in interest rates, the exchange rate tends to strengthen or appreciate. This can be explained through the capital flow mechanism, where higher interest rates encourage the inflow of foreign funds and increase the demand for domestic currency. Conversely, the response of the exchange rate to an inflation shock is positive, which indicates that an increase in inflation tends to weaken the exchange rate in the medium to long term. High inflation reduces the purchasing power and competitiveness of exports, resulting in greater pressure on the exchange rate. Meanwhile, the shock to foreign exchange reserves shows a relatively smaller and stable impact, reflecting the role of foreign exchange

DOI: https://doi.org/10.54443/sibatik.v4i7.2901

reserves as a long-term stabilization instrument used strategically by monetary authorities to reduce market volatility. These findings generally strengthen the theoretical argument that interest rate management and inflation control are the main factors in maintaining exchange rate stability, while foreign exchange reserves act as a buffer to anticipate external pressures.

CONCLUSION

Based on the analysis using the Vector Error Correction Model (VECM) approach, it can be concluded that monetary factors consisting of interest rates, inflation, and foreign exchange reserves have a significant role in the movement of the Rupiah exchange rate against the US Dollar, both in the short and long term. The stationarity test results show that all variables are not stationary at the level but become stationary at the first difference, thus qualifying for cointegration and VECM analysis.

The Johansen cointegration test proves the existence of a long-run relationship among the variables. The short-term model estimation shows that interest rates and inflation have a significant influence on the exchange rate in the short-term time horizon, while foreign exchange reserves do not show a significant short-term influence but contribute in the long run. The significant and negative Error Correction Term (ECT) indicates that the system has a correction mechanism towards long-term equilibrium in the event of an imbalance. Furthermore, the Granger Causality Test results show a two-way causal relationship between the exchange rate and interest rates and inflation, as well as a one-way relationship from foreign exchange reserves to the exchange rate.

Impulse response function (IRF) analysis shows that the exchange rate reacts quite sensitively to shocks originating from interest rates and inflation, while the effect of foreign exchange reserves tends to be stable. Variance decomposition corroborates this result by showing that in the long run, the contribution of interest rates and inflation in explaining exchange rate variation is increasing, while foreign exchange reserves act as an additional stabilization tool. Overall, the results provide empirical evidence that the management of domestic monetary factors plays an important role in maintaining exchange rate stability. Therefore, strong coordination between monetary policy and foreign exchange policy needs to be improved in order to create national economic resilience amidst changing global dynamics.

REFERENCES

Anwar, M., Hidayat, R., & Zainudin, A. (2022). Inflation, exchange rate, and macroeconomic stability in emerging markets: Evidence from Indonesia. Journal of Monetary and Economic Policy, 14(3), 211–228.

Bank Indonesia. (2023). Laporan Perekonomian Indonesia 2023. Diakses dari https://www.bi.go.id/

Clarida, R., Galí, J., & Gertler, M. (1998). Monetary policy rules in practice: Some international evidence. European Economic Review, 42(6), 1033–1067. https://doi.org/10.1016/S0014-2921(98)00046-4

Dornbusch, R. (1976). Expectations and exchange rate dynamics. Journal of Political Economy, 84(6), 1161–1176. https://doi.org/10.1086/260506

Engle, R. F., & Granger, C. W. J. (1987). Co-integration and error correction: Representation, estimation, and testing. Econometrica, 55(2), 251–276. https://doi.org/10.2307/1913236

Flood, R. P., & Taylor, A. M. (1996). Exchange rate dynamics and fundamentals: A simulation analysis. Journal of International Economics, 39(3–4), 287–319. https://doi.org/10.1016/S0022-1996(96)01427-4

Frankel, J. A., & Rose, A. K. (1996). A panel project on purchasing power parity: Mean reversion within and across countries. Journal of International Economics, 40(1–2), 209–224. https://doi.org/10.1016/0022-1996(95)01333-2

Frenkel, J. A. (1976). A monetary approach to the exchange rate: Doctrinal aspects and empirical evidence. Scandinavian Journal of Economics, 78(2), 200–224.

Krugman, P. R., & Obstfeld, M. (2018). International economics: Theory and policy (10th ed.). Pearson Education.

Lothian, J. R., & Taylor, M. P. (1996). Real exchange rate behavior: The recent float from the perspective of the past two centuries. Journal of Political Economy, 104(3), 488–509. https://doi.org/10.1086/262022

MacDonald, R. (1997). What determines real exchange rates? The long and the short of it. IMF Staff Papers, 44(1), 5–38.

Madura, J. (2022). International financial management (13th ed.). Cengage Learning.

Meese, R. A., & Rogoff, K. (1983). Empirical exchange rate models of the seventies: Do they fit out of sample? Journal of International Economics, 14(1–2), 3–24. https://doi.org/10.1016/0022-1996(83)90029-6

Obstfeld, M., & Rogoff, K. (1996). Foundations of International Macroeconomics. MIT Press.

Palupi, I., & Purwono, R. (2024). Kebijakan suku bunga dan stabilitas nilai tukar di Indonesia. Jurnal Ekonomi dan Kebijakan Publik, 19(1), 44–56.

Rogooff, K. (1996). The purchasing power parity puzzle. Journal of Economic Literature, 34(2), 647–668. https://doi.org/10.2307/2729795

Sarno, L., & Taylor, M. P. (2002). Purchasing power parity and the real exchange rate. International Journal of Finance & Economics, 7(4), 289–309. https://doi.org/10.1002/ijfe.219

Setiawan, D., Nurlina, N., & Putra, R. A. (2021). Peran cadangan devisa dalam menjaga stabilitas moneter Indonesia. Jurnal Ekonomi dan Pembangunan Indonesia, 21(2), 99–113.

Taylor, A. M. (2002). A century of purchasing-power parity. Review of Economics and Statistics, 84(1), 139–150. https://doi.org/10.1162/003465302317331976

World Bank. (2023). World Development Indicators. Diakses dari https://databank.worldbank.org/