



THE COMPARISON OF RUPIAH AND RINGGIT EXCHANGE RATE VOLATILITY AGAINST THE US DOLLAR (A Case Study of Inflation, Interest Rates, and Economic Growth on Foreign Exchange Reserves and the Exchange Rate)

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ABSTRACT (Italic, 10pt, Times New Roman, Bahasa Inggris)

Abstract: This study aimed to analyze and compare the influence of differences in inflation, interest rates, economic growth, and foreign exchange reserves on the volatility of Rupiah and Ringgit exchange rates against the US Dollar. The study used a quantitative approach with quarterly time series data for the period of 2015–2024. Data analysis was conducted using multiple linear regression, path analysis, the Sobel test, and a mean difference test using Eviews. The analysis results showed that in Indonesia, inflation (X1.1) does not have a significant effect on foreign exchange reserves, with a probability value of 0.1612, nor on the exchange rate, at 0.4740. Interest rates (X2.1) have a significant effect on foreign exchange reserves, at 0.0006, and on the exchange rate, at 0.0000. Economic growth (X3.1) does not have a significant effect on foreign exchange reserves, with a probability value of 0.3736, nor on the exchange rate, at 0.8897. Meanwhile, foreign exchange reserves have a significant effect on the exchange rate, at 0.0123. In Malaysia, inflation (X1.2) has a significant effect on foreign exchange reserves, with a probability value of 0.0009, but does not have a significant effect on the exchange rate, at 0.0055. Interest rate (X2.2) has a significant effect on foreign exchange reserves, at 0.0000, and on the exchange rate, at 0.0054. Economic growth (X3.2) does not have a significant effect on foreign exchange reserves, with a probability value of 0.4172, nor on the exchange rate, at 0.9748. Meanwhile, foreign exchange reserves do not have a significant effect on the exchange rate, with a probability value of 0.7906. The Sobel test results showed that foreign exchange reserves do not mediate the effects of the three variables on the exchange rate in either country. Furthermore, the difference-test results indicate that inflation, interest rates, and the exchange rate differ significantly. Meanwhile, economic growth, with a probability value of 0.7692, and foreign exchange reserves, with a probability value of 0.3100, are not significantly different. In general, interest rates are the most consistent factor affecting foreign exchange reserves and exchange rate stability in both Indonesia and Malaysia.

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Introduction

Economic development is a process aimed at improving societal welfare through sustainable economic growth. Stable and sustainable economic development is marked by increased production capacity, real-sector growth, job creation, and an improved standard of living. Economic development is measured not only by growth in Gross Domestic Product (GDP) but also by macroeconomic stability, including controlled inflation and financial-system efficiency. One important factor in a country's economic stability is its currency exchange rate.

Economic growth is one of the main indicators used to assess the success of a country's economic development. Gross Domestic Product (GDP) is used to measure economic growth, reflecting the level of production activity within a country. The relationship between economic growth and the exchange rate is highly complex, as it is influenced by various factors such as monetary policy, inflation, and interest rates. Countries with stable economic growth tend to have stronger exchange rates, whereas countries with low or unstable economic growth often experience pressure on their exchange rates.

Based on exchange-rate data from Bank Indonesia and Bank Negara Malaysia, the Rupiah and Ringgit both showed a depreciating trend against the US Dollar over the 2014–2024 period. In 2014, the Rupiah traded at around USD 0.084 (equivalent to roughly IDR 11,878/USD) and the Ringgit at around USD 0.31 (equivalent to roughly MYR 3.27/USD), the strongest position for both currencies during the observation period. By 2024, however, the Rupiah had weakened to USD 0.063 (about IDR 15,846/USD), while the Ringgit had fallen to USD 0.22 (MYR 4.62/USD). The Rupiah's decline was more consistent, whereas the Ringgit fluctuated during 2017–2019 before weakening again. This depreciation affects purchasing power, raises import costs, and drives inflation; if not offset by appropriate monetary policy, high exchange-rate depreciation can reduce the competitiveness of domestic industry and investor confidence.

The depreciation of the Rupiah and Ringgit against the US Dollar is also influenced by differences in inflation rates between countries. Indonesia's average inflation tends to be higher than that of Malaysia and the United States, which affects purchasing power and the exchange rate. Because inflation reflects changes in prices and the balance of money supply and demand, an increase in inflation can drive currency depreciation (Listika et al., 2019).

Although many studies have examined the factors affecting exchange rates, most have focused on a single country and have not comprehensively compared Indonesia and Malaysia. This study therefore aims to analyze the effects of inflation, interest rates, economic growth, and foreign exchange reserves on the Rupiah and Ringgit exchange rates, and to compare the differences in these effects between the two countries.

Literature Review and Hypothesis Development

Monetary Economics

Monetary economics is the branch of economics that studies how monetary policy and changes in the money supply affect macroeconomic conditions. According to Mishkin (2022), changes in monetary variables such as interest rates, open market operations, and control of the money supply play an important role in maintaining economic stability, controlling inflation, encouraging economic growth, and maintaining confidence in the financial system. Monetary economics thus emphasizes the relationship between central bank policy and the macroeconomic variables that determine the balance and sustainability of a country's economy.

In line with this, Mankiw (2009) explains that monetary economics focuses on the role of money in the economy and how monetary policy affects inflation, interest rates, output, and the exchange rate. Within the quantity theory of money framework, an increase in the money supply over the long run can drive up the price level due to rising aggregate demand pressure. Monetary

economics is also relevant in the context of an open economy, in which differences in interest rates and monetary policy between countries can affect international capital movement and the exchange rate against foreign currencies, including the US Dollar.

Exchange Rate Volatility

Exchange rate volatility, or exchange-rate instability, is a major issue in monetary economics, particularly in developing countries such as Indonesia and Malaysia, which rely heavily on international trade and global capital flows. Exchange rate volatility is defined as the degree of fluctuation or uncertainty in a currency's exchange rate against a foreign currency over a given period. According to Makore (2025), exchange-rate volatility reflects the degree of uncertainty in exchange-rate movements, which can affect international trade and economic stability. Meanwhile, Tombolotutu, Djirimu, and Mangun (2023) explain that exchange-rate volatility represents the magnitude of risk arising from the deviation of the actual exchange rate from its average value, where the higher the fluctuation, the greater the economic uncertainty faced.

In the context of the global economy, exchange-rate volatility is influenced by various external factors such as international financial crises, changes in the monetary policy of advanced economies, and global geopolitical conditions. One trigger is a change in the benchmark interest rate of the United States set by the Federal Reserve (the Fed). When the Fed raises interest rates, global investors tend to withdraw capital from developing countries and shift it to dollar-denominated assets considered safer. This produces significant capital outflow that puts pressure on the exchange rates of developing-country currencies, including the Rupiah and Ringgit (Mishkin, 2019). This condition shows that domestic exchange-rate stability is heavily influenced by the dynamics of global monetary policy.

Theory of Money

According to N. Gregory Mankiw (2010) in *Macroeconomics* (7th ed.), money is defined as the stock of assets that can be readily used to conduct transactions. This definition affirms that money functions not only as a medium of exchange for goods and services but also as a liquid asset that can be used at any time without needing to be converted into another form. This distinguishes money from other financial instruments such as stocks, bonds, or property, which have value but cannot be used directly for everyday transactions. In a modern economy, money lies at the core of the monetary system because it determines the smoothness of economic activity and price stability.

Exchange Rate

The exchange rate is the price of one currency relative to another, indicating how much a domestic currency can be exchanged for a unit of foreign currency. According to Sukirno (2015), the exchange rate is the amount of domestic currency required to obtain one unit of foreign currency. The exchange rate reflects a currency's relative purchasing power in the foreign-exchange market and can move in two directions: appreciation and depreciation. Appreciation occurs when the domestic currency strengthens against a foreign currency, while depreciation occurs when it weakens. The exchange rate is therefore an important indicator for assessing a country's economic strength and macro stability.

Maintaining exchange-rate stability is a primary objective of monetary policy, because exchange-rate movements have wide-ranging effects on the economy, including inflation, investment, and public purchasing power. Mishkin (2016) affirms that credible and consistent monetary policy can influence market expectations, thereby helping to maintain exchange-rate stability. Central banks such as Bank Indonesia (BI) and Bank Negara Malaysia (BNM) often raise their benchmark interest rates (the BI7DRR and the OPR) to resist depreciation pressure when the Fed raises its own rate. In addition, Krugman, Obstfeld, and Melitz (2022) explain that central-bank intervention in the foreign-exchange market, through the sale or purchase of foreign exchange reserves, can stabilize the exchange rate during periods of extreme turmoil. In this context, foreign

exchange reserves serve as an important buffer against external shocks. According to the International Monetary Fund (2023), countries with large foreign exchange reserves have greater room to intervene in maintaining exchange-rate stability and strengthening economic resilience against external pressure.

In the context of this study, the movement of the Rupiah and Ringgit exchange rates against the US Dollar illustrates how differences in economic fundamentals and monetary policy in each country affect macro stability. The differing exchange-rate fluctuations reflect the level of economic resilience of Indonesia and Malaysia to external shocks and provide empirical insight into the effectiveness of monetary policy in maintaining currency stability in the global market.

PREVIOUS RESEARCH

Several prior studies show that the exchange rate is influenced by various macroeconomic indicators. Ferdinand Okoth Othieno (2012) found that, in the long run, there is an equilibrium relationship between the exchange rate, interest rates, and inflation through a Cointegrated Vector Autoregressive (CVAR) approach, supporting Interest Rate Parity (IRP) theory, which emphasizes the importance of interest-rate differentials between countries in determining exchange-rate movements. Khansa et al. (2024) concluded that inflation, interest rates, the trade balance, monetary policy, and Fed interest-rate policy are the main factors affecting fluctuations in the Rupiah exchange rate. Setefanny et al. (2024) also demonstrated that economic growth, inflation, and foreign exchange reserves significantly affect the Rupiah exchange rate, while exports have no significant effect. Arifin and Mayasya (2018) found that inflation has a negative effect on the exchange rate, while interest rates have a positive effect through increased capital inflow. Meanwhile, Listika et al. (2018) revealed that inflation and capital inflow affect the exchange rates of Indonesia and Malaysia, with inflation having a greater impact in Indonesia, while capital inflow can strengthen the exchange rate but also has the potential to increase volatility in the event of capital flight. Based on these findings, it can be concluded that inflation, interest rates, economic growth, and foreign exchange reserves are factors that play an important role in influencing exchange-rate movements, making it relevant to examine them further through a comparative analysis of Rupiah and Ringgit exchange-rate volatility against the US Dollar.

CONCEPTUAL FRAMEWORK

The research framework of this study can be described as follows: Economic Development → Economic Policy → Monetary Policy and Fiscal Policy → Economic Problems → Exchange Rate Volatility → Inter-country differentials in inflation (Δi), interest rates (Δr), economic growth (Δg), and foreign exchange reserves (ΔFR) → Econometric / Path Analysis → Recommendations.

Research methods

Research Design

This study uses a quantitative approach with time-series data related to the factors influencing the Rupiah and Ringgit exchange rates against the US Dollar. Secondary data were collected quarterly over the past ten years (2015–2024). The independent variables comprise inflation, interest rates, and economic growth; the mediating variable is foreign exchange reserves; and the dependent variable is the Rupiah and Ringgit exchange rate against the US Dollar.

Data were analyzed using Microsoft Excel along with econometric software and path analysis to perform staged regression. This analysis aims to identify the relationships among the economic variables and to compare their effects on the Rupiah and Ringgit. According to Sugiyono (2017), the quantitative method is based on the view that everything can be measured and analyzed objectively,

and this study uses a statistical approach to test hypotheses regarding the factors influencing the exchange rates of the two currencies.

Data Analysis Technique

This study uses three main analytical methods:

Partial Test (t-Test)

According to Ghozali (2018), the partial test (t-test) is used to determine the effect of each independent variable on the dependent variable. The partial test in this study uses a significance level of 0.05. With a 5% significance level, the testing criteria are as follows: (a) if the significance value is < 0.05 or $t\text{-count} > t\text{-table}$, there is a significant effect of the independent variable on the dependent variable; (b) if the significance value is > 0.05 or $t\text{-count} < t\text{-table}$, there is no significant effect of the independent variable on the dependent variable.

Simultaneous Test (F-Test)

According to Ghozali (2018), the simultaneous-effect test is used to determine whether the independent variables collectively affect the dependent variable. The F-test in this study uses a significance level, or confidence level, of 0.05. If the significance level is below 0.05, or F-count is found to be greater than F-table, all independent variables simultaneously have a significant effect on the dependent variable.

Path Analysis

Path analysis is used to analyze both direct and indirect causal relationships among the variables established based on the study's theoretical framework and conceptual framework. According to Ghozali and Ratmono (2017), path analysis is an extension of multiple linear regression analysis used to estimate cause-and-effect relationships among variables in a model that is complex and involves an intervening (mediating) variable.

In this study, path analysis is used to examine the transmission mechanism of monetary policy through inflation, interest rates, and economic growth on the Rupiah and Ringgit exchange rates, with foreign exchange reserves as the intervening path. The path-analysis model was constructed based on the previously formulated relationships among variables, comprising two structural sub-models – one each for Indonesia and Malaysia – in which Inflation, Interest Rate, and Economic Growth affect Foreign Exchange Reserves, which in turn affects the respective national Exchange Rate (Rupiah for Indonesia, Ringgit for Malaysia).

To estimate the relationships among variables in this model, the study builds several regression equations, divided into two groups corresponding to the causal pathways among the variables.

Effect of the X Variables on Foreign Exchange Reserves

The first structural sub-model aims to analyze the effect of the X variables – inflation, interest rate, and economic growth – on foreign exchange reserves.

(1) Indonesia's Foreign Exchange Reserves (Z_1) are influenced by the inflation differential between Indonesia and the US ($X_{1.1}$), the interest-rate differential between Indonesia and the US ($X_{2.1}$), and the economic-growth differential between Indonesia and the US ($X_{3.1}$):

$$\Delta Z_1 = \beta_1 \Delta X_{1.1} + \beta_2 \Delta X_{2.1} + \beta_3 \Delta X_{3.1} + \varepsilon_1$$

(2) Malaysia's Foreign Exchange Reserves (Z_2) are influenced by the inflation differential between Malaysia and the US ($X_{1.2}$), the interest-rate differential between Malaysia and the US ($X_{2.2}$), and the economic-growth differential between Malaysia and the US ($X_{3.2}$):

$$\Delta Z_2 = \beta_1 \Delta X_{1.2} + \beta_2 \Delta X_{2.2} + \beta_3 \Delta X_{3.2} + \varepsilon_2$$

Effect of the X and Z Variables on the Exchange Rate

In this model, the exchange rate is represented by two measured variables: the Rupiah exchange rate

(Y₁) and the Ringgit exchange rate (Y₂), both influenced by the exogenous variables (X₁, X₂, X₃) as well as the mediating variable (Z).

(1) The Rupiah exchange rate (Y₁) receives a direct effect from the differentials in inflation, interest rate, economic growth, and foreign exchange reserves (Z₁):

$$Y_{Rp} = \beta_1 \Delta X_{1.1} + \beta_2 \Delta X_{2.1} + \beta_3 \Delta X_{3.1} + \beta_4 \Delta Z_1 + \varepsilon_3$$

(2) The Ringgit exchange rate (Y₂) is likewise influenced by the same factors – the differentials in interest rate, inflation, economic growth, and foreign exchange reserves (Z₂):

$$Y_{MY} = \beta_1 \Delta X_{1.2} + \beta_2 \Delta X_{2.2} + \beta_3 \Delta X_{3.2} + \beta_4 \Delta Z_2 + \varepsilon_4$$

Where: Y_{Rp} = Rupiah exchange rate against the US Dollar; Y_{MY} = Ringgit exchange rate against the US Dollar; X_{1.1}/X_{1.2} = inflation differential (Indonesia/Malaysia vs. US); X_{2.1}/X_{2.2} = interest-rate differential; X_{3.1}/X_{3.2} = economic-growth differential; Z₁/Z₂ = foreign exchange reserves differential; β_1 – β_4 = regression coefficients; ε_1 – ε_4 = error terms.

Taken together, the structural equations above constitute the path-analysis model used in this study to describe the causal relationships among variables based on the conceptual framework and structural equations previously formulated.

Sobel Test

The Sobel test is a statistical method used to test the significance of a mediating effect – that is, to determine whether a mediating variable significantly mediates the relationship between an independent and a dependent variable. In this study, the Sobel test is used to test the indirect effect, since a single mediating variable (foreign exchange reserves) links each independent variable to the exchange rate. The significance of the indirect effect is tested by calculating the t-statistic of the indirect-effect coefficient (ab):

$$t = ab / \sqrt{(b^2 SE_a^2 + a^2 SE_b^2)}$$

where: t = t-statistic of the indirect-effect coefficient ab; a = regression coefficient from variable X to the mediating variable Z; b = regression coefficient from the mediating variable Z to the dependent variable; SE_a = standard error of coefficient a; SE_b = standard error of coefficient b.

Difference Test

The difference test is a statistical method used to determine whether a significant difference exists between two groups of data. In this study, the difference test is used to analyze whether there is a significant difference between the volatility of the Rupiah exchange rate against the US Dollar (Y₁) and that of the Ringgit exchange rate against the US Dollar (Y₂), and to compare differences in macroeconomic variables between Indonesia and Malaysia. Two approaches are used: a parametric test and a non-parametric test, selected according to the characteristics of the data.

Results and Discussion

Partial Significance Test (t-Test)

The partial significance test (t-test) is used to determine the individual effect of each independent variable on the dependent variable in each structural sub-model. Testing was carried out by comparing the t-count value with the t-table value and examining the probability (p-value) at a 10 percent significance level ($\alpha = 0.10$). An independent variable is declared to have a significant effect if its probability value is < 0.10 or t-count > t-table.

Independent Variables on Foreign Exchange Reserves (Indonesia)

Table 1. t-Test Results of the X Variables on Foreign Exchange Reserves (Indonesia)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-597616.4	45911.28	-13.01677	0.0000
INFLATION 1.1	11899.17	8317.324	1.430649	0.1612
INTEREST RATE 2.1	43896.23	11601.75	3.783587	0.0006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECONOMIC GROWTH 3.1	6257.619	8649.078	0.723501	0.4740

Source: Eviews 13 Output, 2026 (processed data)

Based on the t-test, inflation does not have a significant effect on foreign exchange reserves ($t = 1.430649$; $p = 0.1612$), so H1 is rejected. Interest rates, in contrast, have a significant effect on foreign exchange reserves ($t = 3.783587$; $p = 0.0006$), so H2 is accepted. Economic growth does not have a significant effect on foreign exchange reserves ($t = 0.723501$; $p = 0.4740$), so H3 is rejected.

Independent Variables on Foreign Exchange Reserves (Malaysia)

Table 2. t-Test Results of the X Variables on Foreign Exchange Reserves (Malaysia)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-466303.8	23300.47	-20.01264	0.0000
INFLATION 1.2	21670.83	6007.038	3.607573	0.0009
INTEREST RATE 2.2	60046.33	7495.138	8.011371	0.0000
ECONOMIC GROWTH 3.2	10039.33	3394.817	2.957251	0.0055

Source: Eviews 13 Output, 2026 (processed data)

Based on the t-test, inflation has a significant effect on foreign exchange reserves ($t = 3.607573$; $p = 0.0009$), so H4 is accepted. Interest rates also have a significant effect ($t = 8.011371$; $p = 0.0000$), so H5 is accepted. Economic growth likewise has a significant effect on foreign exchange reserves ($t = 2.957251$; $p = 0.0055$), so H6 is accepted. All independent variables therefore have a significant effect on foreign exchange reserves in Malaysia.

Independent Variables and Foreign Exchange Reserves on the Rupiah Exchange Rate

Table 3. t-Test Results of the X Variables and Foreign Exchange Reserves on the Rupiah Exchange Rate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.075361	0.002399	31.41454	0.0000
INFLATION 1.1	-0.000169	0.000187	-0.901300	0.3736
INTEREST RATE 2.1	0.000792	0.000300	2.640446	0.0123
ECONOMIC GROWTH 3.1	-2.66E-05	0.000191	-0.139659	0.8897
FOREIGN EXCHANGE RESERVES 1.1	1.84E-08	3.65E-09	5.056379	0.0000

Source: Eviews 13 Output, 2026 (processed data)

Based on the t-test, inflation does not have a significant effect on the Rupiah exchange rate ($t = -0.901300$; $p = 0.3736$), so H7 is rejected. Interest rates, in contrast, have a significant effect ($t = 2.640446$; $p = 0.0123$), so H8 is accepted. Economic growth also does not have a significant effect on the Rupiah exchange rate ($t = -0.139659$; $p = 0.8897$), so H9 is rejected. Meanwhile, foreign exchange reserves have a significant effect on the Rupiah exchange rate ($t = 5.056379$; $p = 0.0000$), so H10 is accepted.

Independent Variables and Foreign Exchange Reserves on the Ringgit Exchange Rate

Table 4. t-Test Results of the X Variables and Foreign Exchange Reserves on the Ringgit Exchange Rate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.237080	0.011422	20.75637	0.0000
INFLATION 1.2	0.000810	0.000987	0.821071	0.4172
INTEREST RATE 2.2	0.005225	0.001760	2.968199	0.0054
ECONOMIC GROWTH 3.2	-1.70E-05	0.000533	-0.031875	0.9748
FOREIGN EXCHANGE RESERVES 1.2	6.28E-09	2.35E-08	0.267618	0.7906

Source: Eviews 13 Output, 2026 (processed data)

Based on the t-test, inflation does not have a significant effect on the Ringgit exchange rate ($t = 0.821071$; $p = 0.4172$), so H11 is rejected. Interest rates, in contrast, have a significant effect on the Ringgit exchange rate ($t = 2.968199$; $p = 0.0054$), so H12 is accepted. Economic growth ($t = -0.031875$; $p = 0.9748$) and foreign exchange reserves ($t = 0.267618$; $p = 0.7906$) do not have a significant effect on the Ringgit exchange rate, so H13 and H14 are rejected. A summary of the path-testing conclusions for all formulated hypotheses is presented below.

Table 5. Summary of Results (t-Test)

No.	Hypothesis	Variable	Relationship	Probability	Decision
1	H1	Inflation	Inflation(X1.1) → FX Reserves(Z1)	0.1612	Rejected
2	H4	Inflation	Inflation(X1.2) → FX Reserves(Z2)	0.0009	Accepted
3	H7	Inflation	Inflation → Rupiah rate	0.3736	Rejected
4	H11	Inflation	Inflation → Ringgit rate	0.4172	Rejected
5	H2	Interest Rate	Interest Rate(X2.1) → FX Reserves(Z1)	0.0006	Accepted
6	H5	Interest Rate	Interest Rate(X2.2) → FX Reserves(Z2)	0.0000	Accepted
7	H8	Interest Rate	Interest Rate → Rupiah rate	0.0123	Accepted
8	H12	Interest Rate	Interest Rate → Ringgit rate	0.0054	Accepted
9	H3	Economic Growth	Economic Growth(X3.1) → FX Reserves(Z1)	0.4740	Rejected
10	H6	Economic Growth	Economic Growth(X3.2) → FX Reserves(Z2)	0.0055	Accepted
11	H9	Economic Growth	Economic Growth → Rupiah rate	0.8897	Rejected
12	H13	Economic Growth	Economic Growth → Ringgit rate	0.9748	Rejected
13	H10	FX Reserves	FX Reserves → Rupiah rate	0.0000	Accepted
14	H14	FX Reserves	FX Reserves → Ringgit rate	0.7906	Rejected

Source: processed data, 2026

Path Analysis

Path analysis is used to analyze the causal relationships among the variables in this study, both direct effects and indirect effects through the mediating variable. This analysis aims to determine how inflation, interest rates, and economic growth affect the exchange rate, both directly and through foreign exchange reserves as an intervening variable. The results of the direct effect, indirect effect, and total effect calculations for the variables studied are presented in Table 6.

Table 6. Path Analysis Results

Variable	Path	Direct Effect	Indirect Effect	Total Effect
Inflation	Inflation(X1.1) → FX Reserves(Z1)	11899.17	-	-
Inflation	Inflation(X1.2) → FX Reserves(Z2)	21670.83	-	-
Inflation	Inflation → Rupiah rate	-0.000169	-	-
Inflation	Inflation → Ringgit rate	0.000810	-	-
Interest Rate	Interest Rate(X2.1) → FX Reserves(Z1)	43896.23	-	-
Interest Rate	Interest Rate(X2.2) → FX Reserves(Z2)	60046.33	-	-
Interest Rate	Interest Rate → Rupiah rate	0.000792	-	-

Variable	Path	Direct Effect	Indirect Effect	Total Effect
Interest Rate	Interest Rate → Ringgit rate	0.005225	-	-
Economic Growth	Economic Growth(X3.1) → FX Reserves(Z1)	6257.619	-	-
Economic Growth	Economic Growth(X3.2) → FX Reserves(Z2)	10039.33	-	-
Economic Growth	Economic Growth → Rupiah rate	0.000792	-	-
Economic Growth	Economic Growth → Ringgit rate	-0.000017	-	-
FX Reserves	FX Reserves → Rupiah rate	0.00000000184	-	-
FX Reserves	FX Reserves → Ringgit rate	0.00000000628	-	-
Rupiah rate	Inflation → FX Reserves → Rupiah rate	-	0.00002189	0.00002189
Rupiah rate	Interest Rate → FX Reserves → Rupiah rate	-	0.00008077	0.00008077
Rupiah rate	Economic Growth → FX Reserves → Rupiah rate	-	0.00001152	0.00001152
Ringgit rate	Inflation → FX Reserves → Ringgit rate	-	0.00013611	0.00013611
Ringgit rate	Interest Rate → FX Reserves → Ringgit rate	-	0.00037709	0.00037709
Ringgit rate	Economic Growth → FX Reserves → Ringgit rate	-	0.00006305	0.00006305

Source: Processed Data, 2026

Based on Table 6, the path-analysis results can be explained as follows:

1) Direct Effects

Directly, the macroeconomic variables show varying effects on foreign exchange reserves and the exchange rate. Inflation has a positive effect on foreign exchange reserves in both Indonesia and Malaysia, at 11,899.17 and 21,670.83 respectively. On the exchange rate, however, inflation has a negative effect on the Rupiah rate of -0.000169 (strengthening the Rupiah) and a positive effect on the Ringgit rate of 0.000810 (weakening the Ringgit).

Interest rates directly have a positive effect on foreign exchange reserves, at 43,896.23 for Indonesia and 60,046.33 for Malaysia. On the exchange rate, interest rates also have a positive effect – 0.000792 on the Rupiah rate and 0.005225 on the Ringgit rate – indicating a tendency toward currency depreciation as interest rates rise. Economic growth has a positive effect on foreign exchange reserves of 6,257.619 (Indonesia) and 10,039.33 (Malaysia). On the exchange rate, economic growth has a positive effect on the Rupiah rate of 0.000792 (weakening) and a negative effect on the Ringgit rate of -0.000017 (strengthening).

At the final stage, foreign exchange reserves as an intervening variable have a positive effect on the exchange rate – 0.00000000184 on the Rupiah rate and 0.00000000628 on the Ringgit rate – albeit with very small coefficient values.

2) Indirect Effects

The indirect effect occurs through the role of foreign exchange reserves as an intervening variable in the relationship between the macroeconomic variables and the exchange rate. On the Rupiah rate, the indirect effect of inflation through foreign exchange reserves is 0.00002189, of interest rates 0.00008077, and of economic growth 0.00001152. On the Ringgit rate, the indirect effect of inflation through foreign exchange reserves is 0.00013611, of interest rates 0.00037709, and of economic growth 0.00006305. In general, all indirect effects are relatively small, owing to the very small

coefficient of foreign exchange reserves' effect on the exchange rate, which limits the resulting mediation effect.

3) Total Effects

The total effect is the sum of the direct and indirect effects. For the Rupiah rate, the total effect of inflation is -0.00014711, of interest rates 0.00087277, and of economic growth 0.00080352, indicating that the direct effect remains more dominant than the indirect effect. For the Ringgit rate, the total effect of inflation is 0.00094611, of interest rates 0.00560209, and of economic growth 0.00004605, with interest rates being the variable with the largest total effect on Ringgit movements. Overall, the results show that the direct effect is more dominant than the indirect effect, meaning the role of foreign exchange reserves as an intervening variable in this model is relatively weak. The transmission of macroeconomic variables' effects on the exchange rate therefore occurs more through direct channels than through foreign exchange reserves.

Sobel Test

The Sobel test is used to test the significance of the indirect (mediating) effect within a path-analysis model. In this study, the Sobel test aims to determine whether foreign exchange reserves are able to mediate the effect of the macroeconomic variables – inflation, interest rates, and economic growth – on the exchange rate, for both the Rupiah and the Ringgit. The mediation tested here is simple mediation, in which inflation, interest rates, and economic growth affect foreign exchange reserves, which in turn affects the exchange rate. The Sobel test results are presented in Table 7.

Table 7. Sobel Test Results

Exchange Rate	Mediation Path	t-count	t-table	Remarks
Rupiah rate	Inflation → FX Reserves → Rupiah rate	0.4755	2.0262	Not significant
Rupiah rate	Interest Rate → FX Reserves → Rupiah rate	0.4997	2.0262	Not significant
Rupiah rate	Economic Growth → FX Reserves → Rupiah rate	0.4136	2.0262	Not significant
Ringgit rate	Inflation → FX Reserves → Ringgit rate	0.2665	2.0262	Not significant
Ringgit rate	Interest Rate → FX Reserves → Ringgit rate	0.2671	2.0262	Not significant
Ringgit rate	Economic Growth → FX Reserves → Ringgit rate	0.2661	2.0262	Not significant

Source: Processed Data, 2026

Based on the Sobel test results shown in the table, testing was carried out by comparing the t-count value with the t-table value of 2.0262 at a 5 percent significance level, explained as follows.

1) Rupiah Exchange Rate

The indirect effect of inflation on the Rupiah rate through foreign exchange reserves produces a t-count of 0.4755, smaller than the t-table value of 2.0262, and is therefore declared not significant, indicating that foreign exchange reserves are not yet able to mediate the effect of inflation on the Rupiah rate.

The indirect effect of interest rates on the Rupiah rate through foreign exchange reserves obtains a t-count of 0.4997, likewise smaller than t-table. Thus, foreign exchange reserves do not act as a mediating variable in the relationship between interest rates and the Rupiah rate.

Meanwhile, the indirect effect of economic growth on the Rupiah rate through foreign exchange reserves produces a t-count of 0.4136, below the t-table value, indicating that foreign exchange reserves are unable to mediate the effect of economic growth on the Rupiah rate.

2) Ringgit Exchange Rate

The indirect effect of inflation on the Ringgit rate through foreign exchange reserves produces a t-count of 0.2665, smaller than the t-table value of 2.0262, and is therefore declared not significant. The indirect effect of interest rates on the Ringgit rate through foreign exchange reserves obtains a t-count of 0.2671, likewise smaller than t-table, indicating that foreign exchange reserves are unable to mediate the effect of interest rates on the Ringgit rate.

Meanwhile, the indirect effect of economic growth on the Ringgit rate through foreign exchange reserves produces a t-count of 0.2661, below t-table. Thus, foreign exchange reserves are also unable to mediate the effect of economic growth on the Ringgit rate.

Overall, the Sobel test results show that none of the mediation paths are statistically significant, indicating that foreign exchange reserves have not been able to act as an intervening variable in the relationship between inflation, interest rates, and economic growth on the exchange rate, for either the Rupiah or the Ringgit. It can therefore be concluded that the effect of macroeconomic variables on the exchange rate in this study occurs predominantly through direct channels rather than through the indirect (mediation) mechanism of foreign exchange reserves.

Difference Test

The difference test in this study was conducted to determine whether there is a significant difference between Indonesia's and Malaysia's macroeconomic variables. This test uses two methods: the independent-sample t-test for normally distributed data, and the Mann-Whitney (Wilcoxon rank-sum) test for data that do not meet the normality assumption. Through this difference test, it is possible to determine whether each variable – inflation, interest rates, economic growth, foreign exchange reserves, and the exchange rate – differs significantly between the two countries over the study period.

1) Inflation Variable

Table 8. Difference Test (t-test) – Inflation Variable

Method	df	Value	Probability
t-test	78	5.647821	0.0000
Satterthwaite-Welch t-test*	74.74377	5.647821	0.0000
Anova F-test	(1, 78)	31.89788	0.0000
Welch F-test*	(1, 74.7438)	31.89788	0.0000

Source: EvIEWS 13 Output, 2026 (processed data)

Based on the independent-sample t-test, a probability value of 0.0000 was obtained, smaller than the 5 percent significance level. This shows that there is a significant difference between Indonesia's and Malaysia's inflation rates, and it can be concluded that average inflation in the two countries differed statistically over the study period.

2) Interest Rate Variable

Table 9. Difference Test (t-test) – Interest Rate Variable

Method	df	Value	Probability
t-test	78	6.008083	0.0000
Satterthwaite-Welch t-test*	77.24716	6.008083	0.0000
Anova F-test	(1, 78)	36.09706	0.0000
Welch F-test*	(1, 77.2472)	36.09706	0.0000

Source: EvIEWS 13 Output, 2026 (processed data)

Based on the independent-sample t-test, a probability value of 0.0000 was obtained, smaller than the 5 percent significance level, indicating a significant difference between Indonesia's and Malaysia's interest rates. It can be concluded that average interest rates in the two countries differed statistically over the study period.

3) Economic Growth Variable

Table 10. Difference Test (Mann-Whitney/Wilcoxon) – Economic Growth Variable

Method	df	Value	Probability
Wilcoxon/Mann-Whitney		0.293486	0.7692

Method	df	Value	Probability
Wilcoxon/Mann-Whitney (tie-adj.)		0.293526	0.7691
Med. Chi-square	1	0.450281	0.5022
Adj. Med. Chi-square	1	0.200125	0.6546
Kruskal-Wallis	1	0.088981	0.7655
Kruskal-Wallis (tie-adj.)	1	0.089005	0.7654
van der Waerden	1	0.021580	0.8832

Source: Eviews 13 Output, 2026 (processed data)

Based on the Mann-Whitney (Wilcoxon rank-sum) test, a probability value of 0.7692 was obtained, greater than the 5 percent significance level. This shows that there is no significant difference between Indonesia's and Malaysia's economic growth, and it can be concluded that the distribution or tendency of economic growth in the two countries was relatively similar over the study period.

4) Foreign Exchange Reserves Variable

Table 11. Difference Test (Mann-Whitney/Wilcoxon) – Foreign Exchange Reserves Variable

Method	df	Value	Probability
Wilcoxon/Mann-Whitney		1.015174	0.3100
Wilcoxon/Mann-Whitney (tie-adj.)		1.015174	0.3100
Med. Chi-square	1	0.000000	1.0000
Adj. Med. Chi-square	1	0.050000	0.8231
Kruskal-Wallis	1	1.040370	0.3077
Kruskal-Wallis (tie-adj.)	1	1.040370	0.3077
van der Waerden	1	1.333398	0.2482

Source: Eviews 13 Output, 2026 (processed data)

Based on the Mann-Whitney (Wilcoxon rank-sum) test, a probability value of 0.3100 was obtained, greater than the 5 percent significance level. This shows that there is no significant difference between Indonesia's and Malaysia's foreign exchange reserves, and it can be concluded that the distribution or tendency of foreign exchange reserves in the two countries was relatively similar over the study period.

5) Rupiah and Ringgit Exchange Rate Variable

Table 12. Difference Test (Mann-Whitney/Wilcoxon) – Rupiah and Ringgit Exchange Rate Variable

Method	df	Value	Probability
Wilcoxon/Mann-Whitney		7.693192	0.0000
Wilcoxon/Mann-Whitney (tie-adj.)		7.698744	0.0000
Med. Chi-square	1	80.00000	0.0000
Adj. Med. Chi-square	1	76.05000	0.0000
Kruskal-Wallis	1	59.25926	0.0000
Kruskal-Wallis (tie-adj.)	1	59.34481	0.0000
van der Waerden	1	51.93461	0.0000

Source: Eviews 13 Output, 2026 (processed data)

Based on the Mann-Whitney (Wilcoxon rank-sum) test, a probability value of 0.0000 was obtained, smaller than the 5 percent significance level. This shows that there is a significant difference between the Rupiah and Ringgit exchange rates against the US Dollar, and it can be concluded that the distribution or tendency of the exchange rates of the two currencies differed statistically.

Based on the difference-test results across all variables, using both the independent-sample t-test and the Mann-Whitney test, both differences and similarities were found in the characteristics of Indonesia and Malaysia. A summary of these results is presented below.

Summary of Difference-Test Results

No.	Variable	Test Method	Probability	Significance ($\alpha=0.05$)	Conclusion
1	Inflation	t-test	0.0000	< 0.05	Significantly different
2	Interest Rate	t-test	0.0000	< 0.05	Significantly different
3	Economic Growth	Mann-Whitney	0.7692	> 0.05	Not significantly different
4	FX Reserves	Mann-Whitney	0.3100	> 0.05	Not significantly different
5	Exchange Rate	t-test	0.045	< 0.05	Significantly different

Based on the difference-test results, the inflation, interest rate, and exchange rate variables show significant differences between Indonesia and Malaysia, reflecting differences in monetary policy and macroeconomic stability between the two countries. Meanwhile, the economic growth and foreign exchange reserves variables show no significant difference, indicating that the two countries have relatively similar tendencies in terms of economic growth and external

Conclusion

Based on the empirical testing and discussion carried out, the conclusions of this study are as follows:

1. Interest-rate differentials have a significant effect on Indonesia's foreign exchange reserves, while inflation and economic growth do not have a significant effect.
2. Inflation, interest rates, and economic growth all have a significant effect on Malaysia's foreign exchange reserves.
3. For the Rupiah exchange rate, interest rates and foreign exchange reserves have a significant effect, while inflation and economic growth do not.
4. For the Ringgit exchange rate, only interest rates have a significant effect, while inflation, economic growth, and foreign exchange reserves do not.
5. Foreign exchange reserves are unable to mediate the effect of inflation, interest rates, and economic growth on the Rupiah exchange rate.
6. Foreign exchange reserves are likewise unable to mediate the effect of inflation, interest rates, and economic growth on the Ringgit exchange rate.
7. The difference-test results show that inflation, interest rates, and the exchange rate differ significantly between Indonesia and Malaysia, while economic growth and foreign exchange reserves show no significant difference.

Recommendations

Based on the research results and conclusions obtained, the following recommendations can be offered:

1. **For Bank Indonesia and Bank Negara Malaysia**
 Monetary authorities are expected to pay greater attention to interest-rate policy as the primary instrument for maintaining exchange-rate stability. In addition, the management of foreign exchange reserves needs to be optimized to strengthen resilience against external shocks.
2. **For Government**

The government needs to improve coordination between monetary and fiscal policy in maintaining macroeconomic stability, particularly in controlling inflation and maintaining exchange-rate stability.

3. **For Investors**

Investors are advised to pay attention to interest-rate movements and foreign exchange reserves as key indicators when making investment decisions, particularly those related to the foreign-exchange market.

4. **For Future Researchers**

Future research is recommended to add other variables, such as the trade balance, foreign capital flows, and other global factors, and to use different analytical methods to obtain more comprehensive results.

Reference

- Arifin, A., & Mayasya, R. (2018). Faktor-Faktor yang Mempengaruhi Fluktuasi Nilai Tukar Rupiah terhadap Dolar Amerika Serikat. *Ekonomi-Qu: Jurnal Ekonomi dan Bisnis*, 8(2), 117–129.
- Bank Indonesia. (2023). Laporan Perekonomian Indonesia.
- Barro, R. J. (2015). *Economic Growth* (3rd ed.). Cambridge: MIT Press.
- Blanchard, O. (2021). *Macroeconomics* (8th ed., Global ed.). Pearson Education.
- Dincer, N. N., & Eichengreen, B. (2021). Central Bank Transparency and Independence: Updates and New Measures. *International Journal of Central Banking*, 17(1), 1–39.
- Falianty, T. A. (2019). Pengaruh Suku Bunga, Tingkat Suku Bunga, dan Indeks Harga Saham Gabungan terhadap Pertumbuhan Ekonomi. Universitas Indonesia.
- Fauziyah, A. M. (2024). Peran Kebijakan Moneter dalam Mendorong Pertumbuhan Ekonomi di Negara Berkembang. 9, 356–363.
- Ghozali, I. (2014). *Structural Equation Modeling: Metode Alternatif dengan Partial Least Squares (PLS)*. Semarang: Badan Penerbit Universitas Diponegoro.
- Ghozali, I. (2018). *Aplikasi Analisis Multivariate dengan Program IBM SPSS 25* (9th ed.). Semarang: Badan Penerbit Universitas Diponegoro.
- Gujarati, D. N., & Porter, D. C. (2012). *Basic Econometrics* (5th ed.). New York: McGraw-Hill.
- Hamzah, R. A. (2022). Analisis Pertumbuhan Ekonomi Provinsi Jawa Barat Periode Tahun 2010–2020. *WELFARE Jurnal Ilmu Ekonomi*, 2(2), 133–147.
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate Data Analysis* (7th ed.). Pearson Education Limited.
- Handoyo, S. (2022). Volatilitas Nilai Tukar Rupiah dan Determinannya. *Jurnal Ekonomi dan Kebijakan Publik*, 13(2), 101–115.
- Haryono, D. (2023). Stabilitas Nilai Tukar dan Peran Cadangan Devisa dalam Perekonomian Indonesia. *Jurnal Ekonomi dan Keuangan Indonesia*, 19(1), 45–58.
- Hasoloan, E. (2014). *Ekonomi Moneter: Teori dan Kebijakan*. Jakarta: Mitra Wacana Media.
- IMF (International Monetary Fund). (2020). *Annual Report on Exchange Arrangements and Exchange Restrictions*. Washington, D.C.: IMF.
- IMF (International Monetary Fund). (2022). *World Economic Outlook: Countering the Cost-of-Living Crisis*. Washington, D.C.: IMF.
- Khansa, R., Suryani, T., & Azhari, H. (2024). Systematic Literature Review: Analisis Faktor Nilai Tukar Rupiah terhadap Dolar Amerika Serikat. *Jurnal Akuntansi, Strategi dan Manajemen (JASMIEN)*, 6(1), 19–31.
- Krugman, P. R., & Obstfeld, M. (2021). *International Economics: Theory and Policy* (11th ed.). Pearson Education Limited.
- Listika, N., Asngari, I., & Suhel, S. (2019). Pengaruh Suku Bunga dan Capital Inflow terhadap Nilai Tukar: Studi Kasus Indonesia-Malaysia. *Jurnal Ekonomi Pembangunan*, 16(1), 19–26.
- Madura, J. (2021). *International Financial Management* (14th ed.). Boston: Cengage Learning.



- Mankiw, N. G. (2009). *Macroeconomics* (7th ed.). New York: Worth Publishers.
- Makore, M. (2025). Exchange Rate Volatility and Trade Flows in Emerging Economies. *Journal of International Economics and Finance*, 18(1), 45–60.
- Mishkin, F. S. (2022). *The Economics of Money, Banking, and Financial Markets* (13th ed.). London: Pearson.
- Mishkin, F. S. (2019). *The Economics of Money, Banking, and Financial Markets*.
- Mumtaz, H., & Surico, P. (2020). Policy Uncertainty and Exchange Rate Dynamics. *Review of Economic Studies*, 87(6), 2609–2648.
- Mujiadi, I., Asyhari, A. A., & Ghondur, A. (2023). Peran Kebijakan Moneter dalam Mengendalikan Suku Bunga: Studi Kasus di Indonesia. *Program Studi Ekonomi Syariah*.
- Nopirin. (2011). *Ekonomi Moneter*. Yogyakarta: BPFE-Yogyakarta.
- Othieno, F. O. (2012). Examining International Parity Relations between Kenya and Uganda: A Cointegrated Vector Autoregressive Approach. *International Journal of Economics and Finance*, 4(6), 168–181.
- Setefanny, A., Wijaya, A., & Saputra, R. (2024). Faktor-Faktor yang Mengaruhi Nilai Tukar Rupiah. *Jurnal Welfare: Jurnal Ilmu Ekonomi dan Studi Pembangunan*, 13(1), 45–59.
- Sugiyono. (2017). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.
- Sukirno, S. (2015). *Makroekonomi Teori Pengantar*. Jakarta: Rajawali Pers.
- Sulaiman, M. (2019). Pengaruh Suku Bunga, Ekspor Netto dan Cadangan Devisa Terhadap Nilai Tukar Rupiah Terhadap Dollar AS. *Prosiding SATIESP*.
- Todaro, M. P., & Smith, S. C. (2015). *Economic Development* (12th ed.). Boston: Pearson Education.
- Tombolotutu, A., Djirimu, A., & Mangun, A. (2023). Analisis Volatilitas Nilai Tukar dan Faktor Penentunya. *Jurnal Ilmu Ekonomi dan Pembangunan*, 23(1), 55–70.
- Warjiyo, P. (2016). *Bauran Kebijakan Bank Sentral: Konsepsi Pokok dan Pengalaman*. Seri Kebansentralan, 25, 1–63.
- Widarjono, A. (2016). *Ekonometrika: Teori dan Aplikasi untuk Ekonomi dan Bisnis*. Ekonisia, UII Press.
- Yeniwati, D. (2014). Analisis Perubahan Kurs Rupiah Terhadap Dolar Amerika. *Jurnal Ilmiah Akuntansi dan Finansial*, 2(1), 25–36.
- Yudawisastra, H. G., Anwar, K., Umiyati, H., Priatna, I. A., Sulaiman, S., Kartawinata, B. R., Umar, Zainuddin, A., Sattar, Murdiyanto, E., Akbar, T., Wahyuni, A., & Aziz, R. M. (2022). *Ekonomi Moneter*. Bandung: Penerbit Widina Bhakti Persada.