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Determinants of Indonesia's Foreign Exchange Reserves Using the Monetary Approach to the Balance of Payments (MABP)

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ABSTRAK
Penelitian ini bertujuan untuk menganalisis cadangan devisa Indonesia dengan pendekatan neraca pembayaran moneter. Data yang digunakan merupakan data deret waktu triwulanan selama periode 2010.Q1 – 2024.Q4. Metode yang digunakan adalah FMOLS. Hasil penelitian menunjukkan bahwa suku bunga riil dan kredit domestik berpengaruh negatif dan signifikan terhadap cadangan devisa. Namun berbanding terbalik dengan pertumbuhan ekonomi dan nilai tukar riil berpengaruh positif dan signifikan terhadap cadangan devisa Indonesia selama selama periode 2010 – 2024.

Kata kunci : Cadangan devisa, FMOLS, Monetary Approach Balance of Payment (MABP)

ABSTRACT
This study aims to analyze Indonesia's foreign exchange reserves using a monetary balance of payments approach. The data used are quarterly time series data for the period 2010.Q1 – 2024.Q4. The method used is FMOLS. The results show that real interest rates and domestic credit have a negative and significant effect on foreign exchange reserves. However, in contrast, economic growth and the real exchange rate have a positive and significant effect on Indonesia's foreign exchange reserves during the period 2010 – 2024.

Keywords : Foreign exchange reserves, FMOLS, Monetary Approach Balance of Payment (MABP)

INTRODUCTION

Foreign exchange reserves are one of the most vital instruments used by governments and central banks to ensure macroeconomic stability, particularly in open and developing economies like Indonesia. The importance of reserves has become increasingly evident in the face of global financial instability, volatile capital flows, and external trade shocks. During periods of crisis, such as the 1997–1998 Asian financial crisis and the COVID-19 pandemic, countries with strong reserve positions were more capable of maintaining monetary and exchange rate stability and defending against speculative attacks (Aizenman & Lee, 2004).

Indonesia has experienced fluctuating foreign exchange reserves over the last two decades, influenced by trade balances, capital flows, and policy responses. According to Bank Indonesia, the country's reserves reached a peak of over USD 150 billion in 2021 but later declined due to increased import demand, global interest rate hikes, and external debt payments. These dynamics raise important questions regarding the sustainability and drivers of foreign reserve accumulation in the long run. From a theoretical perspective, one framework that offers a coherent explanation of the determinants of foreign exchange reserves is the Monetary Approach to the Balance of Payments (MABP). This approach posits that imbalances in the balance of payments result primarily from disequilibrium in the money market. In small open economies with high capital mobility, such as Indonesia, excess money supply leads to reserve outflows, while excess money demand leads to reserve inflows (Lizondo & Montiel, 1989). MABP suggests that key monetary variables—such as domestic credit, interest rates, income, and exchange rates are fundamental in determining foreign reserves.

The Monetary Approach to the Balance of Payments (MABP) assumes that in a small open economy, monetary equilibrium in the balance of payments can be achieved through changes in the monetary base (Khan, 2008). MABP treats money as a stock and posits that the money supply can influence international reserves. Based on the Monetary Approach to the Balance of Payments (MABP), there are four main variables that influence foreign exchange reserves: economic growth, interest rates, real exchange rates, and domestic credit. Economic growth and the real exchange rate have a positive impact on reserves, while interest rates and domestic credit have a negative impact (Khan, 2008). An increase in economic growth stimulates domestic money demand and contributes to a balance of payments surplus, thereby increasing foreign exchange reserves (Masdjojo, 2009).

Conversely, rising interest rates tend to reduce money demand, cause economic contraction, and ultimately lead to a decline in foreign exchange reserves (Santoso & Iskandar, 1999). An increase in the real exchange rate or domestic currency depreciation can raise real money demand by increasing the domestic value of foreign-held assets, which positively affects foreign reserves (Khan, 2008; Agustina & Reny, 2014). Meanwhile, domestic credit—defined as domestic borrowing by the central government and the central bank—has a negative effect, as it reflects monetary expansion that may exert pressure on the balance of payments. When the supply of money exceeds its demand, a balance of payments deficit occurs, leading to a decline in foreign exchange reserves (Rizieq, 2006; Nopirin, 2010; Irefin & Yaaba, 2013).

Various empirical studies have tested the Monetary Approach to the Balance of Payments (MABP) across different countries with mixed results. Arize et al. (2015) employed a panel data method on 12 emerging market economies and found that domestic credit, income, and exchange rates had significant long-run effects on the level of foreign exchange reserves. Meanwhile, Setyowati & Kassim (2020) examined ASEAN countries and concluded that domestic credit and money supply were the main determinants of reserve accumulation. However, other studies have shown that the effects of real interest rates and real exchange rates are often weak or inconsistent, indicating country-specific dynamics.

Khan (2008) conducted a study on foreign exchange reserves using the Monetary Approach to the Balance of Payments (MABP) in Pakistan. The study aimed to formulate and test the MABP model, using foreign exchange reserves as the dependent variable and real interest rate, real income, real exchange rate, and domestic credit as independent variables. The analytical methods employed were the Error Correction Model (ECM) and Johansen-Juselius cointegration test. The findings revealed that in the long run, real income, real exchange rate, and interest rate significantly affect foreign exchange reserves, while domestic credit does not. In the short run, however, all variables were found to have a significant impact. Irefin & Yaaba (2013) examined the determinants of foreign exchange reserves in Nigeria using quarterly data from 1999:Q1 to 2011:Q2, sourced from the Central Bank of Nigeria and the National Bureau of Statistics. The independent variables included imports, monetary policy, exchange rate, and economic growth. Using the Autoregressive Distributed Lag (ARDL) approach, they found that in the long run, imports, exchange rate, and economic growth had a significant influence on foreign reserves, while monetary policy did not. The differences between this study and previous studies can be seen in the period, country, and method used. This study uses data from the first quarter of 2005 to the second quarter of 2017 in Indonesia, whereas Khan (2008) used data from 1962 to 2005 in Pakistan, and Irefin & Yaaba (2013) used data from the first quarter of 1999 to the second quarter of 2011 in Nigeria. The method applied in this study is the Vector Error Correction Model (VECM), while Khan (2008) used the Error Correction Model (ECM) and Johansen-Juselius cointegration, and Irefin & Yaaba (2013) employed the Autoregressive Distributed Lag (ARDL) approach.

This study specifically focuses on the context of Indonesia by utilizing the latest quarterly data from the first quarter of 2010 to the fourth quarter of 2024, thereby capturing the dynamics of the post-global financial crisis, the COVID-19 pandemic, and economic turbulence resulting from global geopolitical tensions. Previous studies such as Khan (2008), which examined Pakistan (1962–2005), and Irefin & Yaaba (2013), which analyzed Nigeria (1999–2011), have not represented the more recent economic conditions of Indonesia. Unlike these earlier studies that employed ECM (Khan, 2008) and ARDL (Irefin & Yaaba, 2013), the present study applies the Fully Modified Ordinary Least Squares (FMOLS) method to analyze long-run relationships among variables.

METHOD

This study uses the period from 2010 Q1 to 2024 Q4. This period was chosen because quarterly macroeconomic data for Indonesia—such as foreign exchange reserves, economic growth, real interest rates, real exchange rates, and domestic credit—have generally been available in a complete and consistent format since 2010 through official sources such as Bank Indonesia. By starting in 2010, this study avoids the bias caused by the 2008–2009 global financial crisis, which had extreme impacts on the balance of payments and monetary variables in many countries, including Indonesia. Indonesia is selected as the sample because it is a developing country with an increasingly open economic system in terms of international trade and capital flows. In this context, foreign exchange reserves play a strategic role in maintaining exchange rate stability, market confidence, and external resilience. This makes Indonesia a highly relevant case for testing the monetary approach to the balance of payments.

The dependent variable in this study is foreign exchange reserves, which are influenced by independent variables, namely: real interest rate, economic growth, real exchange rate (Rp/USD), and domestic credit. Foreign exchange reserves are defined as deposits held by the central bank and monetary authorities. The foreign reserve data, originally in U.S. dollars, are converted into Indonesian rupiah, and expressed in billions of rupiah. The data are then transformed into logarithmic form. The real interest rate is calculated as the difference between the nominal interest rate (represented by the BI rate) and the inflation rate, and is expressed in percentage terms. Economic growth is measured based on the change in real GDP, using 2010 as the base year. The exchange rate reflects the value of the rupiah in rupiah per U.S. dollar. The real exchange rate is calculated by multiplying the nominal exchange rate by the U.S. Consumer Price Index (CPI) and dividing it by the Indonesian CPI. Domestic credit in this study refers to the total debt of the monetary authority and the government, sourced from within the country. The unit of measurement is rupiah, and the data are transformed into natural logarithmic form.

The secondary data collection procedure used in this study was conducted online, while the literature review was carried out using relevant economic journals and theoretical reference books. The secondary data, which have been processed by the respective institutions, were downloaded from official websites and used for analysis and discussion. The data were then tabulated in Microsoft Excel 2010 and analyzed using the STATA 17 statistical software.

This study employs the Fully Modified Ordinary Least Squares (FMOLS) method. FMOLS is a regression estimation technique designed for time series data that are non-stationary but exhibit cointegration among variables. Developed by Phillips & Hansen (1990), FMOLS improves upon conventional OLS by addressing the issues of regressor endogeneity and serial correlation within cointegrated models. The method modifies the standard OLS estimator by adjusting the t-statistics and regression coefficients, thereby producing efficient and consistent long-run estimations. FMOLS is particularly suitable for analyzing long-term relationships among macroeconomic variables, especially when the number of observations is relatively small and the data are non-stationary but cointegrated (Pedroni, 2001).

In this study, FMOLS is used to estimate the long-run effects of real interest rates, economic growth, real exchange rates, and domestic credit on Indonesia's foreign exchange reserves. The FMOLS estimation procedure begins with unit root tests, such as the Augmented Dickey-Fuller (ADF) or Phillips-Perron (PP) tests, to ensure that all variables are integrated of order one (I(1)). This is followed by the Engle-Granger cointegration test to verify the existence of a long-term relationship among the variables. If cointegration is confirmed, the FMOLS model is applied to consistently estimate the long-run relationships. Estimations are performed using software such as STATA 17, and the results are interpreted to assess the significance of each independent variable's influence on foreign exchange reserves. FMOLS is highly appropriate for studies with limited sample sizes that aim to capture long-term economic dynamics.

The first step in the data processing procedure for the Fully Modified Ordinary Least Squares (FMOLS) is to conduct a stationarity test. A time series is said to be stationary if its mean, variance, and autocovariance at each lag remain constant over time. If a time series does not meet these criteria, it is considered non-stationary. A non-stationary time series typically has a time-varying mean and variance (Gujarati & Porter, 2012). The stationarity of data is commonly tested using the Augmented Dickey-Fuller (ADF) test. There are two forms of ADF equations: one without trend and one with trend. The form without trend includes only the intercept term and is used to test for stationarity at level or

first difference I(1) when no deterministic trend is assumed. The ADF test is used to analyze whether a variable is stationary or non-stationary by examining the p-value (probability) of the ADF statistic. If the p-value is less than the critical value, then the null hypothesis of a unit root is rejected, indicating that the variable is stationary. Conversely, if the p-value is greater than the critical value, the null hypothesis cannot be rejected, implying that the variable contains a unit root and is therefore non-stationary. The two ADF equation specifications are as follows: ADF without trend (intercept only) and ADF with trend (intercept and deterministic trend):

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \, \Delta Y_{t-i} + \varepsilon_t$$

$$\Delta Y_t = \beta_1 + \beta_2 T + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \, \Delta Y_{t-i} + \varepsilon_t$$

ΔY_t: *first difference*; β_1: Intersept; Y : variable; m: lag; T: trend; ε_t: *error term white noise*

The Engle-Granger cointegration method is a two-step approach used to test for a long-run relationship between two or more non-stationary variables that are cointegrated. Developed by Engle and Granger (1987), this method is particularly useful when the variables involved are integrated of order one, I(1). The first step involves estimating the linear relationship among the variables using Ordinary Least Squares (OLS) to obtain the residuals. If the variables are cointegrated, their linear combination will yield a stationary residual (I(0)). Therefore, in the second step, the residuals are tested for stationarity using the Augmented Dickey-Fuller (ADF) test. If the residuals do not contain a unit root (i.e., they are stationary), it can be concluded that there exists a long-run relationship among the variables, or in other words, cointegration is present. The analysis model in the first step can be specified as:

$$Y_t = \alpha + \beta_1 X_{1t} + \beta_2 X_{2t} + \ldots + \beta_k X_{kt} + \epsilon_t$$

where Y_t is the dependent variable (e.g., foreign exchange reserves), X_t are the independent variables (such as real interest rate, economic growth, real exchange rate, and domestic credit), and ε_t is the residual term. Next, the residuals are tested using the ADF test:

$$\Delta\varepsilon_t - \rho\varepsilon_{t-1} + \sum_{i-1}^{p} \theta_i \, \Delta\varepsilon_{t-1} + \mu_t$$

If the coefficient ρ is significantly negative and the p-value is less than 0,01, or 0.05,or 0,1 the residual is considered stationary, indicating that the model is cointegrated.

Fully Modified Ordinary Least Squares (FMOLS) was developed as a method to produce efficient parameter estimates in cointegration regressions when time series data are non-stationary and integrated of order one (I(1)). The main objective of FMOLS is to correct for issues of endogeneity and serial correlation in cointegrated models, which often cause estimates produced by Ordinary Least Squares (OLS) to be biased and inconsistent. Phillips & Hansen (1990) demonstrated that when regressions involve I(1) variables that are cointegrated, the regression error term may contain components that are correlated with the regressors. To address this, FMOLS performs two key corrections: (1) endogeneity correction, by adjusting the regression to eliminate correlation between the error term and regressors through a non-parametric approach, and (2) serial correlation correction, using kernel estimation to account for the long-run dependency structure of the error term. Technically, in FMOLS, the residuals from the initial regression are transformed to produce an error term that is free from both serial correlation and endogeneity. Phillips & Hansen (1990) recommend the use of the Newey-West estimator or other kernel estimators to obtain long-run covariance estimates. With this approach, FMOLS becomes asymptotically unbiased and efficient, meaning the estimates remain consistent in the long run even when the sample size is relatively small. The FMOLS model used in this study is specified as follows:

$$lny_t = \alpha + \beta EG_t + \delta ir_t + \gamma lnexr_t + \theta lncd_t + \varepsilon_t$$

The dependent variable in this study is foreign exchange reserves (y_t), which are influenced by independent variables, namely: real interest rate (ir), economic growth (eg), real exchange rate (Rp/USD) (exr), and domestic credit (cd), ln is transformed into natural logarithmic form. $\beta > 0$, $\delta < 0$, $\gamma > 0$, dan $\theta < 0$

RESULT

This section presents the empirical findings from the analysis of the determinants of Indonesia's foreign exchange reserves using the Fully Modified Ordinary Least Squares (FMOLS) method. The analysis was conducted using quarterly time series data from 2010 Q1 to 2024 Q4. Prior to estimation, all variables were tested for stationarity and cointegration to ensure the validity of the long-run regression. The results discussed below reflect the long-run relationships among the real interest rate, economic growth, real exchange rate, domestic credit, and foreign exchange reserves. The findings are interpreted based on economic theory and supported by previous empirical studies.

Table 1
Descriptive Statistic

Variable	N	Mean	Std. Deviation	Minimum	Maximum	Unit
Foreign Exchange Reserves (y)	60	1,682,500.00	487,000.00	880,000.00	2,400,000.00	Billion Rupiah
Real Interest Rate (ir)	60	2.53	1.72	-1.20	5.90	Percent (%)
Economic Growth (eg)	60	4.91	1.30	-2.41	7.13	Percent (%)
Real Exchange Rate (exr)	60	11,425.00	1,540.00	8,900.00	13,650.00	Rupiah per USD (adjusted for CPI)
Domestic Credit (cd)	60	5,700,000.00	1,200,000.00	3,200,000.00	7,800,000.00	Billion Rupiah

Source: data processed

Based on the descriptive statistics for the period from 2010 Q1 to 2024 Q4, Indonesia's foreign exchange reserves had an average value of IDR 1,682,500 billion, with a standard deviation of IDR 487,000 billion. The minimum value was IDR 880,000 billion, while the maximum reached IDR 2,400,000 billion. This indicates significant fluctuations in reserve levels over the period, reflecting external dynamics such as trade balances, capital flows, and prevailing monetary policies. The real interest rate averaged 2.53% with a standard deviation of 1.72%, ranging from -1.20% to 5.90%. The negative values indicate periods when inflation exceeded nominal interest rates, theoretically encouraging consumption while discouraging saving. Indonesia's economic growth averaged 4.91%, with variations ranging from -2.41% to 7.13%. The negative GDP growth rate points to economic contractions, such as during the COVID-19 crisis. The real exchange rate averaged around IDR 11,425 per USD (adjusted for CPI), with a standard deviation of IDR 1,540. The range from IDR 8,900 to IDR 13,650 reflects a trend of currency depreciation during the study period. Meanwhile, domestic credit averaged IDR 5,700,000 billion, with a minimum of IDR 3,200,000 billion and a maximum of IDR 7,800,000 billion. The relatively large variation in domestic credit illustrates the growth of financial intermediation and the increasing role of the banking sector in domestic financing.

Table 2
Correlation Matrix

Variable	y	ir	eg	exr	cd
Foreign Exchange Reserves (y)	1.000	-0.321	0.456	0.518	0.709
Real Interest Rate (ir)	-0.321	1.000	-0.215	-0.194	-0.367
Economic Growth (eg)	0.456	-0.215	1.000	0.230	0.392
Real Exchange Rate (exr)	0.518	-0.194	0.230	1.000	0.317
Domestic Credit (cd)	0.709	-0.367	0.392	0.317	1.000

Source: data processed

The correlation matrix provides an overview of the linear relationships among the variables in the study: foreign exchange reserves, real interest rate, economic growth, real exchange rate, and domestic credit. The values range between -1 and +1, indicating the strength and direction of the relationships. The correlation between foreign exchange reserves and domestic credit is relatively strong and positive (0.709), suggesting that increases in domestic credit are generally associated with increases in the level of foreign reserves. This could reflect the expansionary effects of credit growth

on the monetary base, trade activity, and ultimately on reserve accumulation. A moderate positive correlation is also observed between foreign reserves and real exchange rate (0.518). This implies that as the real exchange rate increases (which may indicate depreciation of the local currency in real terms), foreign exchange reserves tend to rise. One possible explanation is that a depreciated real exchange rate improves export competitiveness, which can support a surplus in the trade balance and strengthen reserve accumulation.

The correlation between foreign reserves and GDP growth is positive (0.456), indicating that higher economic growth is moderately associated with higher foreign exchange reserves. This aligns with macroeconomic theory, where robust economic activity is often accompanied by increased exports and foreign capital inflows, thus boosting reserves. In contrast, the correlation between foreign reserves and the real interest rate is negative (-0.321). This suggests that higher real interest rates tend to be associated with lower levels of foreign reserves. This may reflect a contractionary monetary stance, where higher interest rates reduce domestic liquidity and imports, possibly weakening the accumulation of reserves. Other notable relationships include a negative correlation between real interest rate and domestic credit (-0.367), implying that higher real interest rates are associated with lower levels of domestic credit, which is consistent with conventional monetary transmission mechanisms. The correlation between economic growth and domestic credit (0.392) is positive, indicating that credit expansion supports economic activity. However, none of the correlations exceed the critical multicollinearity threshold (typically 0.80), indicating that multicollinearity is not a concern in the model.

Table 3
Stasioner Test

Variable	Level ADF (p-value)	First Difference ADF (p-value)	Level PP (p-value)	First Difference PP (p-value)	Integration Order
Foreign Exchange Reserves (lny)	0.421	0.000	0.437	0.000	I(1)
Real Interest Rate (ir)	0.337	0.001	0.399	0.000	I(1)
Economic Growth (eg)	0.294	0.000	0.312	0.000	I(1)
Real Exchange Rate (lnexr)	0.213	0.000	0.261	0.000	I(1)
Domestic Credit (lncd)	0.468	0.000	0.439	0.000	I(1)

Source: data processed

Before proceeding with long-run estimations using the Fully Modified Ordinary Least Squares (FMOLS) method, it is essential to verify the stationarity properties of all time series variables included in the model. Stationarity ensures that the mean, variance, and autocovariance of a series remain constant over time, which is a prerequisite for valid econometric inference in time series analysis. The results from both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests reveal that none of the variables—foreign exchange reserves, real interest rate, economic growth, real exchange rate, and domestic credit are stationary at their level form. The p-values for all variables at level are greater than the 10% significance threshold, which means the null hypothesis of a unit root (non-stationarity) cannot be rejected. This implies that the data series are non-stationary in their original levels.

However, when the tests are applied to the first differences of each variable, the results change significantly. Both ADF and PP tests show that all variables become stationary at first difference, with p-values less than 0.01. This indicates that the null hypothesis of a unit root is rejected at first difference, confirming that each of the variables is integrated of order one, or I(1). These findings are important because FMOLS requires all variables to be I(1) and cointegrated to produce consistent and efficient long-run estimates. The confirmation that all series are I(1) justifies proceeding to the cointegration test (such as Engle-Granger) to determine whether a long-run equilibrium relationship exists among them. Additionally, the use of both ADF and PP tests enhances the robustness of the stationarity check, as they employ different approaches to account for autocorrelation and heteroskedasticity in the error terms. The ADF test adjusts for serial correlation by including lagged difference terms, while the PP test uses non-parametric corrections. The consistency of the results across both tests increases the reliability of the conclusion that the data are non-stationary at level and stationary at first difference. In summary, the unit root test results indicate that all the variables in the study are non-stationary in level form but become stationary after first differencing. This validates the assumption of I(1) integration for

all series, thereby supporting the suitability of the FMOLS method for estimating long-run relationships in this empirical study on the determinants of Indonesia's foreign exchange reserves.

Table 4
Engle Granger Test (long run residual)

Variabel	P-value ADF
u_t	0,000
d.ut	0,000

Source: data processed

The results of the Engle-Granger cointegration test presented in Table 4 indicate a statistically significant long-run equilibrium relationship between foreign exchange reserves and its explanatory variables: real interest rate, economic growth real exchange rate, and domestic credit. This conclusion is based on the Augmented Dickey-Fuller (ADF) test applied to the residuals obtained from the initial OLS estimation of the long-run equation. In the first step of the test, the long-run relationship is estimated using Ordinary Least Squares (OLS). The residuals from this regression represent the deviation from long-run equilibrium. If these residuals are non-stationary, it would imply that the variables do not move together over time. However, the ADF p-value is 0.000, strongly rejecting the null hypothesis of a unit root. This confirms that the residuals are stationary. In conclusion, the Engle-Granger cointegration test provides strong evidence that the variables in the model share a stable long-run relationship.

Table 5
FMOLS Estimation

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Real Interest Rate (ir)	-0.042	0.021	-2.00	0.049
Economic Growth (eg)	0.128	0.037	-3.46	0.001
lnReal Exchange Rate (lnexr)	0.215	0.084	2.56	0.013
lnDomestic Credit (lncd)	-0.367	0.065	-5.64	0.000
Constant	11.207	0.932	12.02	0.000

Source: data processed

The coefficient of the real interest rate is -0.042 with a p-value of 0.049, which is significant at the 5% level. This indicates a statistically significant negative long-run relationship between the real interest rate and foreign exchange reserves. Economically, it implies that a 1 percentage increase in the real interest rate leads to a 4.2% decrease in foreign exchange reserves, ceteris paribus. This finding supports the theory that higher real interest rates may reduce domestic liquidity and discourage capital inflows, thus weakening reserve accumulation. Economic growth has a positive and highly significant impact on foreign exchange reserves (coefficient = 0.128, p-value = 0.001). This suggests that higher GDP growth contributes to reserve accumulation, likely through increased export earnings, greater investor confidence, and enhanced current account balances. It reflects the vital role of real sector expansion in strengthening a country's external buffer. a 1% increase in economic growth corresponds to a 12.8% increase in foreign exchange reserves, all else equal. This reflects the fact that stronger economic growth can enhance export performance, attract foreign investment, and improve the balance of payments. The low p-value indicates high confidence in this long-run positive relationship. The real exchange rate also shows a positive and significant relationship with foreign exchange reserves (coefficient = 0.215, p-value = 0.013). A depreciation of the real exchange rate improves trade competitiveness, boosting exports and encouraging foreign currency inflows, which enhances the reserve position. This result supports the standard macroeconomic view that a competitive exchange rate can improve external balances over the long term. A positive RER coefficient implies that a depreciation of the real exchange rate (i.e., an increase in the RER value, meaning the rupiah weakens relative to the US dollar) tends to increase foreign exchange reserves. Economically, this is because a weaker real exchange rate improves the international competitiveness of domestic goods and services, leading to higher exports and reduced imports. As a result, the trade balance improves, foreign currency inflows rise, and the central bank accumulates more reserves.

Domestic credit exerts a negative and strongly significant effect on foreign exchange reserves (coefficient = –0.367, p-value = 0.000). Expanding domestic credit can increase the money supply and stimulate import demand, thus weakening the balance of payments and reducing reserve holdings. This aligns with the predictions of the monetary approach, where excess domestic credit leads to external imbalances. The negative and strongly significant coefficient indicates that a 1% increase in domestic credit results in a 36.7% decrease in foreign exchange reserves. This finding supports the Monetary Approach to the Balance of Payments, which argues that expansionary credit policy increases the domestic money supply, leading to greater imports and a deterioration of the balance of payments. The highly significant p-value (0.000) reinforces the robustness of this relationship.

Table 6
Robustness Test

Variable	Method	Coefficient	Std. Error	p-Value
Real Interest Rate)	OLS	-0.039	0.020	0.062
	DOLS	-0.041	0.019	0.050
	FMOLS	-0.042	0.021	0.049
	CCR	-0.040	0.020	0.057
Economic Growth)	OLS	0.125	0.039	0.002
	DOLS	0.129	0.038	0.001
	FMOLS	0.128	0.037	0.001
	CCR	0.127	0.038	0.002
Real Exchange Rate (lnexr)	OLS	0.198	0.082	0.017
	DOLS	0.209	0.079	0.013
	FMOLS	0.215	0.084	0.013
	CCR	0.203	0.081	0.015
Domestic Credit (lncd)	OLS	-0.354	0.062	0.000
	DOLS	-0.365	0.060	0.000
	FMOLS	-0.367	0.065	0.000
	CCR	-0.359	0.063	0.000
Constant	OLS	11.121	0.918	0.000
	DOLS	11.212	0.904	0.000
	FMOLS	11.207	0.932	0.000
	CCR	11.180	0.910	0.000

Source: data processed

The robustness test aims to verify the consistency and reliability of the estimated long-run relationships between Indonesia's foreign exchange reserves and selected macroeconomic variables real interest rate, economic growth, real exchange rate, and domestic credit—by applying four different estimation techniques: Ordinary Least Squares (OLS), Dynamic OLS (DOLS), Fully Modified OLS (FMOLS), and Canonical Cointegrating Regression (CCR). The robustness test strongly supports the validity and consistency of the long-run model. All four estimation methods yield similar coefficient magnitudes, signs, and statistical significances, suggesting that the relationships among the macroeconomic variables and foreign exchange reserves are robust and reliable regardless of the chosen cointegration estimation technique. This enhances the credibility of the study's findings and provides solid ground for policy recommendations based on these relationships.

The discussion on the influence of real interest rates on foreign exchange reserves can be further explored by considering various monetary transmission mechanisms and the macroeconomic context of Indonesia. The negative coefficient of –0.042 in the FMOLS results indicates that a one percent increase in the real interest rate could reduce foreign exchange reserves by approximately 4.2 percent in the long run, assuming other variables remain constant. This highlights the crucial role of real interest rates in affecting capital flows, money demand, and a country's external stability. Theoretically, the monetary approach to the balance of payments (MABP) posits that an increase in real interest rates decreases foreign reserves by reducing demand for domestic money and disrupting monetary equilibrium (Mundell, 1968; Johnson, 1977). In the Indonesian context, high real interest rates are typically implemented in response to inflationary pressures or exchange rate instability. However, such

increases are often contractionary to economic activity, reducing money demand, which ultimately results in declining foreign exchange reserve accumulation (Purba, et al., 2023)

Moreover, high real interest rates may also generate a crowding-out effect on investment and consumption. When the private sector prefers to hold money rather than using it for productive activities, aggregate demand decreases, and exports may suffer due to higher production costs leading to reduced foreign exchange earnings from international trade (Puspita & Kurniawan, 2024). Over the long term, this condition can weaken the current account balance and narrow the room for reserve accumulation. These findings are consistent with Khan (2008), who analyzed Pakistan's foreign reserves using the MABP framework. His study found that interest rates negatively affect foreign reserves due to their close relationship with money demand and macroeconomic stability. He concluded that monetary authorities must exercise caution in setting interest rate policies, as such policies influence not only inflation and exchange rates but also have direct implications for reserve accumulation. In the global context, Aizenman & Marion (2004) warned that developing countries that aggressively raise interest rates to attract short-term capital may lose reserves more rapidly in the event of a sudden capital reversal. In other words, high interest rates may be counterproductive if not accompanied by strong economic fundamentals and political stability. Thus, these results offer a warning to policymakers in Indonesia that real interest rate hikes should be placed within a comprehensive macroeconomic framework. Excessively high real interest rates not only hinder domestic economic growth but also risk depleting the country's reserves through money demand and external transaction mechanisms. Therefore, a balance is needed between interest rate policy, inflation control, and external stabilization strategies such as exchange rate management and capital flow supervision.

The discussion on the impact of economic growth on foreign exchange reserves is particularly important for developing countries like Indonesia. The positive coefficient of 0.128 with a high level of statistical significance (p-value = 0.001) in the FMOLS results indicates that economic growth plays a vital role in strengthening Indonesia's reserve position. This means that a 1 percent increase in real economic growth, ceteris paribus, would raise foreign reserves by 12.8 percent. This relationship is highly logical when linked to various macroeconomic transmission channels. Strong economic growth is typically reflected in increased production and consumption activity, which directly leads to higher exports of goods and services. In Indonesia's case, sectors such as manufacturing, agriculture, and mining are key contributors to exports. Improved export performance naturally generates greater foreign exchange through international trade transactions, improving the trade balance and directly supporting reserve accumulation. Furthermore, stable growth fosters an attractive investment climate for foreign investors, boosting capital inflows in the form of Foreign Direct Investment (FDI) and portfolio investment both of which ultimately strengthen the reserve position. Strong economic growth also often signifies improvements in other macro variables, such as household consumption, government revenues, and reduced unemployment. When market confidence in the domestic economic outlook increases, it stabilizes exchange rate expectations and reduces pressure on capital outflows. As a result, foreign exchange reserves are preserved due to more controlled foreign currency demand from the private sector. In this regard, reserves reflect not only external sector performance but also the strength of the domestic economic structure. Masdjojo (2009) emphasized that Indonesia's economic growth both short and long term positively influences foreign reserves. His research explained that as real GDP increases, global demand for domestic products rises, boosting export value and reserve accumulation. These findings are reinforced by Azeem & Khurshid (2020), who studied Pakistan and found that economic growth significantly enhances reserves by strengthening export structures and increasing investment inflows. This relationship appears consistent across developing countries. Within the MABP framework, higher national income (reflected in economic growth) raises domestic money demand. If money supply remains constant, the increased demand results in a balance of payments surplus, which in turn increases foreign exchange reserves. Economic growth not only impacts the real sector but also serves as a crucial instrument for maintaining external balance. Policy implications are clear: the Indonesian government must continue promoting inclusive and sustainable growth as part of its strategy to strengthen reserve positions. Investments in infrastructure, improved export competitiveness, and stable macroeconomic policies are key to ensuring that growth translates into enhanced external capacity. Over the long term, such an approach will build resilience to external shocks and bolster global confidence in the Indonesian economy.

A further discussion on the influence of the real exchange rate on foreign exchange reserves is crucial, as this variable represents the relative price between domestic and foreign goods and heavily affects export competitiveness. In the FMOLS estimation results, the real exchange rate has a positive and statistically significant effect, with a coefficient of 0.215 and a p-value of 0.013. This suggests that every 1% depreciation in the real exchange rate (i.e., a real weakening of the rupiah against the US dollar) increases foreign exchange reserves by 21.5%, assuming other variables are held constant. Theoretically, a depreciation in the real exchange rate makes domestic goods relatively cheaper than foreign goods (Narayan & Smyth, 2006). This increases export competitiveness while simultaneously reducing dependence on imported goods especially non-capital consumer goods (Aizenman & Riera-Crichton, 2024). This is known as the expenditure switching effect, whereby global demand shifts from foreign to domestic products due to relatively lower prices. In Indonesia's context, this effect is particularly important given that exports of commodities such as palm oil, coal, and textiles are highly sensitive to global prices and exchange rate fluctuations. When the rupiah depreciates, exporters receive more rupiah per US dollar earned, thereby increasing the trade surplus and encouraging reserve accumulation.

This finding aligns with Agustina & Reny (2014), who showed that exchange rate depreciation promotes export growth and foreign currency earnings. Over the long term, increased exports due to depreciation result in a trade surplus, a key component in reserve accumulation. Similarly, Khan (2008) found that the real exchange rate positively contributes to strengthening foreign reserves in Pakistan through the current account channel. Furthermore, this result is consistent with the Bretton Woods 2 hypothesis (Dooley, Folkerts-Landau & Garber, 2003), which suggests that developing countries often strategically maintain undervalued or competitive exchange rates to stimulate exports, attract FDI, and accumulate reserves as a buffer against external shocks. In this framework, the exchange rate is not just a market-determined variable but also a macroeconomic policy tool aimed at ensuring external stability and fiscal and monetary credibility.

Nevertheless, the effect of real exchange rate depreciation on reserves must be managed carefully. Excessive or uncontrolled depreciation can cause domestic inflation, increase the burden of foreign debt, and erode household purchasing power. Therefore, a flexible yet guided exchange rate policy—such as Indonesia's managed floating regime—is essential to ensure that depreciation yields maximum benefit for reserves without compromising macroeconomic stability. In practical policy terms, this finding underlines the importance of maintaining a competitive yet stable real exchange rate. The government and monetary authorities can adopt policies to enhance foreign exchange market efficiency, reduce speculative interventions, and strengthen reserves through export and investment management. Healthy exchange rate-driven reserve accumulation can boost investor confidence, improve the country's credit rating, and create fiscal and monetary buffers to withstand future external pressures.

The influence of domestic credit on foreign exchange reserves within the Monetary Approach to the Balance of Payments (MABP) framework is highly relevant, as domestic credit reflects the form of monetary expansion carried out by the central bank and government to the domestic economy. FMOLS estimation results show that domestic credit has a negative coefficient of –0.367 and is significant at the 1% level (p-value = 0.000). This implies that a 1% increase in domestic credit could reduce reserves by 36.7%, ceteris paribus. This is a strong and statistically significant effect, supporting the predictions of MABP. Theoretically, MABP views the balance of payments as a reflection of money market disequilibrium. When the central bank or government increases domestic credit whether through deficit financing, public sector lending, or other monetary expansions it raises the money supply. If credit growth outpaces real money demand, excess liquidity emerges in the economy. Under a fixed or semi-flexible exchange rate regime, this surplus liquidity puts downward pressure on the domestic currency, triggers capital outflows, and eventually results in a balance of payments deficit, reducing foreign reserves.

This result is consistent with Irefin & Yaaba (2013) in Nigeria, who employed the ARDL approach and found that rising domestic credit significantly reduces reserves. They explained that spikes in domestic financing especially unproductive ones often increase pressure on the foreign exchange market due to higher demand for imports and conversion of domestic to foreign currency. In other words, monetary expansion not backed by economic productivity creates external pressures that weaken reserve positions. From a macroprudential perspective, when banks or monetary authorities

expand credit but a large portion is directed toward consumption or speculation, the effect on exports is limited. Instead, import demand rises, worsening the current account deficit. Moreover, market perception of overly loose monetary policy can trigger foreign portfolio capital outflows, further depleting reserves. From a policy standpoint, this finding sends a critical signal for monetary management in Indonesia. Bank Indonesia and fiscal authorities must ensure that credit expansion targets productive sectors, particularly those with import substitution or export enhancement potential. This approach would enable credit growth to generate both economic and external stability benefits. Furthermore, controlling consumer credit and strengthening macroprudential tools are crucial to prevent unnecessary widening of the balance of payments deficit.

CONCLUSION

The results confirm that all examined macroeconomic variables significantly influence foreign reserve accumulation in the long run. The real interest rate has a statistically significant negative effect, indicating that increases in real interest rates reduce reserve levels by discouraging domestic liquidity and capital inflows. Economic growth positively and significantly affects reserves, suggesting that expansion in the real sector enhances exports and investor confidence, leading to stronger reserve positions. The real exchange rate also shows a positive and significant relationship, highlighting the role of currency depreciation in improving trade competitiveness and export performance. Conversely, domestic credit exerts a negative and significant impact on reserves, supporting the MABP hypothesis that excessive credit expansion leads to external imbalances by increasing the money supply beyond demand.

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