

Analysis of Factors Affecting Foreign Exchange Reserves in Indonesia (2017-2021)

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Analysis of Factors Affecting Foreign Exchange Reserves in Indonesia (2017-2021)

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ABSTRACT

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This study aims to see the factors that affect foreign exchange reserves in Indonesia. The data is monthly time series data, starting from January 2017 to December 2021. Data is obtained from Bank Indonesia and the Central Bureau of Statistics. The purpose of this study is to determine how the influence of exchange rates, exports, BI rate, and consumer price index on foreign exchange reserves in Indonesia. The analysis tool is VECM (Vector Error Correction Model). The research finding is that the Consumer Price Index has a significant positive influence in the short term. The exchange rate in lag 1 and lag 3 did not have a significant effect, but in lag 2 had a significant negative effect. Export variables have a significant negative influence on all three lags. Bank Indonesia's variable interest rate at lag one and lag 2 has no significant effect, while lag 3 has a significant negative effect on foreign exchange reserves. The implication of this study is the importance of maintaining economic stability from external shocks in the form of rupiah exchange rate shocks because it has a major impact on the stability of foreign exchange reserves.

Keywords: Foreign Exchange Reserves, Exchange Rates, BI rate, Consumer Price Index (CPI), Vector Error Correction Model (VECM)

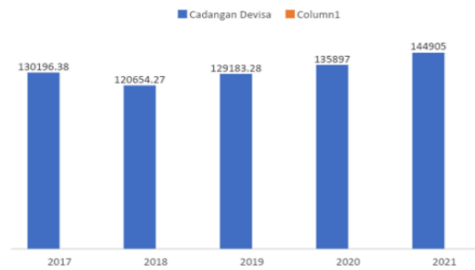
INTRODUCTION

Foreign exchange reserves are used as a measure of a country's economic strength to determine how much trade is carried out internationally. The term "foreign exchange" refers to the type of payment that can be used as a means of transaction on an international scale and in the form of gold, securities, and foreign currency. Foreign exchange reserves are defined by Dąbrowski (2021) as large-value liquid assets owned by a country whose value is recognized by global citizens and can be used as a legal currency in global transactions or payments.

A country may experience economic challenges as a result of the limited availability of foreign exchange reserves. The objective of foreign exchange reserves is to formulate and analyze national economic regulations so that the country can make balanced payments. As a significant factor in determining credit rights and public policy legitimacy, foreign exchange reserves also have the function of being a national shield against financial crisis problems. As a result, countries with foreign exchange reserves can qualify for loans, which keeps the country safe from foreign exchange reserves and maintains liquidity capacity to maintain exchange rate stability. In addition, having foreign exchange reserves also helps global trade. Foreign trade, whether in a direct or indirect manner, contributes to the economic development process by enhancing income, creating employment opportunities, boosting foreign exchange earnings, facilitating the influx of capital and technology from overseas, and fostering the growth of domestic industries or industrialization initiatives (Rachman in Rahayu, 2021).

Indonesia's fluctuating foreign exchange reserves make it difficult for Indonesia to make global payments and stabilize the exchange rate, resulting in a payment deficit and a depreciation of the rupiah. Frankel and Wei (2004) state that by managing its foreign exchange reserves, Bank Indonesia can carry out a number of foreign exchange operations and obtain loans. The quantity of foreign exchange reserves is determined by exports and imports, and global economic growth is strongly influenced by these two economic activities. Due to Indonesia's open economic structure, which means that its operational activities are always related to and cannot be separated from international interactions, Indonesia's economic development shows that Indonesia is increasingly linked to the global economy.

Figure 1. Data on Indonesia's Foreign Exchange Reserves for 2017-2021



Source: Bank Indonesia and the Indonesian Ministry of Trade

It appears that the value of Indonesia's reserves in 2017-2021 has increased, but in 2018 the value has decreased. Based on Indonesia's financial economic data for 2017 to 2021

regarding the growth of foreign exchange reserves, the value of foreign exchange reserves increased in 2017 by \$130,196.38 million and continued to increase until 2021, which unfortunately decreased by \$120,654.27 million in 2018. Indonesia's inability to make payments internationally and stabilized currency values in 2018 due to having the lowest foreign exchange reserves in the last five years, resulting in inflation as well as high interest rates. Foreign exchange reserves or commonly referred to as foreign exchange reserves are the amount of money held by a country in foreign currency, usually in US dollars, euros, Japanese yen and British pounds.

Foreign exchange reserves have several important functions for a country, including (1) Maintaining the stability of the country's currency exchange rate: Foreign exchange reserves are used to maintain the country's currency exchange rate so that it remains stable against foreign currencies. By having sufficient foreign exchange reserves, the country can buy or sell foreign currency to keep the country's currency exchange rate from fluctuating too much; (2) Meeting import needs: Foreign exchange reserves are also used to meet a country's import needs. By having sufficient foreign exchange reserves, the country can pay for the imported goods it needs without having to worry about running out of foreign currency; (3) Maintaining investor confidence: Large and fairly stable foreign exchange reserves can increase investor confidence in a country's economy. This can increase the interest of investors to invest in the country, so that it can encourage economic growth; and (4) Maintain financial system stability: Foreign exchange reserves can also be used to maintain the stability of a country's financial system. If a financial crisis occurs, foreign exchange reserves can be used to pay off foreign debt and minimize the impact of the crisis on the country's economy.

Thus, it can be concluded that foreign exchange reserves are very important for a country because they can provide protection against fluctuations in currency exchange rates, meet import needs, increase investor confidence, and maintain the stability of the country's financial system.

Foreign exchange reserves are an important indicator in measuring a country's economic stability. Therefore, it is important to study a country's foreign exchange reserves in order to understand macroeconomic conditions and potential risks that could affect its stability.

Indicators of Economic Health

Foreign exchange reserves can be an indicator of a country's economic health. Adequate and stable amounts of foreign exchange reserves indicate that the country is able to pay foreign debts, meet import needs, and maintain currency exchange rates. However, if foreign exchange reserves decline sharply, it could be a signal of risks affecting the country's economic stability.

Predictors of Financial Crises

Foreign exchange reserves can also be predictors of financial crises. If a country's foreign exchange reserves decline sharply, this can be an indication of the risk of a financial crisis. Therefore, a study of foreign exchange reserves can help countries to take preventive measures before a crisis occurs.

Influence on Monetary Policy

The amount of foreign exchange reserves can affect a country's monetary policy. If a country's foreign exchange reserves are excess, the central bank can expand liquidity by increasing the supply of domestic money supply. Conversely, if foreign exchange reserves decrease, the central bank needs to tighten monetary policy to maintain economic stability.

Impact on Currency Exchange Rates

Foreign exchange reserves can also affect a country's currency exchange rate. If a country's foreign exchange reserves are large enough, the currency exchange rate can remain stable or even strengthen. However, if foreign exchange reserves decrease, the currency exchange rate may depreciate.

Therefore, it is important to conduct a study of a country's foreign exchange reserves in order to understand macroeconomic conditions and risks that could affect the country's economic stability. Indonesia, a developing country, has made the export sector a crucial role in national development, the foreign exchange earned from export activities continues to increase the country's foreign exchange reserves and can strengthen the Indonesian economy. The government's efforts to obtain foreign exchange from other countries include making loans to other countries and carrying out natural resource export activities, where the money from these activities can then be used to increase funding for the country's development. Exports, BI rate, Consumer Price Index, and the exchange rate have an impact on foreign exchange reserves in this study.

LITERATURE REVIEW

The amount of a country's foreign exchange reserves, which are basically its national savings, is often influenced by capital flows and commercial activities (including exports and imports). Bank Indonesia buys, sells, and positions foreign currencies and other securities in cash or futures as part of the management of foreign exchange reserves. External assets that meet the liquidation requirements, are denominated in primary foreign currencies, are under the control of the monetary authority, and can be used immediately to handle international transactions, are foreign exchange reserves.

According to the International Monetary Fund (IMF), foreign exchange reserves refer to monetary assets owned by a country's central bank in the form of foreign currency that can be used to fulfill the country's international payment obligations (Krušković & Maričić, 2015). Foreign exchange reserves play a role as a tool to maintain monetary and financial stability of the country as well as provide sufficient liquidity in the face of potential economic and financial instability. Foreign exchange reserves may consist of internationally accepted foreign currencies, such as US dollars, euros, pounds sterling, Japanese yen, and other currencies. In addition, foreign exchange reserves can also include other financial instruments, such as foreign government securities, certificates of deposit, and special drawing rights (SDRs) issued by the IMF. A country's foreign exchange reserves are an important indicator in assessing the country's financial health and economic stability. Adequate foreign exchange reserves provide protection for the country against financial crisis risks, help maintain currency exchange rate stability, and meet foreign payment obligations.

The country's large foreign exchange reserves can guarantee sufficient liquidity in dealing with potential crises and to support global financial stability. Adequate foreign exchange reserves can provide protection against financial crisis risks, protect currency exchange rates, and maintain stability in international payments (Frankel, 2006). Obstfeld's findings underscore the importance of foreign exchange reserves in maintaining financial and economic stability, protection against financial crises, as well as the role of foreign exchange reserves in monetary policy and international economic relations (Obstfeld et al., 2010). There is a need for foreign exchange intervention by the central bank in maintaining currency exchange rate stability, sufficient foreign exchange reserves can give power to the central bank to intervene and prevent excessive fluctuations that are detrimental to the economy.

The existence of sufficient foreign exchange reserves can provide flexibility and room for central banks to implement effective monetary policy. Strong foreign exchange reserves can provide confidence to foreign investors and creditors, as well as increase a country's bargaining and negotiating power in global economic cooperation. Eichengreen emphasizes the importance of foreign exchange reserves in maintaining economic stability, protection against financial crises, diversification, and the role of the global financial system (Eichengreen et al., 2016; Eichengreen & Flandreau, 2010; Eichengreen & Gupta, 2015). These researches provide valuable insights into the management of foreign exchange reserves and the factors that influence countries' financial stability. The findings provide a better understanding of the role of foreign exchange reserves in economic stability, overcoming financial crises, the effect on trade and investment, and their impact on monetary policy. His research provides valuable insights into the importance of foreign exchange reserves and their implications in the global economic context (Chinn & Ito, 2006; Chinn & Frankel, 2008).

The use of foreign exchange reserves during the financial crisis period has a real impact in controlling financial crises, that countries with higher foreign exchange reserves tend to have a better ability to overcome financial crises and minimize their negative impact. Reinhart's findings highlight the importance of foreign exchange reserves in dealing with financial crises, their role in monetary policy, economic resilience, and their impact on overall economic policy (Malagon & Orbegozo, 2019). This research provides valuable insights into the role of foreign exchange reserves in maintaining the economic and financial stability of countries. Reinhart examines the role of foreign exchange reserves in increasing a country's economic resilience. The researchers found that sufficient foreign exchange reserves can provide a country with protection against external fluctuations and increase the country's ability to cope with economic pressures. Good policies in managing foreign exchange reserves can support economic stability and encourage long-term growth.

Exchange Rate Or Exchange

The exchange rate can be defined as the exchange rate of one currency against another, which reflects the relative price between the two currencies. The exchange rate reflects how many units of one currency are needed to buy one unit of another currency. The link between the exchange rate and foreign exchange reserves is that a country's currency will be more valuable and the government and society will be better prepared to carry out economic transactions when there are more foreign exchange reserves.

The relationship between the exchange rate or exchange rate and foreign exchange reserves is very close because foreign exchange reserves are used to maintain the stability of a country's currency exchange rate (Ali, 2014). The availability of sufficient foreign exchange reserves will give confidence to investors and market players that the country is able to pay its foreign debt and meet import needs. In this case, foreign exchange reserves can help prevent excessive fluctuations in currency exchange rates.

If a country's foreign exchange reserves are sufficient, the central bank can use foreign exchange reserves to buy foreign currency in sufficient quantities to maintain the stability of the country's currency exchange rate. This can reduce the demand for the country's currency and in the end can maintain or even increase the exchange rate of the country's currency. Conversely, if a country's foreign exchange reserves are depleted or exhausted, the central bank cannot use foreign exchange reserves to buy foreign currency and maintain currency exchange rate stability. This can cause the exchange rate of the country's currency to depreciate and potentially trigger a financial crisis.

Thus, it can be concluded that foreign exchange reserves have an important role in maintaining the stability of a country's currency exchange rate. The availability of sufficient foreign exchange reserves will give confidence to market participants and investors and help prevent excessive currency exchange rate fluctuations. Meanwhile, if foreign exchange reserves run low or run out, it can cause the country's currency exchange rate to depreciate and have the potential to trigger a financial crisis.

Rahim and Alam (2013) and Akdogan (2020) argue that the relationship between exchange rates and foreign exchange reserves are two sides of the same equation, currency exchange rates can affect foreign exchange reserves, and conversely, foreign exchange reserves can also affect currency exchange rates. . In terms of the effect of exchange rates on foreign exchange reserves, he stated that a strengthening currency (appreciating currency) can cause an increase in the country's foreign exchange reserves. When the exchange rate of a country's currency increases, it can increase the purchasing power of that currency and encourage capital inflows and foreign investment. This can lead to an increase in the country's foreign exchange reserves.

Appreciation or depreciation of currency exchange rates can have an impact on a country's foreign exchange reserves. If a country's currency strengthens (appreciating currency), it can affect the trade balance by making goods and services from that country more expensive on the international market so that exports can decrease, while imports can increase, which in turn can affect the country's foreign exchange reserves (Eichengreen et al., 2020; Obstfeld, 2013; Stiglitz, 2010).

Export

Export is an international trade operation that helps increase local demand, which encourages the expansion of a sizable manufacturing sector with strong social institutions and foundations. The relationship between exports and foreign exchange reserves is also very close because most of the foreign exchange reserves come from the country's exports. In this case, the greater the value of a country's exports, the greater the inflow of foreign exchange into the country which can increase foreign exchange reserves (Rahim et al., 2019). When a country exports, that country will get payment in foreign currency. The greater the value of a country's exports, the greater the potential for foreign exchange flows into the country and the greater the country's foreign exchange reserves. In addition, the higher the export value of a country, the greater its contribution to the country's economic growth. High economic growth can increase the confidence of investors and market players, which in turn can attract investment flows into the country and increase the country's foreign exchange reserves. Thus, it can be concluded that exports have an important role in increasing a country's foreign exchange reserves and economic growth. Exports have an important role in increasing a country's foreign exchange reserves, strong exports can generate significant foreign currency inflows, which in turn can strengthen foreign exchange reserves and support the country's economic stability (Cerutti et al., 2021; Suripto et al., 2022).

BI Rate

The BI rate is also interpreted as a policy in determining the value of interest rates set and issued by Bank Indonesia (Ramadhani & Nugroho, 2019). One of the functions of the BI rate is to maintain inflation stability, high inflation is indicated by an increase in the prices of goods and services in society. To control it, the government uses monetary policy by raising or lowering the BI rate reference rate.

The BI rate (or reference rate) is the interest rate set by a country's central bank to control interest rates on the domestic money market. The relationship between the BI rate and foreign exchange reserves is that the interest rate policy applied by the central bank can

affect foreign exchange inflows or outflows in a country. When the central bank increases the BI rate, this can increase interest rates on the domestic money market and attract foreign exchange flows into the country (Ismail et al., 2015; Surtpto et al., 2022). This happens because investors will be interested in investing in countries that offer higher interest rates, so that foreign exchange flows into the country increase and a country's foreign exchange reserves can increase.

Conversely, when the central bank lowers the BI rate, this can lower interest rates on the domestic money market and cause foreign exchange to flow out of the country. This is because investors will look for investment opportunities in other countries that offer higher interest rates, so that foreign exchange outflows from the country and foreign exchange reserves can be reduced. However, interest rate policy is not the only factor affecting foreign exchange reserves. Other factors such as exports, imports and foreign investment can also affect foreign exchange inflows and outflows in a country.

In practice, the central bank usually pays attention to the development of foreign exchange reserves in determining interest rate policy. If a country's foreign exchange reserves are low, the central bank can increase interest rates to attract foreign exchange flows into the country and increase foreign exchange reserves. Conversely, if a country's foreign exchange reserves are already high, the central bank can lower interest rates to encourage investment flows and strengthen economic growth. Interest rates can affect foreign exchange reserves through various channels, including foreign capital inflows, currency exchange rates, economic growth, and financial stability (Arslanalp et al., 2022).

Consumer Price Index

The CPI, according to the Central Statistics Agency, is an index that determines the average price change over a certain period of time from a set of prices for products and services purchased by residents and households during a certain period (Pohan et al., 2021). The various products and services are divided into seven categories, namely food; drink; cigarettes and tobacco; clothing; health; education, tourism and sports; as well as transportation and communication.

The Consumer Price Index (CPI) or inflation can affect a country's foreign exchange reserves in several ways: First, inflation can affect the purchasing power and bargaining power of a country's currency. When the inflation rate is high, the bargaining power of the country's currency decreases, so that the price of imported goods and services becomes more expensive and the outflow of foreign exchange increases. Conversely, if the inflation rate is low, then people's purchasing power will increase, so that exports increase and foreign exchange flows into the country also increase. Second, inflation can affect the reference interest rate set by a country's central bank. If the inflation rate is high, then the central bank tends to raise the benchmark interest rate to control inflation. However, an increase in the benchmark interest rate can make the country less attractive to investors and investment flows can decrease, thereby potentially affecting the flow of foreign exchange into the country and foreign exchange reserves of a country. Third, inflation can affect the prices of commodities exported by a country. If the inflation rate is high, then the price of commodities sold by a country can be more expensive and can increase the flow of foreign exchange into the country. Higher domestic interest rates can attract greater foreign capital inflows. If the interest rates offered are higher compared to other countries, this can encourage investors to invest in the country, which in turn can strengthen foreign exchange reserves (Cerutti et al., 2021; Eichengreen et al., 2020; Froyen et al., 1997; Krugman et al., 2017; Obstfeld, 2013). Setting interest rates by monetary authorities will strengthen foreign exchange reserves, appropriate

interest rate policies can contribute to strong economic growth and financial stability, which in turn can affect a country's foreign exchange reserves (Maddison, 2001).

RESEARCH METHOD

This study uses VECM to explain the research objectives. The Vector Error Correction Model (VECM) is a derivative of the Vector Autoregressive (VAR). With the exception of the stationarity test problem, the assumptions required are the same as those used for the VAR. VECM, which has a difference with VAR, should be stationary at the first difference level and all variables should have the same stationary or comparable properties, namely differentiation in the first derivative (first different) (Apergis et al., 2011; Bronzini & Piselli, 2009).

According to Cziráky and Gillman (2006), the determination of variables in the VECM research model used can be written using a number of econometric models. VECM is a multivariate model used to analyze the relationship between endogenous and exogenous variables. This model considers long-term effects (cointegration) and short-term effects (imbalance) between these variables. The following is the writing of an econometric model for VECM with the dependent variable on Indonesia's foreign exchange reserves (Y) and the independent variables on exchange rates (X1), exports (X2), BI rate (X3), as well as the consumer price index (X4):

$$\begin{aligned}\Delta Y_t &= \beta_1 \Delta Y_{t-1} + \beta_2 \Delta X_{1t-1} + \beta_3 \Delta X_{2t-1} + \beta_4 \Delta X_{3t-1} + \beta_5 \Delta X_{4t-1} + \varepsilon_{1t} \\ \Delta X_{1t} &= \gamma_1 \Delta Y_{t-1} + \gamma_2 \Delta X_{1t-1} + \gamma_3 \Delta X_{2t-1} + \gamma_4 \Delta X_{3t-1} + \gamma_5 \Delta X_{4t-1} + \varepsilon_{2t} \\ \Delta X_{2t} &= \delta_1 \Delta Y_{t-1} + \delta_2 \Delta X_{1t-1} + \delta_3 \Delta X_{2t-1} + \delta_4 \Delta X_{3t-1} + \delta_5 \Delta X_{4t-1} + \varepsilon_{3t} \\ \Delta X_{3t} &= \lambda_1 \Delta Y_{t-1} + \lambda_2 \Delta X_{1t-1} + \lambda_3 \Delta X_{2t-1} + \lambda_4 \Delta X_{3t-1} + \lambda_5 \Delta X_{4t-1} + \varepsilon_{4t}\end{aligned}$$

Where:

ΔY_t : variable foreign exchange reserves Million USD data obtained at Bank Indonesia

ΔX_{1t} , ΔX_{2t} , ΔX_{3t} , ΔX_{4t} : independent variables at time t

$\Delta X_{4t} = \theta_1 \Delta Y_{t-1} + \theta_2 \Delta X_{1t-1} + \theta_3 \Delta X_{2t-1} + \theta_4 \Delta X_{3t-1} + \theta_5 \Delta X_{4t-1} + \varepsilon_{5t}$

ε_{1t} , ε_{2t} , ε_{3t} , ε_{4t} , ε_{5t} : error in each equation

β_1 , β_2 , β_3 , β_4 , β_5 : coefficients for the dependent variable at time t-1

γ_1 , γ_2 , γ_3 , γ_4 , γ_5 : coefficients for the independent variable X1 at time

t-1

δ_1 , δ_2 , δ_3 , δ_4 , δ_5 : coefficients for the independent variable X2 at time

t-1

λ_1 , λ_2 , λ_3 , λ_4 , λ_5 : coefficients for the independent variable X3 at time

t-1

θ_1 , θ_2 , θ_3 , θ_4 , θ_5 : coefficients for the independent variable X4 at time

t-1

In the model above, there are two simultaneous equations, each of which connects the change vectors of endogenous and exogenous variables in period t with variables in the previous period (t-1). The cointegration coefficient matrix β shows the long-term relationship between variables, while the error correction coefficients α_1 and α_2 measure the speed of adjustment of endogenous and exogenous variables to errors in cointegration.

Before applying the Vector Error Correction Model (VECM) estimation, it is necessary to apply a number of steps that must be passed including the data stationarity test (unit root test), determining the optimal lag length, VAR stability test, degree of cointegration test, granger causality test. After the data has been estimated using VECM, then the analysis can be continued using the impulse response function (IRF) and variance decomposition

(VD) methods. Steps to carry out Vector Error Correction Model (VECM) analysis are as follows.

Firstly, Data Stationarity Test (Unit Root Test) to test data stationarity or perform unit root tests using the Augmented Dickey-Fuller (ADF) test, Phillips-Perron (PP) test, and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. After the time series data is stationary, cointegration testing is carried out between the variables involved. Cointegration testing can be done using the Engle-Granger test or the Johansen test. By using a test known as the Augmented Dickey Fuller Test (ADF), Dickey and Fuller developed and further tested this unit root test (Mills, 2011).

The test phase continues to determine the optimal lag length, in a VECM model. Referring to Florens et al. (2007) who argue that estimation using the Vector Autoregressive (VAR) model is very dependent on the duration of the lag (Basuki & Prawoto). The Vector Error Correction Model (VECM) lag length test model can be performed using information criteria such as the Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan Quinnon (HQ). These three criteria are used to select the optimal lag length in the VECM model.

$$\text{VECM}(p) : \Delta Y_t = \pi Y_{t-1} + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \dots + \Gamma_p \Delta Y_{t-p} + \epsilon_t$$

The VECM stability test is used to check whether the autoregressive coefficient in the VECM model is stable or not. Methods that can be used to test the stability of the VECM model include: Trace Test and Maximum Eigenvalue Test. This method tests whether there is cointegration in panel data. The Trace test tests the hypothesis.

Impulse Response Function (IRF) analysis can also be performed on the Vector Error Correction Model (VECM). VECM is an econometric model used to analyze long-run relationships between two or more variables in time. In VECM, IRF is used to measure the impact of changing variables within a certain period of time. The IRF matrix shows the change in the value of a variable in time based on the number of standard deviations of the shock given to one particular variable. The influence of disturbance by one standard error to innovation by one endogenous variable over other endogenous variables can be traced using IRF analysis.

Variance Decomposition (VD) analysis is a technique in econometric analysis used to measure how much variation in a variable is explained by other variables in the model. This technique is very useful in understanding the relationship between variables in the model and identifying which variables contribute the most to explaining the variation of a variable. In the VAR model, the Forecast Error Variance Decomposition (FEVD) or also known as the forecasting error variance decomposition, reveals and communicates innovation in one variable to other variable components. The information in the FEVD is the percentage of coherent movement that might be due to the shock of the variable in question or to other variables, according to Millia et al. (2021).

RESULTS

The first step in calculating the results of a times series data aimed at testing its stationarity is to apply the root test. The root test uses Augmented Dickey Fuller (ADF) through the first stage of the level test. If it is not stationary because the probability value is above 0.05, then the next first different test is carried out which has a probability of less than 0.05, at which time it can be declared stationary so that it is continued to the next test stage.

Table 1. Unit Root Test – Augmented Dickey-Fuller (ADF)

No	Variable	Probability		Description	
		Level	First Different	Levels	First Different
1	Indonesia's Foreign Exchange Reserves (Y)	0.7588	0.0000	Not Stationary	Stationary
2	The Exchange Rate (X1)	0.0353	0.0000	Stationary	Stationary
3	Exports (X2)	0.4288	0.0000	Not Stationary	Stationary
4	The BI Interest Rate (X3)	0.9184	0.0000	Not Stationary	Stationary
5	The Consumer Price Index (X4)	0.7306	0.0000	Not Stationary	Stationary

Source: Eviews estimation results (data processed), 2022

Table 1 shows that foreign exchange reserves, exports, BI rate, and CPI are not stationary on the level test, as shown by the test results above. This is supported by a probability value above 0.05. A probability value below 0.05 indicates that the exchange rate variable is stationary or passes the level test. It was concluded that all variables, foreign exchange reserves, exchange rates, exports, BI rate, and CPI, stated stationary results at the first difference with a significance level of 0.05, in line with the results of the root test on the first difference test.

Test Lag Length Criteria

This test is run to determine the optimal lag length. The criteria used to determine the ideal lag length refer to the Likelihood Ratio (LR), Final Prediction Error (FPE), and Akaike Information Criterion (AIC) criteria. In this study, the sequential modified LR test statistic criterion was used to determine the ideal lag. The table below shows that the lag obtained is lag 3 and is declared the most stars.

Table 2. Lag Length Criteria Test

Lag	LogL	LR	FPE	AIC
0	-1830.644	NA	1.26e+25	71.98604
1	-1810.741	35.12357	1.55e+25	72.18591
2	-1776.196	54.18821	1.10e+25	71.81159
3	-1740.284	49.29078*	7.70e+24*	71.38368*

Var Stability Test

The VECM stability test is run to determine whether the selected variable is stable or not. The modulus criterion of all root values is less than 1, indicating that the variable is said to be stable. The findings from IRF and vector decomposition tests are invalid if the test results are unstable. The table below provides specific information regarding the VECM stability test in this study.

Table 3. VECM Stability Test

Unit Root	Modulus
0.598062	0.598062
-0.490660	0.490660
-0.202425 - 0.436791i	0.481416
-0.202425 + 0.436791i	0.481416
-0.025597 - 0.459514i	0.460227
-0.025597 + 0.459514i	0.460227
-0.268119 - 0.280255i	0.387854
-0.268119 + 0.280255i	0.387854
-0.025777 - 0.104763i	0.107888
-0.025777 + 0.104763i	0.107888

Source: Eviews estimation results (data processed), 2022

From Table 3, it shows that the VECM test results are stable. So that the data can be forwarded to the next stage. This is obvious if the modulus of all root values is less than 1.

Cointegration Test

Cointegration test to ascertain whether the research variables can complete the integration process requirements or not. The Johansen Trace Statistics test technique is used for the cointegration test, as can be seen from the findings in the table. By adjusting the cointegration ranking with the number of systems of equations that can describe all available systems, long-term information can be obtained. Cointegration test criteria are based on trace statistics. Cointegration is said to occur if the trace statistic value is above the 5% threshold value required for the alternative hypothesis that the cointegration amount is accepted. Proven cointegration, can pass to VECM steps. Therefore, VECM cannot be forwarded if it is not found.

Table 4. Cointegration Test Results (Johansen Cointegration Test)

Hypothesized No. of CE (s)	Eigenvalue	Test (Trace)			Test (Maximum Eigenvalue)		
		Trace Statistic	0,05 Critical Value	Prob.**	Max- Eigen Statistic	0,05 Critical Value	Prob.**
None *	0.559697	112.5391	69.81889	0.0000	40.19427	33.87687	0.0077
At most, 1 *	0.505857	72.34486	47.85613	0.0001	34.54154	27.58434	0.0054
At most, 2 *	0.325935	37.80332	29.79707	0.0049	19.32698	21.13162	0.0878
At most, 3 *	0.274467	18.47634	15.49471	0.0172	15.72159	14.26460	0.0292
At most 4	0.054668	2.754744	3.841466	0.0970	2.754744	3.841466	0.0970

Source: Eviews estimation results (data processed), 2022

The value of the trace statistic is above the critical value of 5%, so that the rank test cointegration test indicates the existence of cointegration in long-term securities with a value in accordance with the specified requirements. As a consequence of the findings of the cointegration test, it can be concluded that the variables of foreign exchange reserves, exchange rates, exports, the BI rate, and the CPI have a relationship to stability or balance and the similarity of long-term movements. To achieve long-term balance, all variables have a tendency to adapt in each short-term period.

Granger Causality Test

The Granger Causality Test uses Pairwise Granger Causality and has a threshold of 0.05. Details of the Granger Causality Test results can be seen in table 5.

Table 5. Granger Causality Test

Null Hypothesis	Obs	Probability	F-Statistics
EXCHANGE RATE does not Granger Cause FOREIGN EXCHANGE RESERVES	53	0.72481	0.5424
FOREIGN EXCHANGE RESERVES does not Granger Cause EXCHANGE RATE		0.37016	0.7749
EXPOR does not Granger Cause FOREIGN EXCHANGE RESERVES	57	0.14130	0.9348
FOREIGN EXCHANGE RESERVES does not Granger Cause EKSPOR		3.70950	0.0174
BI_RATE does not Granger Cause FOREIGN EXCHANGE RESERVES		0.47957	0.6979
FOREIGN EXCHANGE RESERVES does not Granger Cause BI_RATE		3.13065	0.0337
CPI does not Granger Cause FOREIGN EXCHANGE RESERVES		7.75576	0.0002
FOREIGN EXCHANGE RESERVES does not Granger Cause IHK		0.77780	0.5119
EKSPOR does not Granger Cause EXCHANGE RATE	53	0.76565	0.5192
EXCHANGE RATE does not Granger Cause EKSPOR		0.10820	0.9549
BI_RATE does not Granger Cause EXCHANGE RATE		0.35243	0.7876
EXCHANGE RATE does not Granger Cause BI_RATE		0.89546	0.4507
CPI does not Granger Cause EXCHANGE RATE		25.6066	7.E-10
EXCHANGE RATE does not Granger Cause IHK		0.08388	0.9685
BI_RATE does not Granger Cause EKSPOR	57	1.91617	0.1389
EKSPOR does not Granger Cause BI_RATE		1.42110	0.2476
IHK does not Granger Cause EKSPOR		0.70512	0.5535
EKSPOR does not Granger Cause IHK		0.14848	0.9302
IHK does not Granger Cause BI_RATE		1.94723	0.1340
BI_RATE does not Granger Cause IHK		0.16559	0.9191

Source: Eviews estimation results (data processed), 2022

Table 5 contains the findings of the Granger Causality test through Pairwise Granger Causality which shows that a number of the variables used have a causal relationship because there is a one-way relationship compared to a two-way relationship and the probability value is below 0.05. This finding states that the data can be used to test the VECM and indicates that a number of variables do not have a causal relationship because the probability value is above 0.05.

VECM Test

The Vector Error Correction Model (VECM) is a type of Vector Autoregression (VAR) in which it is designed to be used on non-stationary data that is shown to have a cointegration relationship. VECM analysis is used to understand the effects of long and short term influences on the observed variables. The VECM estimation results are summarized in Table 6.

Table 6. Short-Term VECM Estimation

Variable	Coefficient	t-statistic	Relationship	Description
D(EXCHANGE RATE(-1))	-2.032837	-1.28441	Negative	Not Significant
D(EXCHANGE RATE(-2))	-1.929300	-1.74138	Negative	Significant
D(EXCHANGE RATE(-3))	-1.289772	-1.38463	Negative	Not Significant
D(EKSPOR(-1))	-0.042824	-2.14110	Negative	Significant
D(EKSPOR(-2))	-0.032130	-2.07247	Negative	Significant
D(EKSPOR(-3))	-0.018881	-1.82954	Negative	Significant
D(BI RATE(-1))	-20.73381	-1.00703	Negative	Insignificant
D(BI RATE(-2))	-21.60997	-1.15020	Negative	Not Significant
D(BI RATE(-3))	-37.59303	-1.87868	Negative	Significant
D(IHK(-1))	151.6232	2.02508	Positive	Significant
D(IHK(-2))	340.8895	4.05084	Positive	Significant
D(IHK(-3))	-245.0686	-1.90202	Negative	Significant
R ² =0.611834				
t-table=1.654				

Source: Eviews estimation results (data processed), 2022

Referring to table 6, the effect of the Regression Exchange Rate variable in the table states that in the short term the lag 1 exchange rate variable has an insignificant effect on foreign exchange reserves because the t-statistic value is less t-table as much as $-1.28441 < 1.645$. The t-statistic value above the t-table in lag 2 is $-1.74138 > 1.645$ where the exchange rate variable has a significant influence on foreign exchange reserves. The t-statistic value is less than the t-table meaning that the lag 3 exchange rate variables do not have a significant effect on foreign exchange reserves of $-1.38463 < 1.645$. The three lags indicate a negative relationship, because the resulting coefficients are 2.032837, -1.929300, and -1.289772. This means that the exchange rate has a non-significant negative effect on foreign exchange reserves in lag 1 and lag 3, while in lag 2 the exchange rate has a significant negative effect.

Export Variables Table 6 states that the short-term export variable lag 1 has a significant effect on foreign exchange reserves because the t-statistic value above the t-table is $-2.14110 > 1.645$. Lag 2 the export variable has a significant influence on foreign exchange reserves because the t-statistic value above the t-table is $-2.07247 > 1.654$. Lag 3 variable exports have a significant influence on foreign exchange reserves because the value of the t-statistic above the t-table is $-1.82952 > 1.654$ and indicates a negative relationship in the three lags because the coefficient values are -0.042824, -0.032130, and -0.018881, meaning that exports have an influence negative significance to foreign exchange reserves.

The BI rate variable in Table 6 indicates that in the short term the BI rate lag variables 1 and 2 have an insignificant effect on foreign exchange reserves because the t-statistic values are less t-table, namely $-1.00703 < 1.654$ and $-1.15020 < 1.654$. While lag 3 the BI rate variable has a significant influence on foreign exchange reserves because the t-statistic value above the t-table is $-1.87868 > 1.654$ and indicates a negative relationship between the three lags because the coefficient values are -20.73381, -21.60997, and -37.59303. This means that lags 1 and 2 of the BI rate have an insignificant negative effect on foreign exchange reserves, while lag 3 of the BI rate has a significant negative effect on foreign exchange reserves.

The Consumer Price Index (CPI) variable in Table 6 states that the short-term lag 1 CPI variable has a significant effect on foreign exchange reserves because the t-statistic above the t-table is $2.02508 > 1.654$. Lag 2 the CPI variable has a significant influence on foreign exchange reserves due to the t-statistic above from the t-table which is $4.05084 > 1.654$. The lag 3 CPI variable has a significant effect on foreign exchange reserves due to the above t-statistics from t-table $-1.90202 > 1.654$ and the coefficient values are 15.232, 340.8895, and -245.0686, meaning that lag 1 and lag 2 CPI have a significant positive effect on foreign exchange reserves, while lag 3 CPI has a significant negative effect on foreign exchange reserves.

Table 7. Long-Term VECM Estimation Results

Variable	Coefficient	t-Statistics	Relation
EXCHANGE RATE(-1)	4.540127	3.21461	Positive
EKSPOR(-1)	-0.147934	-8.27364	Negative
BI RATE(-1)	-15.11509	-1.18288	Negative
IHK(-1)	469.4345	5.67386	Positive
R ² =0.611834			
t-Table =1. 654			

Source: Eviews estimation results (processed data), 2022

The long-term VECM estimation results are summarized in Table 7. The long-term effect of exchange rate variables according to Table 7 states that long-term exchange rate variables have a significant effect on foreign exchange reserves because the t-statistic value above the t-table is $3.21461 > 1.654$ and has a positive relationship because the coefficient value is 4.540127. This means that the exchange rate has a significant and positive influence on foreign exchange reserves, which when the exchange rate increases by one unit, this will increase foreign exchange reserves by 4.540127.

The long-term effect of Export Variables in Table 7 regression states that the export variable has a significant long-term impact on foreign exchange reserves because of the t-statistic above the t-table, or $-8.27364 > 1.654$, and because of the negative coefficient value (-0.147934). This indicates that exports have a significant negative effect on foreign exchange reserves, so that when exports decrease by one unit, foreign exchange reserves will increase by -0.147934.

The long-term influence of the BI rate variable in Table 7 states that the long-term BI rate variable has an insignificant effect on foreign exchange reserves because the t-statistics value is less than t-table as much as $-1.18288 < 1.654$ and has a negative relationship because the coefficient value is -15.11509. This means that the BI rate has no effect and has a negative relationship to foreign exchange reserves, so if the BI rate drops by one unit, it will increase foreign exchange reserves by -15.11509.

The long-term Consumer Price Index is shown in Table 7, stating that the long-term CPI variable has a significant influence on foreign exchange reserves because the t-statistic above the t-table is $5.67386 > 1.654$ and has a positive relationship because the coefficient value is 469.4345. This means that the CPI has a significant and positive effect on foreign exchange reserves, so that when the CPI rises by one unit, it will increase foreign exchange reserves by 469.4345.

Impulse Response Function (IRF)

The effect of shocks on variables in other variables is explained by Impulse Response Function (IRF) analysis, in which this analysis does not only test the short term, but can also some time in the future as long-term information. If there is a specific shock of one

standard error in each equation, this analysis can examine the long-term dynamic reaction of each variable. IRF also helps determine how long these effects last. The vertical axis shows the response value as a percentage, while the horizontal axis shows the duration in years

The effect of foreign exchange reserves on the foreign exchange reserves themselves is presented in Figure 2.

Figure 2. IRF Foreign Exchange Reserves to Foreign Exchange Reserves

Response to Cholesky One S.D. Innovation

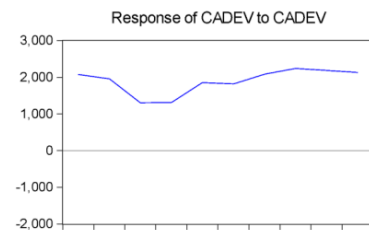
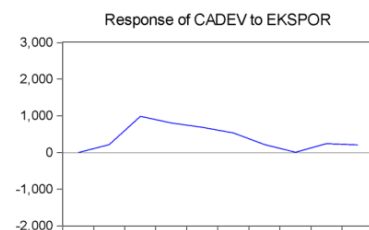


Figure 2 shows that the foreign exchange reserve variable is above the horizontal line in the graph above according to the results of the Impulse Response Function (IRF) on foreign exchange reserves indicating a positive trend in this variable. This is due to foreign exchange reserves fluctuating, up and down from the second period to the tenth period, changing lines and making it possible to adjust the impact of shocks to changes in past foreign exchange reserves alone.

Changes in foreign exchange reserves due to exchange rate changes can be seen in Figure 3 below.

Figure 3. IRF Foreign Exchange Reserves to Exchange Rate Results

Response to Cholesky One S.D. Innovation



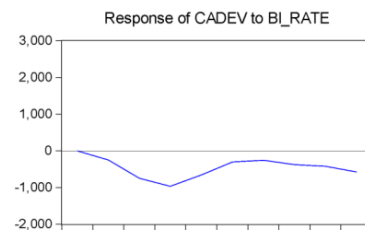
Based on IRF findings, the foreign exchange reserve variable responds to exchange rate variable shocks as shown in the graph in Figure 3. The first period to the fourth period of the response shows a decrease indicating a negative trend, the fourth to the eighth period the response shows an increase indicating a positive trend, and the eighth period

until the tenth period the response shows a decrease indicating a negative trend. Thus, it can be concluded that the reaction of the variable foreign exchange reserves to variable exchange rate shocks has a negative trend because changes in line fluctuations on the graph indicate a decrease which leads to a negative trend statement and tends to move away from the long-term balance point.

The volatility of changes in foreign exchange reserves due to changes in exports is presented in Figure 4.

Figure 4. Foreign Exchange Reserves to BI_RATE

Response to Cholesky One S.D. Innovation

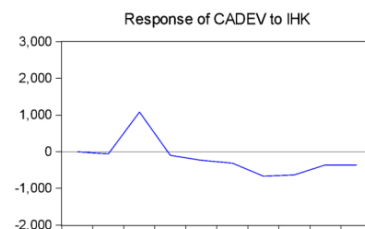


Based on IRF findings, the foreign exchange reserve variable responded to the shock of the BI rate variable as shown in the graph above, decreased from the first to fourth period indicating a negative trend, increased from the fourth to sixth period indicating a positive trend, and decreased from the eighth to tenth period, which indicates a negative trend. Thus, it can be concluded that the reaction of the foreign exchange reserve variable to the BI rate variable shock has a negative trend caused by fluctuations in the line on the changing chart which indicates a decrease, which can be said to have a negative trend.

Changes in foreign exchange reserves due to changes in the consumer price index are presented in Figure 5.

Figure 5. IRF Foreign Exchange Reserves to CPI

Response to Cholesky One S.D. Innovation



The graph in Figure 5 illustrates how the foreign exchange reserve variable responds to CPI variable shocks according to the results of the Impulse Response Function (IRF).

From the first period to the second period there was a decline indicating a negative trend, from the second to the fourth period there was an increase indicating a positive trend, from the fourth to the eighth period there was a decrease in the chart indicating a negative trend, and an increase from the fourth period to the eighth period which indicated a negative trend. indicating a positive trend.

Variance Decomposition Test

Measuring the effect of each independent variable on the dependent variable is the aim of the variance decomposition.

Table 8. Decomposition Variant Results

No	SE.	Foreign Exchange Reserves	Exchange Rate	Export	BI Rate	CPI
1	2075.513	100.000	0.000000	0.000000	0.000000	0.000000
2	3015.019	89.88829	8.872520	0.515575	0.682417	0.041195
3	3950.834	63.37570	18.48309	6.596102	4.020073	7.525042
4	4713.950	52.28152	27.80137	7.570354	7.023226	5.323526
5	5357.035	52.55643	28.67589	7.527063	6.922141	4.318468
6	5833.579	54.04901	28.72656	7.195362	6.101509	3.927561
7	6366.695	56.09476	28.08166	6.158001	5.280929	4.384652
8	6951.880	57.47171	28.13600	5.165210	4.728018	4.499064
9	7472.633	58.33394	28.56667	4.575166	4.406334	4.117891
10	7962.775	58.54067	29.12311	4.099010	4.412239	3.824977

Source: Eviews estimation results (data processed), 2022)

Based on Table 8, it is concluded that the findings of the Variance Decomposition (VD) Test above, it is clear that each variable used in this study, namely the exchange rate, exports, BI rate, and CPI, has a contribution of varying values in each period on foreign exchange reserves variable. This applies to each period starting from the first period to the tenth period.

DISCUSSION

Short Term VECM estimates show that the exchange rate variable has no negative effect on foreign exchange reserves at lag 1, lag 2 and lag 3, this shows that changes in the exchange rate are not accompanied by changes in inward investment and tend to be followed by an increase in imports. This situation shows that the appreciation of the Rupiah does not encourage foreign capital inflows, and the depreciation of the Rupiah does not encourage an increase in exports. An increase in the value of the dollar was followed by an increase in imports of goods, thereby reducing foreign exchange reserves (Islami & Rizki, 2018; Jalunggono, 2020) shows that exchange rates affect foreign exchange reserves through changes in external variables such as exports and imports that have a direct impact on foreign exchange reserves. This is also driven by the influence of the exchange rate which has a significant negative influence. at Lag 3.

The export variable has a significant influence on reserves, both lag 1, lag 2 and lag 3. Export is a variable that triggers an increase in foreign exchange reserves, an increase in exports will increase foreign exchange reserves, showing that net exports during the study increased. Astuty's research (2020) found that exports have a positive effect on foreign exchange reserves through net export inputs. The increase in net exports boosted foreign exchange additions. Akbar and Alhadif's study (2021) found that exports have a positive effect on economic growth. High economic growth will have an impact

on increasing foreign exchange reserves through capital inflows due to increasing foreign confidence in the domestic economy.

The BI rate lag 1 and 2 variables have an insignificant influence on foreign exchange reserves, but lag 3 is significant. Changes in government policy through interest rates can support an increase in foreign exchange through changes in international assets and capital markets. Changes in interest rates are followed by changes in the asset portfolio of international assets that are responsive to interest rates. Suropto et al. (2021) found that monetary policy through changes in Bank Indonesia's interest rate will have an impact on increasing foreign capital through stock market portfolios and increasing export demand.

In the short term, the consumer price index (CPI) variables lag 1 and lag 2 have a significant positive influence on foreign exchange reserves, while lag 3 has a significant negative influence. Changes in CPI indicate changes in inflation. Changes in inflation in the short term will be followed by an increase in foreign exchange reserves but in the long term it will reduce foreign exchange reserves. The decline in foreign exchange reserves occurred due to a decrease in incoming foreign investment and an increase in imports of goods to reduce inflation. Hasan and Sun'an (2020) found that inflation has an impact on increasing poverty. Findings from Suropto and Istanti (2021) revealed that the existence of inflation has an impact on meeting the food needs of the community which has an impact on policies to control basic needs sourced from imported goods. The increase in imports has an impact on decreasing foreign exchange reserves.

Long Term VECM Estimation Results show that the export variable has a significant negative influence on foreign exchange reserves, so that when exports decrease, foreign exchange reserves will rise and fall. Economically, exports are a variable that has a direct effect on foreign exchange reserves. The BI rate has no influence and has a negative relationship on foreign exchange reserves, meaning that monetary instruments through changes in the BI rate have no impact on foreign exchange reserves. The exchange rate has a significant and positive influence on foreign exchange reserves, where when the exchange rate increases by one unit, this will increase foreign exchange reserves. The exchange rate affects foreign exchange reserves through exports and imports. From reading the description of the findings of the Variance Decomposition (VD) Test, it shows that each variable used in this research, namely the exchange rate, exports, BI rate and CPI variables, has a varying value contribution in each period to the foreign exchange reserves variable. This applies to every period starting from the first period to the tenth period. Changes in foreign exchange reserves take time to reach long-term balance. The time period to change the shock of change is approximately 3 months.

CONCLUSION

This study aims to analyze the factors affecting foreign exchange reserves in Indonesia. This study used 59 observational data. Based on the Root Unit test, it shows that the Foreign Exchange Reserve Variable, Export, BI Rate, and Consumer Price Index Variable are not stationary at degree 1, at the second degree all variables are stationary. Referring to the findings of the short-term test of the Vector Error Correction Model (VECM), it can be concluded that the Consumer Price Index Variable in lag 1 and lag 2 has a significant positive effect. The exchange rate variable is not significant in lag 1 but in lag 2 it has a negative and significant effect. The Export variable has a negative and significant effect on all three lags. The variable BI Rate in lag 1 and lag 2 has a negative and significant effect, while in lag 3 it has a negative and significant effect. The findings of the long-term Vector Error Correction Model (VECM) test can be concluded that both the exchange rate and the consumer price index have a significant influence on foreign

exchange reserves. While the BI Rate variable has a negative and insignificant effect on foreign exchange reserves, while the Export Variable has a significant negative effect on foreign exchange reserves.

From these findings, it is recommended to maintain exchange rate stability to maintain the stability of foreign exchange reserves. With a stable exchange rate, it will affect long-term economic expectations through foreign investor confidence and the capital market. Exchange rate stability also has an impact on the short-term economy through improved export performance, which in turn will strengthen foreign exchange reserves. Another suggestion is that monetary policy through changes in Bank Indonesia's interest rate needs to refer to the short-term economy by trying to stabilize the rupiah exchange rate which will have an impact on economic growth. Economic stability through changes in interest rates is also suggested to affect macroeconomic variables that have an impact on maintaining domestic price level stability which is reflected in the consumer price index.

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N/A

DECLARATION OF CONFLICTING INTEREST

There is no personal relationship or affiliation with any individual or organization that could create a conflict of interest or bias the results of this research.

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