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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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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)

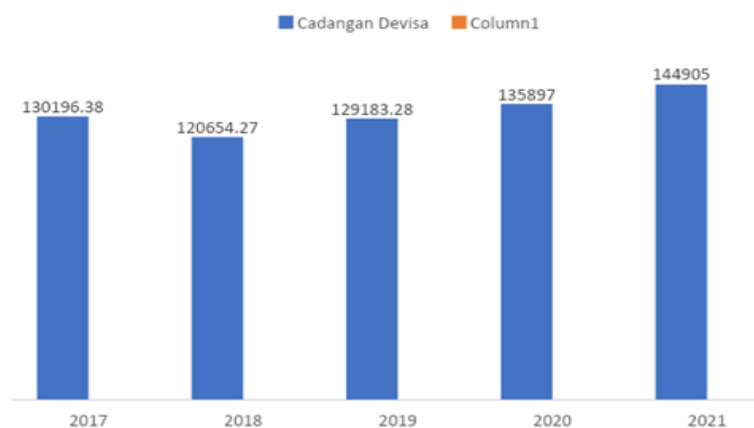
INTRODUCTION

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; Suropto 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; Suropto 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

$\Delta X_{1t}, \Delta X_{2t}, \Delta X_{3t}, \Delta X_{4t}$: independent variables at time t

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

$\varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t}, \varepsilon_{4t}, \varepsilon_{5t}$: error in each equation

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$: coefficients for the dependent equation at time t-1

$\gamma_1, \gamma_2, \gamma_3, \gamma_4, \gamma_5$: coefficients for the independent variable X1 at time t-1

$\delta_1, \delta_2, \delta_3, \delta_4, \delta_5$: coefficients for the independent variable X2 at time t-1

$\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5$: coefficients for the independent variable X3 at time t-1

$\theta_1, \theta_2, \theta_3, \theta_4, \theta_5$: 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.

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

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		0.76565	0.5192
EXCHANGE RATE does not Granger Cause EKSPOR	53	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 leg 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 leg 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 $-2.14110 > 1.645$. Leg 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 151.6232, 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
R2 =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 on 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

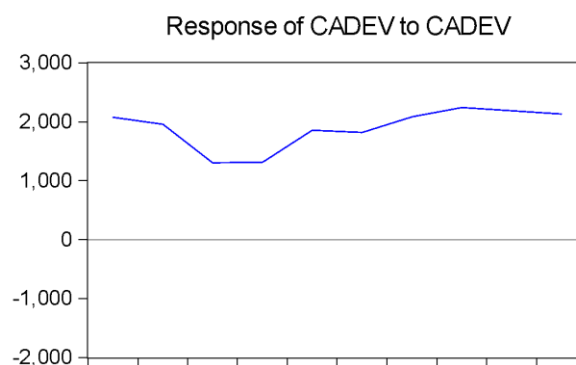
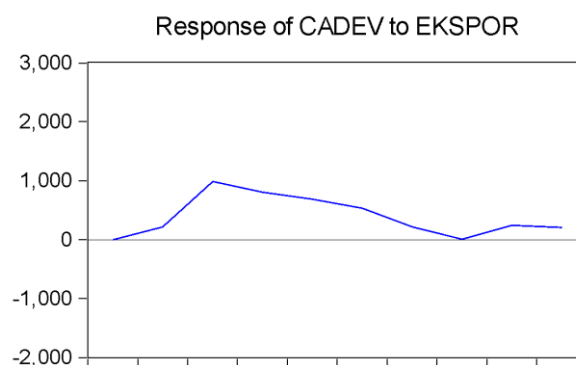


Figure 2 shows that the foreign exchange reserve variable is above the horizontal line in the graph above according to the results of the Impulse Response Function (IRF) on foreign exchange reserves indicating a positive trend in this variable. This is due to foreign exchange reserves fluctuating, up 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

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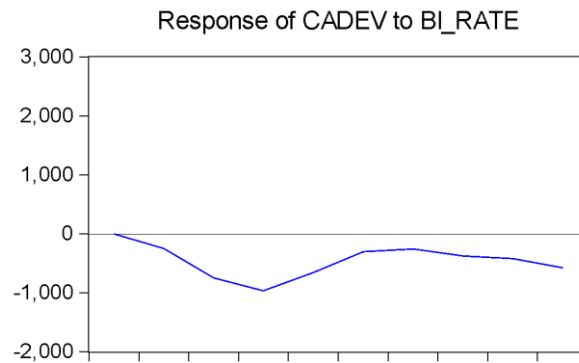
Based on IRF findings, the foreign exchange reserve variable responds to exchange rate variable shocks as shown in the graph in Figure 3. The first period to the fourth period of the response shows a decrease indicating a negative trend, the fourth to the eighth period the response shows an increase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

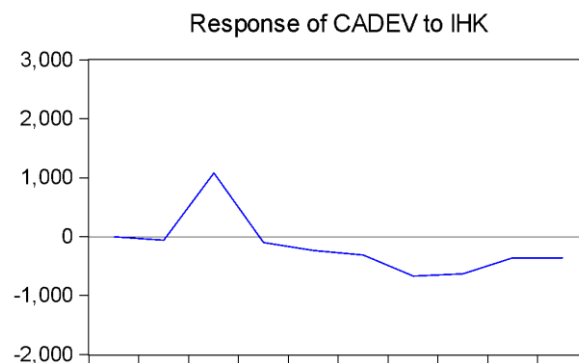


Based on IRF findings, the foreign exchange reserve variable responded to the shock of the BI rate variable as shown in the graph above, decreased from the first to fourth period indicating a negative trend, increased from the fourth to sixth period indicating a positive trend, and decreased from the 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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ANALYSIS OF FACTORS AFFECTING FOREIGN EXCHANGE RESERVES IN INDONESIA

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ANALYSIS OF FACTORS AFFECTING FOREIGN EXCHANGE RESERVES IN INDONESIA

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ABSTRACT

Foreign exchange reserves to maintain currency stability, finance international transactions, provide guarantees against global financial crises, strengthen national credibility, and provide financial flexibility. High foreign exchange reserves will have an impact on the implementation of economic policies to stabilize the domestic currency, diversify the economy, increase competitiveness, and good management of the balance of payments; the state can reduce the risk of a shortage of foreign exchange reserves and the negative impacts that may occur. This study aims to analyze the model of foreign exchange reserves in Indonesia. Variables that affect foreign exchange reserves are the exchange rate, exports, the BI rate, and the consumer price index. The VECM (Vector Error Correction Model) approach estimates the model. This study uses secondary time series data in the form of months from January 2017 to December 2021. The research findings are that the consumer price index has a significant positive effect in the short term, while the consumer price index at lag 3 has a significant negative impact. The exchange rate on lag one and lag 3 has a significant adverse effect, but on lag 2, it has a negative and significant impact. The export variable has a negative and significant effect on the three lags. Variable bit rate on lag one and lag 2 has no significant adverse effect, while lag 3 has a negative and significant impact. In the long term, the exchange rate and consumer price index variables substantially affect foreign exchange reserves. The BI rate variable has no significant effect on foreign exchange reserves, while exports significantly adversely impact foreign exchange reserves.

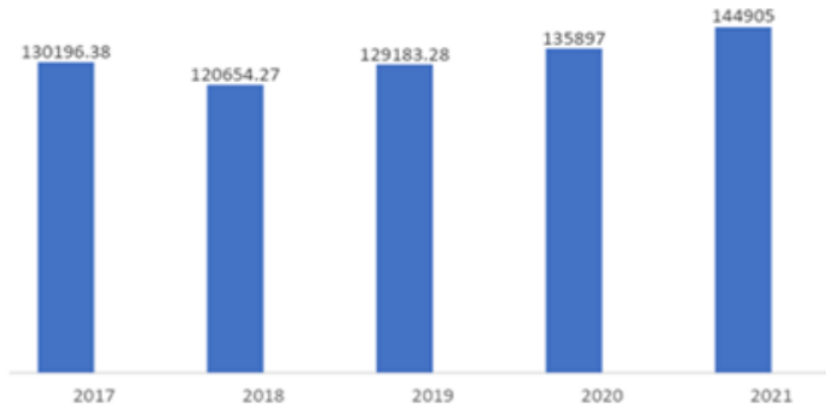
Keywords: foreign exchange reserves, exchange rates, exports, BI rate, CPI (Consumer price index), Vector Error Correction Model (VECM)

INTRODUCTION

Foreign exchange reserves are a collection of monetary assets owned by a country's central bank in the form of foreign currency, usually consisting of foreign currencies such as United States dollars, euros, pounds sterling, or other currencies accepted internationally for payment. Currency stability, financing international transactions, providing guarantees for dealing with global financial crises, strengthening national credibility, and providing financial flexibility. High foreign exchange reserves will have an impact on the implementation of solid economic policies to stabilize the domestic currency, economic diversification, increased power competition, and good management of the balance of payments; the state can reduce the risk of a shortage of foreign exchange reserves and the negative impacts that may occur. A depletion of foreign exchange reserves can pressure the domestic currency exchange rate.

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If the country does not have enough foreign exchange reserves to buy foreign currency and pay for imports, the domestic currency exchange rate tends to depreciate. This can cause inflation and increase the cost of substances, negatively impacting people's purchasing power and overall economic stability.



Source: Bank Indonesia and the Indonesian Ministry of Trade
Figure 1 Data on Indonesia's Foreign Exchange Reserves for 2017-2021

Indonesia's foreign exchange reserves have increased from 2017 to 2021 but decreased in 2018. Based on bps data, foreign exchange reserves increased by 130,196.38 million USD in 2017 and decreased by USD 120,654.27 million in 2018. Foreign exchange reserves are a country's money in a foreign currency, usually US dollars, euros, Japanese yen, and British pounds. Foreign exchange reserves have several essential functions for a country, to maintain the stability of the country's currency exchange rate. Foreign exchange reserves are used to keep the country's currency exchange rate stable against foreign currencies; sufficient foreign exchange reserves allow the government to maintain the stability of the domestic currency so that the country's currency exchange rate is regular. Foreign exchange reserves are used to meet a country's import needs; by having sufficient foreign exchange reserves, the government can pay for imported goods needed to maintain the stability of the goods market to avoid inflation. Sizeable foreign exchange reserves can preserve the strength of a country's financial system and avoid financial crises; foreign exchange reserves can be used to pay off foreign debt and minimize the impact of the problem on the country's economy. Foreign exchange reserves are significant for the country because they can provide protection against changes in exchange rates, meet import needs, increase investor confidence, and maintain the stability of the country's financial system.

Indonesia's foreign exchange reserves are essential in maintaining economic stability from global economic shocks and the need to import consumer goods and capital goods. Sufficient foreign exchange reserves also impact investors and international markets. They can be used to finance imports of goods and services, pay off foreign debt, and maintain currency exchange rate stability. The condition of foreign exchange reserves may change from time to time due to external shock factors such as international trade activities, capital flows, changes in commodity prices, fluctuations in the global geopolitical situation, and economic policies taken by the government. To maintain and predict changes in foreign exchange reserves, it is necessary to research foreign exchange reserve models to be able to predict and make decisions based on controllable factors.

LITERATURE REVIEW

the rise and fall of a country's foreign exchange reserves, essentially state savings, are influenced by capital flows and trading activities (including exports and imports). Bank Indonesia's policy to buy or sell and invest foreign currency and foreign securities futures as part of managing foreign exchange reserves. Foreign exchange reserves are foreign assets denominated in foreign currencies, which are under the control of monetary institutions and can be immediately used for international transactions. According to the IMF (International et al.), foreign currency reserves are financial assets owned by the country's central bank in the form of foreign currency that can be used to fulfill the country's international payment obligations (Krušković and Maričić, 2015). Foreign exchange reserves are a means to maintain the country's monetary and financial stability and ensure sufficient liquidity to guard against economic and financial instability caused by capital account imbalances. Foreign exchange reserves may also include other financial instruments such as foreign government securities, certificates of deposit, and Special Drawing Rights (SDRs) issued by the IMF. The country's foreign exchange reserves are an essential measure for assessing the country's financial situation and economic stability. High foreign currency reserves will protect the country from economic instability due to the financial crisis, help maintain exchange rate stability and fulfill obligations to pay foreign debts. Adequate foreign exchange reserves can provide protection against financial crisis risks, cover exchange rates and maintain stability in international payments. Obstfeld emphasizes the importance of foreign exchange reserves in maintaining financial and economic stability, protection against financial crises, and the role of foreign exchange reserves in monetary policy and international economic relations (Obstfeld et al., 2010). Maintaining currency stability requires adequate foreign currency reserves so that the central bank can intervene and prevent excessive fluctuations that lead to monetary crises.

Sufficient foreign exchange reserves allow the central bank to apply effective monetary policy to stabilize the exchange rate. 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 & Gupta, 2015; Output et al., 2010). His research provides valuable insights into managing foreign exchange reserves and the factors that affect the country's financial stability. Research the importance of maintaining exchange rate stability by looking at the factors that cause instability; foreign exchange reserves viewing the relationship of foreign currency reserves and their impact on the world economy (M. et al., 2006; M. et al., 2008). Using foreign exchange reserves during a financial crisis has a real impact on managing financial crises because countries with more significant foreign exchange reserves usually have a better chance of surviving a financial crisis and minimizing its negative impact. Reinhart's observations emphasize the importance of foreign exchange reserves in managing financial crises, their role in monetary policy, economic sustainability, and their impact on economic policy in general (Malagon & Orbegozo, 2019; Reinhart & Reinhart, 2008; Reinhart & Rogoff, 2018).). His research provides valuable insights into the role of foreign exchange reserves in maintaining the country's economic and financial stability. Reinhart examines the role of foreign exchange reserves in increasing a country's financial flexibility. He found that adequate foreign exchange reserves can protect a country against external fluctuations and increase the country's ability to withstand economic pressures. Good foreign exchange management policies 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, reflecting the relative price of the two currencies. The exchange rate shows how many units of one currency are needed to buy one unit of another currency. The relationship between the exchange rate and currency reserves is that a country's currency is more valuable, and the government and society are more willing to make economic transactions when there are more currency reserves. The relationship between the exchange rate, or the exchange rate, and the

foreign exchange reserve is very close because the foreign exchange reserve is used to maintain the stability of the country's exchange rate. Sufficient foreign exchange reserves give investors and market participants confidence that the country can pay its foreign debt and meet import needs. In this case, currency reserves can help prevent excessive exchange rate fluctuations. Suppose the country's foreign exchange reserves are sufficient. In that case, the central bank can use the foreign exchange reserves to buy enough foreign currency to maintain the stability of the country's exchange rate. This can reduce the demand for the country's currency and ultimately maintain or even increase the exchange rate of the country's currency.

On the contrary, if the country's foreign exchange reserves are exhausted or depleted, the central bank cannot use the foreign exchange reserves to buy foreign currency and maintain exchange rate stability. This could cause the country's currency to depreciate and potentially trigger a financial crisis. Thus, foreign exchange reserves play an essential role in maintaining the stability of the country's exchange rate. Having a sufficient foreign exchange reserve increases the confidence of market participants and investors and helps prevent excessive fluctuations in exchange rates.

Meanwhile, when foreign exchange reserves are low or depleted, this can cause a country's exchange rate to depreciate and potentially trigger a financial crisis. (Bajo-Rubio and Diaz-Roldan, 2011; Maddison, 2001) argue that the relationship between exchange rates and foreign exchange reserves are two sides of the same equation, exchange rates can affect currencies, and conversely, foreign exchange reserves can also affect foreign reserves—exchange rates.

Regarding the effect of the exchange rate on the foreign exchange reserves, he stated that the strengthening of the currency (strengthening of the exchange rate) could cause an increase in the country's foreign exchange reserves. When a country's currency appreciates, it can increase the purchasing power of that currency and encourage capital flows and foreign investment. This can lead to an increase in the country's foreign exchange reserve. A strengthening or weakening of exchange rates can affect the country's foreign exchange reserves. When a country's currency strengthens (the currency appreciates), it can affect the trade balance, making the country's goods and services more expensive on the international market, causing exports to decrease and imports to increase, which in turn can affect the country's economy. Value exchange rate reservations (Krugman et al., 2011; Krugman et al., 2002; Obstfeld, 2013; Prospect et al., 2010).

Export

Exporting is an international business that helps increase local demand, encouraging expansion in a large industrial sector with solid social institutions and foundations. The link between exports and foreign exchange reserves is also very close, most foreign exchange reserves come from the country's exports. In this case, the greater the value of the country's exports, the greater the inflow of foreign currency into the country, which can increase foreign exchange reserves. When a country exports, it receives payment in foreign currency. The greater the value of a country's exports, the greater the possibility of currency flowing into the country and the greater the country's foreign exchange reserves. In addition, the higher the value of a country's exports, the more significant its contribution to its economic growth. Strong economic growth can increase the confidence of investors and market participants, attracting investment flows to the country and increasing the country's foreign exchange reserves. Thus, exports are essential in increasing the country's foreign exchange reserve and economic growth. Exports play an important role in increasing the country's foreign exchange reserves; strong exports can generate significant foreign currency flows, which in turn can strengthen foreign currency reserves and support the economic stability of the country (Cerutti et al., 2021; Froyen et al., 1997). Obstfeld et al., 2010).

BI Rate

The BI interest rate is also interpreted as a principle in determining the value of interest rates set and issued by Bank Indonesia. One of the tasks of the BI interest rate is to maintain the stability of inflation; the increase in the price of goods and services in society indicates high inflation. The government uses monetary policy to control this by raising or lowering the BI interest rate benchmark. The country's central bank sets the **BI** interest rate (or reference interest rate) to regulate domestic money market interest rates. **The relationship between the BI rate and foreign exchange reserves** is that **the** interest rate policy implemented by the central bank can affect the flow or flows of currency in a country. If the central bank raises the BI rate, it can raise domestic money market interest rates and attract foreign inflows to the country. This is because investors are interested in investing in countries with higher interest rates, which increases foreign exchange flows into the country and can increase the country's foreign exchange reserves.

Conversely, if the central bank lowers the BI rate, it may lower interest rates in the domestic money market and cause a foreign exchange rate to fall. This is because investors look for investment opportunities in other countries that offer higher interest rates so that foreign exchange outflows from the country and foreign **e**xchange reserves are reduced. However, interest rate policy is not the only factor affecting **foreign exchange reserves**. Other factors, **such as exports, imports, and** foreign investments, can also affect currency flows in a country. When defining the interest rate policy, the central bank usually pays attention to developing foreign exchange reserves. If a country's foreign exchange reserves are low, **the** central bank can raise interest rates to attract **f**oreign currency inflows and increase **foreign exchange reserves**. **On the other hand, if a country's foreign exchange reserves** are already high, **the** central bank can lower interest rates to encourage investment flows and boost economic growth. Interest rates can affect foreign exchange reserves through various channels, including foreign capital flows, exchange rates, economic growth, and financial stability.

Consumer Price Index

According to Statistics Finland, the consumer price index is an index that determines the average price change of products and services purchased by residents and households over a certain period (Pohan et al., 2021).). The various products and services are divided into seven categories: food, drink, cigarettes, and tobacco; Clothes; Clothes; health; education, tourism, and sport; and transport 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 of a country's **c**urrency. If inflation is high, the bargaining power of the country's currency weakens, so **the prices of imported goods and** services increase, and **the** flow of currency increases. On the other hand, when inflation is low, people's purchasing power increases, so exports increase, and foreign exchange flows into the country also increase. Second, inflation can affect the reference exchange rate set by the country's central bank. When inflation is **h**igh, the central bank tries to raise the benchmark interest rate to control inflation. However, **an increase in the benchmark interest rate** may make **the** country less attractive to investor **s** and investment flows may decrease, affecting foreign exchange flows into the country and **the country's foreign exchange reserves**. Thirdly, inflation **can** affect **the** prices of goods exported to the country. In case of high inflation, the price of goods the country sells can be more expensive and increase the flow of foreign currency into the country. Higher domestic interest rates can attract more foreign capital. 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; Froyen et al., 1997; Krugman & Obstfeld, 2002). Obstfeld et al., 2010). The determination of interest rates by financial institutions strengthens foreign exchange reserves; an appropriate interest rate policy can promote strong economic growth and financial stability, which in turn can affect the country's foreign exchange reserves (Maddison, 2001)

Research Methodology

The purpose of this study is to use the Vector Error Correction Model (VECM), a development of the Vector Autoregressive (VAR). A stationary test is required in the VECM approach; the Difference from VAR is that VECM must be stationary at the level of the first Difference, and all variables must have the same stationary properties, namely differentiation in the first derivative (Bronzini & Piselli, 2009) (Basuki, 2019). VECM is a multivariate model that analyzes the relationship between endogenous and exogenous variables (Czirák & Gillman, 2006). This model considers long-term effects (cointegration) and short-term effects (imbalance) between endogenous and exogenous variables. The VECM model with the variable Indonesia's foreign exchange reserves (Y) as the dependent variable and the exchange rate (X1), exports (X2), the BI interest rate (X3), and the consumer price index (X4) as independent variables are written as follows:

$$\nabla Y_t = \beta_1 \Delta Y_{t-1} + \beta_2 \Delta X1_{t-1} + \beta_3 \Delta X2_{t-1} + \beta_4 \Delta X3_{t-1} + \beta_5 \Delta X4_{t-1} + \varepsilon_1$$

$$\Delta X1_t = \delta_1 \Delta Y_{t-1} + \delta_2 \Delta X1_{t-1} + \delta_3 \Delta X2_{t-1} + \delta_4 \Delta X3_{t-1} + \delta_5 \Delta X4_{t-1} + \varepsilon_2$$

$$\Delta X2_t = \phi_1 \Delta Y_{t-1} + \phi_2 \Delta X1_{t-1} + \phi_3 \Delta X2_{t-1} + \phi_4 \Delta X3_{t-1} + \phi_5 \Delta X4_{t-1} + \varepsilon_3$$

$$\Delta X3_t = \gamma_1 \Delta Y_{t-1} + \gamma_2 \Delta X1_{t-1} + \gamma_3 \Delta X2_{t-1} + \gamma_4 \Delta X3_{t-1} + \gamma_5 \Delta X4_{t-1} + \varepsilon_4$$

$$X4_t = \lambda_1 \Delta Y_{t-1} + \lambda_2 \Delta X1_{t-1} + \lambda_3 \Delta X2_{t-1} + \lambda_4 \Delta X3_{t-1} + \lambda_5 \Delta X4_{t-1} + \varepsilon_5$$

-1 + ε

Where: ΔY_t : variable foreign exchange reserves Million USD data obtained at Bank Indonesia
 $\Delta X1_t$, $\Delta X2_t$, $\Delta X3_t$, $\Delta X4_t$: independent variables at time t, ε_1 , ε_2 , ε_3 , ε_4 , ε_5 : error in each equation.

The VECM model has two simultaneous equations, each connecting the change vectors of endogenous and exogenous variables in period t to the previous period (t-1). The cointegration coefficient matrix from the VECM model approach shows a long-term relationship between variables. In contrast, the error correction coefficient measures the degree of adjustment of endogenous and exogenous variables to cointegration errors. The VECM (Vector Error Correction Model) estimator requires conditions that must be met, including the data stationarity test (first root test), determining the optimal lag length, VAR stability test, cointegration test, and Granger causality test. After the data has been estimated using the VECM model approach, the analysis is continued by analyzing the Impulse Response Function (IRF) and Variance Decomposition (VD).

The data static test (First Root Test) used the Augmented Dickey-Fuller (ADF) test, the Phillips-Perron test (PP), and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. The cointegration test was carried out using the Engle-Granger and Johansen tests. The optimal lag length in VECM research is significant for valid estimation results. Quoting (Florens et al., 2007) suggests that the autoregressive vector model (VAR) estimation is highly dependent on the lag length. The Vector Error Correction Model (VECM) lag length testing model was carried out using information criteria such as Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan Quinnon (HQ). The VECM stability test is used to see whether the VECM model's autoregression coefficient is stable. The methods used to test the stability of the VECM model are Observability Test and Maximum Eigen Value Test. Impulse response function (IRF) analysis can also be performed using a vector error correction model (VECM). In VECM, IRF is used to measure the effect of a variable throughout the study. The IRF matrix shows the change in the value of a variable from time to time based on the standard deviation of the shock given to one variable (hAAAAhhjjjj). The effect of changing one standard error on one endogenous variable relative to other endogenous variables can be observed using IRF analysis.

The econometric analysis method to determine how much influence a variation has on other variables studied can be explained by variance decomposition (VD) analysis. This technique has a function to understanding the relationship between variables in a series of VECM Models and to identify which variables are the most dominant in a series of VAR approach systems. VECM, a VAR development, analysis of variance decomposition (VD) of one

variable is disclosed and transmitted to other variable components through Forecast Error Variance Decomposition (FEVD). The information in the FEVD is the percentage of coherent movement that arises from the shock of the indogen variable towards other endogenous variables (Millia et al., 2021).

Analysis And Discussion

The first step in the VECM approach is to test the stationarity of the selected variables using the root unit test. The unit root test uses the Augmented Dickey-Fuller (ADF) criteria; the results of the unit root test are presented in Table 1 below:

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, the BI rate, and the CPI are not stationary at the level test; this is indicated by the probability values of the related variables above the significance level (above 0.05). The variables studied show stationary in the first derivative; this is indicated by the probability value below the level of significance (below 0.05); it is concluded that all the variables studied (foreign exchange reserves, exchange rates, exports, BI rate, and CPI) are stationary at the first Difference with a significance level of 0.05.

Test Lag Length Criteria

The optimal lag length test was carried out to determine the relationship between the behavior of indogen variables and the optimal exogenous variables in a series of observational data. The criteria used to determine the optimal lag length use the likelihood ratio (LR), final forecast error (FPE), and Akaike information criteria (AIC). The research results in Table 2 show that the optimal lag length is at lag 3.

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

Using IRF (Impulse et al.) criteria and vector decomposition test (vector decomposition test) in the VAR system of equations is used in econometrics to understand the relationships between economic variables and analyze the dynamics of economic systems. In order for the results of the IRF (Impulse et al.) and vector decomposition test (vector decomposition test) to be valid, it is necessary to have a model stability test; if the results of the IRF test and vector decomposition test are unstable, it can indicate several problems that may occur. The stability of the VAR research model by looking at the modulus of the root characteristics of the stability of the VAR system. The Var equation system criterion is stable if all root values have a

modulus less than 1 (gghhHHH). A modulus value that is less than 1 indicates that each VAR root value (VECM) has a more negligible effect on variations in changes in the VAR system over time so that the system formed in VAR tends to return to an equilibrium point or a stable state. Table 3 provides information about the VAR 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

Table 3 shows that the VECM (Vector Error Correction Model) Stability Test gives the results of the unit root and VECM modulus tests. The unit root provides information about the indication of a unit root's existence or the variable's stationarity. At the same time, the modulus describes the stability of each unit root in the dynamics of the VECM system. The unit root value in the unit column is the numerical value of the characteristic root, which indicates that the unit root has a characteristic value less than 1; this indicates the presence of a unit root in the VECM system used stationary. The modulus value describes the stationary existence of the VAR system for each characteristic root ((Czirák & Gillman, 2006)). In Table 3 the value of the characteristic root modulus has a value of less than 1; this modulus indicates that the VECM root is stable and has a minor effect on system dynamics over time, meaning that the VECM system will return to its average if external variable shocks occur.

Cointegration Test

The VECM equation system is an extension of VAR by incorporating cointegration elements. The VECM equation system models the short-term and long-term relationships between variables by analyzing the existence of error correction to see whether there is a long-term equilibrium relationship between the variables in the system. The cointegration test in this study used the Johansen Trace Statistics test; the results of the Johansen test are summarized in Table 4.

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 VECM equation system is an extension of VAR by incorporating cointegration elements. The cointegration test in this study used the Johansen Trace Statistics test; the results of the Johansen test are summarized in Table 4.

The results in Table 4 show the test statistics and critical values for testing the null hypothesis, which states that there is no cointegration relationship in the system. The critical value is decided at a significance level of 0.05, which means that if the value of the test statistic exceeds the critical value, the null hypothesis is rejected, and there is sufficient evidence to conclude that there is a cointegration relationship. Test value (Trace) Statistics to test the null hypothesis, this statistic combines all eigenvalues and tests the overall cointegration relationship in the system. According to the table, the test results show that at a significance level of 0.05, the null hypothesis about the absence of a cointegration relationship is rejected for all cointegrating vector quantities up to 3. However, for the number of cointegration vectors 4, the null hypothesis cannot be rejected. This means there is strong evidence to conclude that the VECM system under study has a cointegration relationship of 3 or less. VECM can be used to analyze the long-term dynamics between the selected variables, with an optimum lag length of 3.

Granger Causality Test

The VECM equation system will be more valid if it uses the Granger causality test to detect whether there is a causal relationship between the variables in the VECM system. In this study, it was conducted pairwise. The Granger causality test on the VECM study model aims to test whether the error correction terms in the VECM model significantly contribute to predicting the behavior of other variables in the VAR system. 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	57	7.75576	0.0002
FOREIGN EXCHANGE RESERVES does not Granger Cause IHI		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	57	0.08388	0.9685
BI_RATE does not Granger Cause EKSPOR		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 6 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. It indicates that some 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) designed to be used on non-stationary data 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 7.

Table 7 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 7, the table Regression Effect of Exchange Rate Variable says that with a short lag of 1, the effect of the exchange rate variable on foreign exchange reserves is small because the t-statistic value is so much lower than the t-table. . as $-1.28441 < 1 > 1.645$ where the exchange rate variable has a significant impact on the foreign exchange reserve. The t-statistic value is smaller than the t-table, which means that the late three exchange rate

variables do not significantly affect foreign exchange reserves $-1.38463 < 1 > 1.645$. In part 2, the export variable significantly affects foreign exchange reserves, as the t-statistic value above the t-table is $-2.07247 > 1.654$. Lag 3-variable export has a significant effect on foreign exchange reserves because the t-statistic above the t-table is $-1.82952 > 1.654$ and shows a negative relationship between the three lags because the coefficient values are -0.042824 , -0.032130 and -0.018881 , which means that exports harm foreign exchange reserves. The BI interest rate variable in Table 7 shows that in the short run, BI interest rate lagged variables 1 and 2 have little effect on foreign exchange reserves because the t-statistic values are smaller than those in the t-table, i.e., $-1.00703 < 1 > 1.654$ and show a negative relationship between the three lags because coefficient values are -20.73381 , -21.60997 and -37.59303 . This means that BI interest rate lag 1 and 2 have a small negative impact on foreign exchange reserves, while BI interest rate lag 3 has a significant negative impact on foreign exchange reserves. According to the Consumer Price Index (CPI) variable in Table 7, the CPI variable with a short lag of 1 significantly affects foreign exchange reserves because the t-statistic above the t-table is $2.02508 > 1.654$. In period 2, the CPI variable significantly affects foreign exchange reserves due to the t-statistic in the t-table above, which is $4.05084 > 1.654$. Lag 3 CPI variable has a significant effect on foreign exchange reserves because in the above t-table, the t-statistic is $-1.90202 > 1.654$, and the coefficient values are 151.6232 , 340.8895 , and -245.0686 , which means that for lag one and two, CPI is 2. Significant positive effect on foreign exchange reserves, while lag 3 CPI has a significant negative effect on foreign exchange reserves. The long-term VECM estimation results are summarized in Table 8.

Table 8 Long-Term VECM Estimation Results

Variable	Coefficient	t-Statistics	Relation	Description
EXCHANGE RATE(-1)	4.540127	3.21461	Positive	significant
EKSPOR(-1)	-0.147934	-8.27364	Negative	significant
BI_RATE(-1)	-15.11509	-1.18288	Negative	Not significant
IHK(-1)	469.4345	5.67386	Positive	significant
R2 =0.611834 t-Table =1. 654				

Source: Eviews estimation results (processed data), 2022

The long-term effect of exchange rate variables, according to Table 8, shows that long-term exchange rate variables have a significant effect on foreign exchange reserves because the t-statistic value above the t-table is $3.21461 > 1.654$, which has a positive relationship. Because the coefficient value is 4.540127 . This means that the exchange rate has a significant and positive effect on the foreign exchange reserve, which increases the foreign exchange reserve by 4.540127 when the exchange rate increases by one unit. The long-term effect of the regression of export variables in Table 8 shows that the export variable has a significant long-term effect on foreign exchange reserves due to the t-statistic above the t-table, i.e. $-8.27364 > 1.654$, and because the negative coefficient value (-0.147934). This suggests that exports significantly negatively impact foreign exchange reserves, so when exports decrease by one unit, foreign exchange reserves increase by -0.147934 . The long-run effect of the BI interest rate variable is presented in Table 8. According to the regression, the long-term BI interest rate variable has a minor effect on the foreign exchange reserve because the t-statistic value is even lower than the t-table $-1.18288 < 1.654$, and it has a positive relationship because the coefficient value is 469.4345 . This means that the CPI has a significant and

positive effect on the foreign exchange reserve, so when the CPI increases by one unit, it increases the foreign exchange reserve by 469.4345.

Impulse Response Function (IRF)

The effect of shocks on variables on other variables is explained by Impulse Response Function (IRF) analysis, in which this analysis not only tests the short term but can also, some time in the future, 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 1.

Response to Cholesky One S.D. Innovation

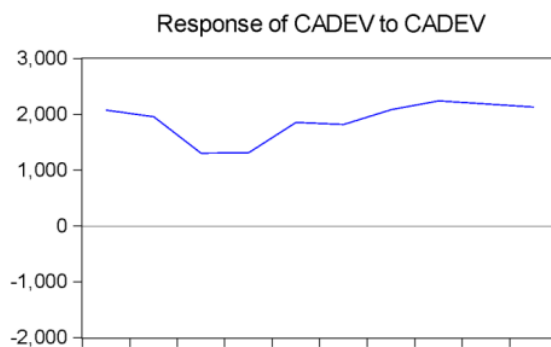


Figure 1 IRF Foreign Exchange Reserves To Foreign Exchange Reserves

Figure 1 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 2 below.

Response to Cholesky One S.D. Innovation

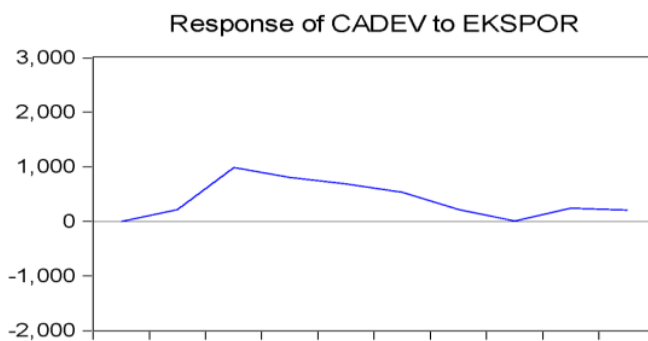


Figure 2 IRF Foreign Exchange Reserves To Exchange Rate Results

Based on IRF findings, the foreign exchange reserve variable responds to exchange rate variable shocks, as shown in the graph Figure 2. The first period to the fourth period of the response shows a decrease indicating a negative trend; the fourth to the eighth period of 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 3.

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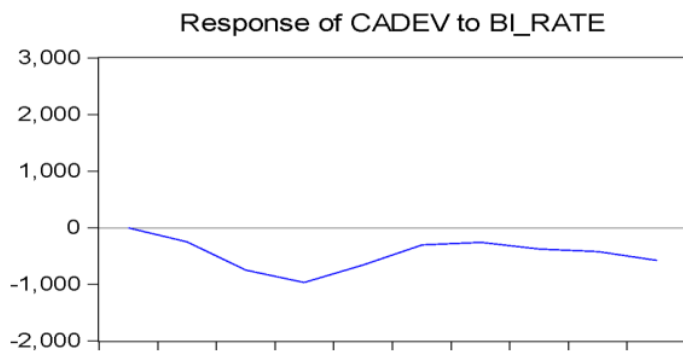


Figure 4 Foreign Exchange Reserves To Bi_Rate

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, 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.

Response to Cholesky One S.D. Innovation

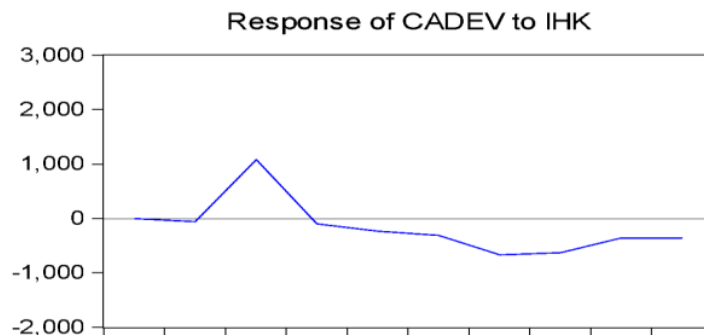


Figure 5 IRF Foreign Exchange Reserves To Cpi

The graph in Figure 5.10 illustrates how the currency variable responds to shocks in the CPI variable according to the Impulse Response Function (IRF) results. From the first to the second period, there was a decrease showing a negative trend; from the second to the fourth, there was a positive increase. Moreover, from the fourth to the eighth period, there was a harmful decrease in the graph. Furthermore, an increase from the fourth to the eighth period showed a negative trend. Show positive development.

Variance Decomposition Test

The variance decomposition aims to measure the effect of each independent variable on the dependent variable.

Table 11 Decomposition Variant Results

No	SE.	Foreign exchange reserves	exchange rate	Export Ekspor	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 11, 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 from the first to the tenth.

CONCLUSION

This study aims to analyze and understand the effect of independent variables on the dependent variable, where the dependent variable is the foreign exchange reserves of Indonesia, and the independent variables are exchange rate variables, export variables, BI variables, and consumer price index. Variables. The test results and discussion are used to draw several conclusions, including the following: The purpose of this study is to analyze and understand the effect of independent variables on the dependent variable used, including exchange variables, exports, and BI exchange rate. And the consumer price index of Indonesia's foreign exchange reserves. Several conclusions can be drawn based on the test results and the discussion:

1. Referring to the findings of Descriptive Statistics, this study uses 59 observational data using the foreign exchange reserve variable, the cruise variable, the export variable, the bit rate variable, and the consumer price index variable. With these descriptive statistics, it can determine the average value (mean), the middle value (median), the lowest value (minimum), a then the highest value (maximum).
2. Referring to the Unit Root Test, it can be concluded that there are several level tests variables, such as foreign exchange reserves, exports, the BI rate, and the consumer price index, which are not stationary or not. The first Difference is used in the second test, and at this point, all variables-including foreign exchange reserves, exchange

rates, exports, the BI rate, and the consumer price index-are stationary, indicating that all variables have successfully passed the First Different.

1. Referring to the findings of the short-term Vector Error Correction Model (VECM) test, it can be concluded that the consumer price index in lag one and lag 2 has a significant positive effect. In contrast, the consumer price index in lag 3 has a significant negative effect. In the exchange rate variables lag one and lag 3, the effect is negative but insignificant, while on lag 2, it has a negative and significant effect. The export variable has a negative and significant effect on the three lags. The bit rate variable on lag one and lag 2 has no significant adverse effect, while on lag 3, it has a negative and significant effect.
2. The findings of the long-term Vector Error Correction Model (VECM) test show that both the exchange rate and the consumer price index significantly influence foreign exchange reserves. Meanwhile, the BI rate variable has a negative and insignificant effect on foreign exchange reserves, and exports have a significant negative effect on foreign exchange reserves.
3. Referring to the short-term a priori test results, the lag 1, 2, and 3 exchange rate variables fail the a priori test. For exports, the a priori test at lags 1, 2, and 3 is declared not to pass, while the BI Rate at lags 1, 2, and 3 is declared to have passed the a priori test. Meanwhile, the consumer price index variable passed the a priori test at lags 1 and 2 but failed at lag 3.
4. The findings of the long-term a priori test clearly show that the exchange rate, BI rate, and consumer price index variables passed the test, but the export variable did not pass the a priori test.

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