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Rupiah exchange rate: The determinants and impact of shocks on the economy

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Abstract: The repetition of policy dynamics on Quantitative Easing (QE) and interest rate by The Fed potentially cause fluctuations in the exchange rate, including in Indonesia. Therefore, this study aims to analyze the determinants and impacts of exchange rate shocks. Inflation (INF), Money Supply (LJUB), Open Market Operations (OPT), Foreign Exchange Reserves (LCD), Expected Inflation (LEHU) and Interest Rates (SB) were used to analyze the determinants of Exchange Rate (NT) through Auto Regressive Distributed Lag (ARDL). The impact of NT shocks was analyzed using Vector Auto Regressive (VAR) by LEHU, Residential Property Price Index (PIHPR), Stock Transactions (LTRANS), and Banking Credit Volume (VK). The Expected Inflation variable and incorporation of ARDL-VAR are novelties in this study. In the secondary time series data for 2014M1 – 2022M9 period, the ARDL results showed that INF and LJUB had positive effect on NT in both long and short run, while OPT, LCD and SB had negative effect. LEHU had negative effect in the short run, but positive in the long run. The speed of adjustment in the model was 49.86% per month. Shock of NT had impacted VK until 15 months, PIHPR at 7 months, LTRANS at 10 months, and LEHU at 14 months. Based on these results, it can be implied that the monetary authority must maintain stability of NT, especially by INF and LJUB transmission. Next, shock's impact must also be overcome, especially on VK. This research is only focused on monetary sector, further research will be refined with other macroeconomic variables.

Keywords: Exchange Rate; Impact; Influence; Monetary; Rupiah
JEL Classification: E31; E42; E50; F45

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Introduction

Monetary policy is a crucial aspect of a country's economy. The main goal to be achieved from monetary policy is to maintain exchange rate stability (Kabundi & Mlachila, 2019). Currently, monetary policy plays an important role in setting the price level, which is reflected by the inflation variable (Le et al., 2021). Even though the main success indicator of monetary policy is inflation, the role of other exogenous factors affecting exchange rates should not be ignored, especially in countries that adhere floating exchange rate regime. The stability of the exchange rate is important to maintain considering the vital role of this variable for the economy. Apart from reflecting the competitiveness of a domestic country's currency toward other countries, movement in exchange rates also has a strong potential impact on public economic behavior in allocating their resources. Exchange rate movements can be used as a reflection of cost, relative prices, and productivity of economic resources (Adewuyi et al., 2021).

Indonesia is one of the developing countries with fluctuating historical exchange rate data and has tended to depreciate over the last 10 years. Apart from the 1998 crisis, the largest exchange rate weakening of the Indonesian Rupiah (IDR) against Dollar of the United States (USD) occurred in 2014, following the control of the Quantitative Easing policy and the increase in interest rates by the Fed since May 2013 in order to economic recovery due to the subprime mortgage crisis that occurred since 2008. These policies raised expectations for the United States economy, causing investors to withdraw their funds (capital outflow) from emerging market countries. This condition resulted in USD strengthening, while the exchange rates of emerging market countries weakened, including Indonesia.

The deteriorating condition of the exchange rate due to the aggressive policies of the Fed has been researched by Basri (2017), Dinata and Oktora (2020), Estrada et al. (2016), Le et al. (2021), Park et al. (2015), and Triggs et al. (2019). The results of these studies suggested various conclusions. The banking sector is the most affected by exchange rate fluctuations due to changes in Quantitative Easing and global interest rates (Basri, 2017; Estrada et al., 2016; Park et al., 2015; Triggs et al., 2019). Different findings resulted from the research of Dinata and Oktora (2020) and Le et al. (2021), the findings of these studies stated that the impact of exchange rate movements does not only occur in the banking sector, but other sectors are also affected, particularly regarding asset price movements and changes in consumption behavior.

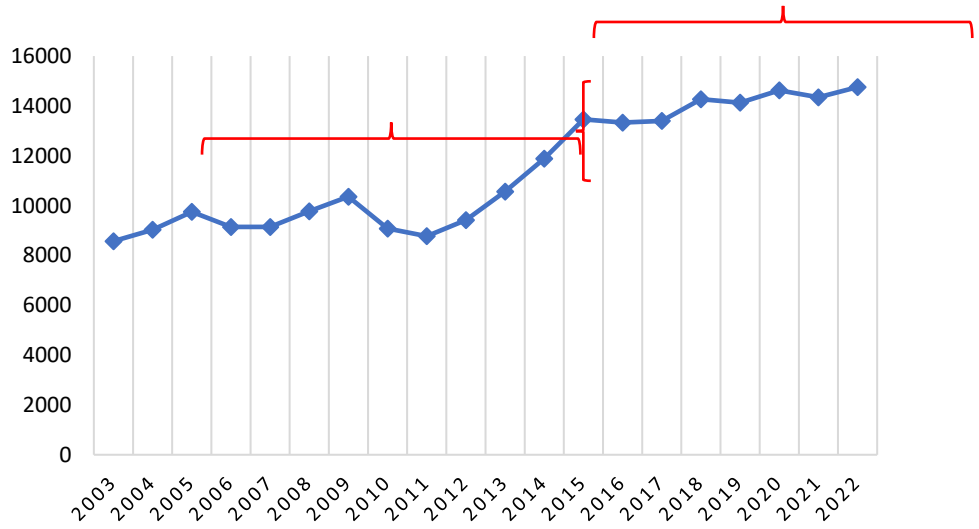

Figure 1. Statistics of IDR/USD in 2003 - 2022
Source: Central Bank of Indonesia, 2023 (data processed)

Various studies regarding the effect of monetary variables on exchange rates have been carried out and found several inconsistent results. Related to inflation, research from Bato et al. (2017) and Chandrarin et al. (2022) stated that inflation has a plus coefficient effect on the exchange rate, whereas the results of research from Fauji (2016) and Wicesa et al. (2021) showed the opposite result. Next, the influence of the money supply is positive (Funashima, 2020; Yulianti, 2014). However, research from Alawiyah et al. (2019) and Ghosh and Bhadury (2018) showed the opposite result. The open market operations has

a negative effect on the exchange rate (Carli & Gomis-Porqueras, 2021; Rocheteau et al., 2018). Meanwhile, the research results of Cassola and Koulischer (2019) dan Kirana (2017) showed that the effect of open market operations on the exchange rate is positive. Furthermore, the monetary policy instrument by increase in interest rates resulted in strengthening of the exchange rate or appreciation (Elias et al., 2022; Kilian & Zhou, 2022). The research results from Sa'adah (2020) and Yung (2021) precisely showed conflicting results, where an increase in interest rates causes depreciation of the exchange rate.

The condition of international economic flows as reflected by the position of foreign exchange reserves also has been studied by various previous studies. The higher foreign exchange reserves have been proven to cause the appreciation of exchange rate (Chanda et al., 2020; Ito & McCauley, 2020). Discordant results were shown from the research findings of Gupta et al. (2014) and Hammoudeh et al. (2022). The exchange rate as a reflection of the condition country's currency competitiveness is also influenced by expectations of future prices or expectations of inflation. Research from Herkenhoff and Sauré (2021) and Lee and Kim (2019) showed that expected inflation have a positive effect on the exchange rate. The expected inflation variable is rarely used in research, so conflicting results have not been found. The findings of different research results show about determinants of exchange rate especially related to the monetary sector and international trade are important to discuss, considering that to intervent the exchange rate movements the main tool used by the state will be realized through policies in the monetary sector and international competitiveness.

Recently, The Fed seems to have re-imposed QE controls and expanded interest rates to overcome post-crisis economic overheating due to the pandemic (Covid-19). From March to December 2022, the Fed has raised interest rates 7 times with an accumulation of 425 basis points, from 0% to 4.25%. Central Bank of Indonesia responded that condition by increasing the Bank Indonesia 7 Day Repo Rate (BI 7DRR) by 200 basis points from July (3.5%) to December 2022 (5.5%). This economic turmoil is predicted to continue, so that the rupiah exchange rate is also predicted to fluctuate and tend to depreciate (Sunaryati & Munandar, 2023).

Historical data on the deteriorating exchange rate as a outcome of QE policy and The Fed's interest rate also economy condition which is predicted continue to worsen for several years after the Covid-19 pandemic crisis must be responded to with appropriate policies so that the negative impact can be overcome immediately. Identification of the factors that work on exchange rate movements as well as analysis of the sectors most affected will assist in formulating these policies. Monetary policy as responsible for exchange rate stability must be properly formulated. Therefore, this research objective is to analyze the determinants of exchange rate, also the impact of exchange rate shocks on the economy. determinants exchange rate carried out using Auto Regressive Distributed Lag (ARDL). Next, to analyze the impact of exchange rate shocks, Vector Auto Regression (VAR) will be used. The use of ARDL combined with VAR is a novelty in this study. In addition, this study also includes Expected Inflation as a variable that rarely used to estimate exchange rate movements, even though this variable has an important role in policy making. The research will be focused 2014 – 2022 period considering there was a massive movement

in the rupiah exchange rate in that period. Apart from contributing theoretically to the literature study regarding the influence factors and impacts of exchange rate shocks, the findings of this study also contribute practically in the form of detailed policy recommendations.

The importance of this research is considering the exchange rate not only as a volatile variable but also its role as monetary policies main goal. Policies are compiled and established with the aim of being a solution of the problem or improving the quality of a condition. At the macroeconomic level, particularly in the monetary sector, policymaking requires complex stages. When the Central Bank as the policy maker for the monetary sector has established a policy, it will continuously affect other sectors. The exchange rate as a reflection of a country's monetary power whose movements are displayed in real time on the foreign exchange market, is a variable that has great power (impactful) in influencing the balance of economy. The position of monetary policy instruments is vital in controlling the rupiah movement. Even though a country adheres to floating exchange rate regime, the intervention of monetary institutions in transmissions that affect exchange rates must still be carried out for the sake of economic stability and public expectations of future conditions. However, exchange rate movements cannot be completely controlled, so the impact of these movements is a consequence that must be addressed. By knowing the factors that determine the exchange rate, it will help in overcoming the impact of shock that occur on the exchange rate. This topic will be shown in this research with 5 main parts, starting from introduction to explain the research background, research gaps, data, research aims, research importance and novelty. Then, the literature review is written to show some of previous studies and hypotheses. The research continued at research method part to explain the analysis technique and the procedure. The answer of hypotheses and research aims are answered in the result and discussion. Finally, research concludes and explained the policies recommendation, which also acknowledged the limitation in the conclusion.

Various literature reviews regarding exchange rates have been carried out to develop research hypotheses. The exchange rate reflects the circumstances of domestic purchasing power also the international competitiveness of a country's currency. When the domestic economy is currently in high inflation, the purchasing power of money in the country becomes weak (theory of money quantity). In addition, on the international trade flow, there will be more Rupiah that must be converted to USD. This condition means that the higher level of domestic inflation, the more depreciated the exchange rate will be Proof that inflation causes exchange rate depreciation had been carried out by Bato et al. (2017), and Chandrarin et al. (2022).

***H_1**: Inflation has a positive effect on the Exchange Rate.*

Inflation is a success indicator of monetary policy. When inflation increase exceeds the target, the monetary authority (Central Bank) will control it through monetary policy instruments. The causes of inflation can be traced from production side (cost push inflation) or by consumption side (demand pull inflation), both of them are related to the

price level and purchasing power. To overcome this, the volume of money supply has a crucial role. The higher volume of money supply, it means that easier for people to consume. This condition will promote the higher quantity of demand (goods and services). If the supply side is unable to equal with the level of demand because economic conditions not yet possible to improve production input factors, then the equilibrium will shift, the price level will rise. If this price increase continues, it is called inflation (demand pull inflation), and in the long run it has the potential to cause exchange rate depreciation. It can be concluded that high volume of money supply involve a depreciation in the exchange rate (Funashima, 2020; Gong et al., 2022).

***H_2**: The Money Supply has a positive effect on the Exchange Rate.*

The movement of money supply represents purchasing power and is influenced by inflation expectations. If the public currently faced high money supply, expectations for future prices of domestic products will also increase. This has resulted in people preferring to buy imported products because they are cheaper than domestic ones. The higher interest in imported products, the quantity of imports will increase, so the trade balance will decrease and result in exchange rate depreciation. The research result from Herkenhoff and Sauré (2021) and Lee and Kim (2019) validated that higher expected inflation led the exchange rate depreciation.

***H_3**: Expected Inflation have a positive effect on Exchange Rates.*

Controlling volume of money supply is a strategic step the Central Bank takes to manage inflation. Instruments that can be responded quickly by financial institutions and the general public in dealing with this matter are interest rates**.** The higher level of interest rate will press the public's interest in applying for bank credit loans (liquidity preference theory). This happens because the rate of return that must be given in the future is higher than the condition when interest rates are slight. Moreover, people will be more interested in saving because the value of money that will be received in the future will be higher. The higher saving cause the smaller of money supply (the volume of money supply decreases). Public interest in declining consumption also suppresses inflation, due to the low level of demand for goods and services (Andrieș et al., 2017). At a fixed level of supply, this shift in demand causes the equilibrium to shift to the lower left, the price level decreases. If this condition happen continuously, deflation will occur. The price of domestic goods and services becomes cheaper. It has the potential to encourage consumption interest in domestic goods to be higher so that the level of imports can be reduced. The lower the import, the less rupiah (domestic currency) that must be converted to USD, the stronger the exchange rate (Ulm & Hambuckers, 2022).

***H_4**: Interest Rates have a negative effect on Exchange Rates.*

A decrease in imports will increase foreign exchange reserves because there is no deficit on trade balance (Aulia & Masbar, 2016). High foreign exchange reserves indicate that the ability of the monetary authority to control exchange rate is getting stronger, it will encourage exchange rate appreciation (Chanda et al., 2020; Ito & McCauley, 2020; Uz Akdogan, 2020).

***H_5**: Foreign Exchange Reserves have a negative effect on the Exchange Rate.*

The interest rate is the instrument taken by the Central Bank to restrain money supply through the transmission of financial institution responses. This requires a time lag, while the exchange rate changes every second and within a certain time requires fast action to prevent the depreciation rate from worsening. To handle this condition, the Central Bank will use the open market operation instrument because it can directly intervene in the foreign exchange (forex) market on a daily basis. When the rupiah is depreciating (high money supply), open market operations to encourage exchange rate strengthening will be carried out (Rocheteau et al., 2018), one of which is through the issuance of Bank Indonesia Certificates (BIC). When BI issues BIC, Commercial Banks and Intermediaries have the right to purchase them. These Commercial Banks and Intermediary Institutions will provide a certain amount of funds (according to the BIC nominal) to Bank Indonesia. This condition reabsorbed money supply, increasing the power to supply rupiah in the forex market. At a constant level of demand for the rupiah, while the supply of rupiah increases (liquidity injection), the equilibrium (exchange rate) in the market will decrease (appreciate). This condition indicates that open market injection operations affect the appreciated exchange rate, while absorption of that instrument will result in exchange rate depreciation (Carli & Gomis-Porqueras, 2021).

***H_6**: Open Market Operations have a negative effect on Exchange Rates.*

Significant exchange rate movements (due to shocks or some phenomena) lead to changes in economic variables, especially macroeconomics. Shocks that occur in exchange rates and lead to depreciation have the potential to reduce bank credit volume (Fabiani et al., 2022). This can be traced from one of the indicators of exchange rate depreciation: the high domestic inflation marked by large money supply volumes. To seek an appreciation of the exchange rate, policies will be taken that are able to reduce the volume of money supply, the example is increasing interest rates. This condition will encourage an increase in saving, but on the other hand it will suppress credit volume (Yun & Cho, 2022).

***H_7**: If there is a shock of Exchange Rate, the Credit Volume will decrease.*

The decline in credit volume indicates that the level of public consumption will decrease. This is a separate signal for the property sector, where a decline in consumption indicates low public purchasing power so that the level of demand for the property sector will also

decrease. To cope with the decline in the level of demand, prices from property supplies will be lowered (Anastasia & Hidayat, 2019; Dąbrowski & Wróblewska, 2020).

***H_8**: If there is a shock of Exchange Rate, Property Prices will decrease.*

Lower interest rates in emerging market countries tend to generate negative sentiment for foreign investors. Low interest rates decrease foreign investors expectations of the rate of return on capital, resulting in an outflow of funds. This condition will be exploited by domestic investors to dominate the stock exchange. Therefore, when the exchange rate depreciates, the volume of stock transactions appears to have increased (Ding, 2021; Huang et al., 2021; Sa'adah, 2020).

***H_9**: If there is a shock of Exchange Rate, Stock Transaction Volume will increase.*

A shock to the exchange rate also has the potential to make expectations of future prices more expensive. This occurs because a weak exchange rate will make production costs and output prices (especially with imported raw materials) more expensive. Such conditions will push future general prices (inflation expectations) higher than at present (Janah & Pujiati, 2018). Exchange rate shocks make people expect future prices to be more expensive than the current price. It can be state that the response of expected inflation to exchange rate shocks is positive or increases (Anderl & Caporale, 2022; Lee & Kim, 2019).

***H_{10}**: If there is a shock of Exchange Rate, Expected Inflation will increase.*

Research Method

Research objectives and methods are two closely related aspects. Auto Regressive Distributed Lag (ARDL) was used in this study to analyze the variables that influence (determinants) exchange rates.

To attain this purpose, the monetary sector's determinants, namely Inflation (INF), Money Supply (LJUB), Open Market Operations (OPT), Foreign Exchange Reserves (LCD), Interest Rates (SB), and Expected 3-month General Prices or Expected Inflation (LEHU), are being broken down. The Rupiah Exchange Rate (NT) toward the United States Dollar (USD) has a role as the dependent variable.

Next, the research objective is the impact of exchange rate shocks on the economy, executed using Vector Auto Regressive (VAR), by positioning the Exchange Rate variable (NT) as a vector as well as the Inflation Expectation variable (LEHU), Changes in Residential Property Price Index (PIHPR), Stock Transaction Volume (LTRANS), and General Banking Credit Volume (VK) as response variables. This research was executed using a quantitative approach to secondary time series data for the period January 2014 to September 2022

in Indonesia obtained from the official websites of Central Bank of Indonesia (BI), the Central Bureau of Statistics (BPS) and the Financial Services Authority (OJK).

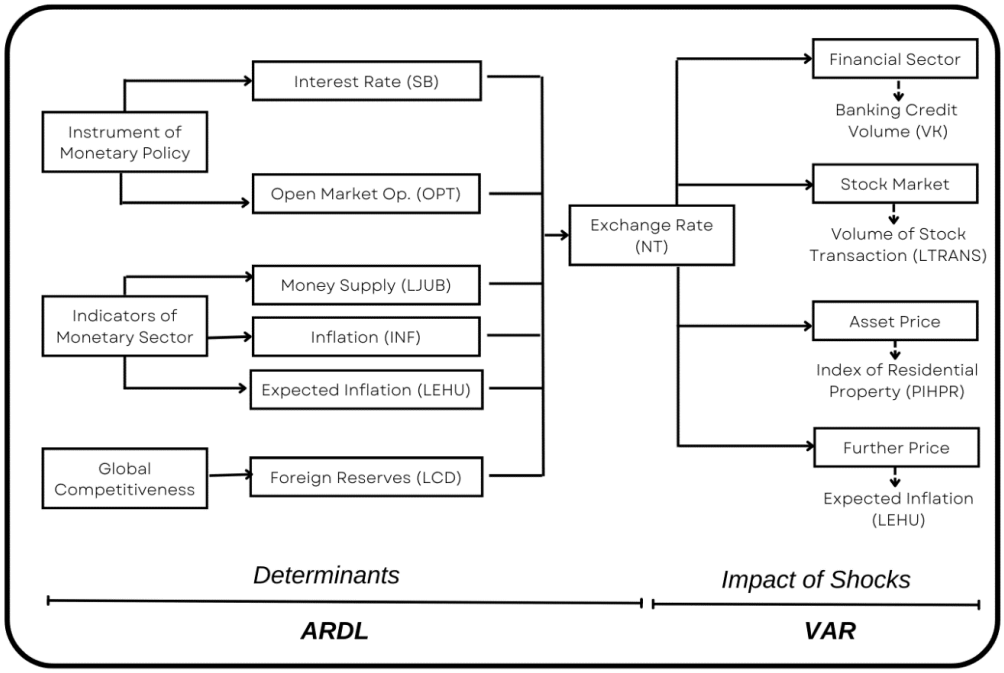

Figure 2 Research Design

Table 1 Attribute of Variables

Code	Variable	Specification	Measurement	Source
NT	Exchange Rate	Last mont of JISDOR kurs Rupiah/USD.	IDR/USD	BI
INF	Inflation	Consumer Price Index approach.	%	BI
LJUB	Money Supply (*Log*)	Broad total of money supply (M2)	Rp Trilion ➔%	BPS
OPT	Open Market Operation	Absorbtion or injection from rupiah and forex intervence	Rp Trilion	BI
LCD	Foreign Exchange Reserves (*Log*)	Amount of monetary external assets (IRFCL concept).	USD Milion ➔%	BI
SB	Interest Rate	Central Bank of Indonesia 7 Days Repo Rate (BI7DRR).	%	BI
LEHU	Expected Inflation (*Log*)	Index of general price expectation on the next 3 months.	Base Point ➔%	BI
PIHPR	Residential Property Index	Average of Residential Property Index by 15 Cities in Indonesia.	Base Point	BI
LTRANS	Stock Transaction Volume (*Log*)	Amount of stock transaction value in Indonesia stock exchange.	Rp Bilion ➔%	BPS
VK	General Banking Credit Volume	Amount of loan realization by general commercial bank.	Rp Bilion	OJK

In the ARDL method, hypothesis testing was done by looking at the direction of the statistical coefficient (positive or negative), if the result is contrary to the established hypothesis, it means the null hypothesis (H0) is accepted. Next, the level of significance decided from the probability (prob) value of the statistical results of the data processing. If the p value is <0.05 then the result is that the effect has a significant probability.

Models with BLUE (Best Linear Unbiased Estimation) criteria in ARDL were obtained through some of the stages, starting from stationarity tests (with the Augmented Dickey Fuller approach unit root test), classic assumption tests (Autocorrelation and Multicollinearity), Bound testing, model selection (Akaike Information Criteria approach), ARDL estimation, and model stability tests (CUSUM and CUSUM Square Test). The mathematical model used was:

$$NT_t = \sum_{i=0}^{n} \alpha_1 . NT_{t-i} + \sum_{i=0}^{n} \alpha_2 . INF_{t-i} + \sum_{i=0}^{n} \alpha_3 . LJUB_{t-i} + \sum_{i=0}^{n} \alpha_4 . OPT_{t-i} + \sum_{i=0}^{n} \alpha_5 . LCD_{t-i} + \sum_{i=0}^{n} \alpha_6 . LEHU_{t-i} + \sum_{i=0}^{n} \alpha_7 . SB_{t-i} + C_t + \varepsilon_t \quad (1)$$

However, if the Bound test results showed cointegration (the value of I(1) is greater than I(0)) then the model that must be used was ARDL-ECM, namely ARDL which was divided into long-run and short-run, with the following mathematical model:

$$\Delta NT_t = \sum_{i=0}^{n} \beta_1 . \Delta INF_{t-i} + \sum_{i=0}^{n} \beta_2 . \Delta LJUB_{t-i} + \sum_{i=0}^{n} \beta_3 . \Delta OPT_{t-i} + \sum_{i=0}^{n} \beta_4 . \Delta LCD_{t-i} + \sum_{i=0}^{n} \beta_5 . \Delta LEHU_{t-i} + \sum_{i=0}^{n} \beta_6 . \Delta SB_{t-i} + CointEq . (NT - (\alpha_1 . INF + \alpha_2 . LJUB_{t-1} + \alpha_3 . OPT_{t-1} + \alpha_4 . LCD_{t-1} + \alpha_5 . LEHU_{t-1} + \alpha_6 . SB_{t-1} + C_t + \varepsilon_t \quad (2)$$

Where: $\sum_i^n is$ the influence period of the variable, β_1 to β_6 is the short-run coefficient of the variable, $CointEq$ is the speed of adjustment of the model, α_1 to α_6 is the long-run coefficient of each variable, C is the constant of the model , and ε is the error term.

Next, the VAR method was carried out procedurally starting from the stationarity test, choosing the optimum lag, VAR stability test, causality test (Granger approach), VAR model estimation, analysis of Impulse Response Function (IRF), and finished with Forecast Error Variance Decomposition (FEVD) analysis. The VAR mathematical model used in this study, was:

$$NT_t = \sum_{i=0}^{n} \alpha_1 . NT_{t-i} + \sum_{i=0}^{n} \alpha_2 . LEHU_{t-i} + \sum_{i=0}^{n} \alpha_3 . PIHPR_{t-i} + \sum_{i=0}^{n} \alpha_4 . LTRANS_{t-i} + \sum_{i=0}^{n} \alpha_5 . VK_{t-i} + \varepsilon_t \quad (3)$$

The research hypothesis regarding the impact of Exchange Rate (ER) shocks was proven by examining each variable's movement response (up or down) in the IRF analysis. Meanwhile, the significance of the effect between variables was seen by comparing the t statistic with the t table.

The stationarity test is crucial in research with time series data. This test serves as a step that is able to show the stability of data changes. Data that is not stationary has the potential to produce an invalid model. Then, the basic assumption that must be met in

ARDL is that data cannot be stationary at the 2nd Difference level. In addition, the stationarity test also serves as a determination of the proper use of the model in the VAR method. When the data is stationary at levels, then the VAR model can be used, but data that is only stationary at the 1st Difference level must be continued with a cointegration test and estimated using the Vector Error Correction Model (VECM).

Result and Discussion

Determinants of Exchange Rate

Analysis of the exchange rate determinants using ARDL began with the data stationarity test. The result of test using the Augmented Dickey Fuller (ADF) unit root test showed that the Exchange Rate (NT) and Expected Inflation (LEHU) variables were stationary at the level (probability value less than 0.05), while at the 1st difference all variables were stationary. These results can be interpreted that all variables can be used in the ARDL method, where the main requirement was that the data must be stationary at the level and/or 1st difference.

Table 2 Result of Stationary Testing on ARDL Data by ADF Test

Prob. Value	Variable						
	NT	**INF**	**LJUB**	**OPT**	**LCD**	**LEHU**	**SB**
Level	0.0371*	0.1511	0.7489	0.9998	0.3380	0.0011*	0.5602
1st Difference	0.0000*	0.0000*	0.0000*	0.0000*	0.0000*	0.0000*	0.0000*

*p-value <0.05

Next, a classical assumption test was performed to ensure that the data produces a BLUE model. The normality test is not required to do on data with more than 30 (n) observations, because it fulfills the assumptions of Central Limit Theorem.

The heteroscedasticity test also not required considering that the study location (cross section) is only 1. Therefore, the classic assumption test that was carried out were autocorrelation and multicollinearity. The results shown in Table 3 can be interpreted that variable formulation of ARDL model clear of classical assumption problems.

Table 3 Result of Classical Asumption Testing

Autocorrelation			Multicolinearity				
Method	***Threshold***	**Result**	**Variable**	**Measurement**	***Threshold***	**Result**	
LM Test	*Prob. Chi Square* <0.05	0.0712 (No Autocor-relation)	INF	*Variance Inflation Factor* (VIF)	*Centered* VIF <10	3.2977	No Multico-linearity
			LJUB			2.3091	
			OPT			1.8261	
			LCD			1.3253	
			LEHU			6.1620	
			SB			7.3349	

The Bound test is a cointegration test approach used to ensure that all variables in the model have a long-run connection. The results of test in Table 4 can be concluded that a long-run connection among variables occurred, because the I(1) Bound value was greater than the I(0) Bound value. After passing the stationarity test, classical assumption, and bound test, data processing can proceed to the ARDL estimation step.

Table 4 Result of Bound Test

Significance Level	I (0) Bound	I (1) Bound
10%	2.12	3.23
5%	2.45	3.61
2.5%	2.75	3.99
1%	3.15	4.43

The selected ARDL model (based on the AIC Graph) is 1,0,1,0,2,4,0 orde (has the smallest AIC value). However, because the results of the Bound Test reveal that cointegration occurred, the model must be further broken down into short run and long run (ARDL-ECM). The results are showed in Table 5.

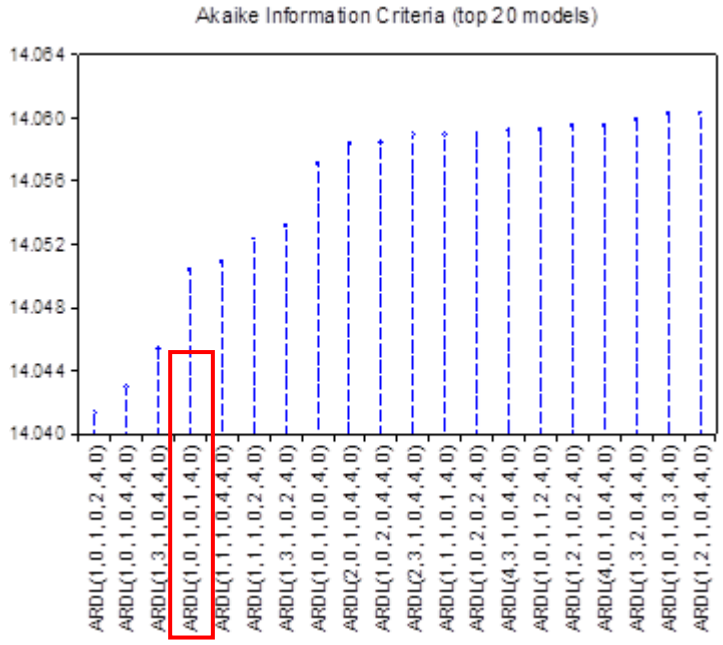

Figure 3 Result of Model Selection Test

In the short run, the Inflation (INF) variable had a significant positive effect on Exchange Rate (NT). It means that the increase of inflation affects the depreciation in the exchange rate. In the long run, % increase in Inflation (INF) of 1% led to depreciation of the Exchange Rate (NT) by 12,616.80 IDR/USD. The long-run coefficient of the Inflation (INF) variable was greater than the short-run coefficient, meaning that if inflation consistently increased in the long run, the coefficient of depreciation experienced by the exchange rate will also increase. These results proved that statistically, Hypothesis 1 was accepted. The Money Supply (LJUB) variable in the short run and long run had a significant positive effect. If the

volume of money supply increases, the exchange rate will depreciate, but the depreciation rate in the long run was smaller than in the short run. This can be observed from the magnitude of the variable coefficient. These results can be concluded that Hypothesis 2 of the study could be accepted.

Expected Inflation (LEHU) in the short-run (in the previous 3 periods) had a significant negative effect on the Exchange Rate (NT), while in the long-run the effect was actually a significant positive one. When the expected inflation in the previous 3 periods were at a good level (high index), the exchange rate for the next 3 months (current period) will appreciate.

Table 5 Result of ARDL Estimation

Short-run				Long-run			
Variable	**Coefficient**	**S.E**	**Prob.**	**Variable**	**Coefficient**	**S.E**	**Prob.**
ΔINF	6,291.57	2,998.78	0.0388**	INF	12,616.80	6,082.73	0.0411**
ΔLJUB	12,109.77	2,020.69	0.0000*	LJUB	7,567.23	832.86	0.0000*
ΔOPT	-0.81	0.26	0.0025*	OPT	-1.62	0.45	0.0005*
ΔLCD	-7,456.24	1,205.07	0.0000*	LCD	-9,738.13	1,698.19	0.0000*
ΔLCD_{t-1}	-1,894.48	1,192.56	0.1158				
ΔLEHU	665.91	470.10	0.1602	LEHU	2,948.81	930.17	0.0021*
$\Delta LEHU_{t-1}$	827.50	600.92	0.1721				
$\Delta LEHU_{t-2}$	-313.75	592.73	0.5979				
$\Delta LEHU_{t-3}$	-1,096.21	453.25	0.0177**				
ΔSB	-106.41	50.40	0.0376**	SB	-213.39	101.28	0.0380**
CointEq(-1)	-0.4986	0.08	0.0000*	C	-18,888.31	7,075.49	0.0091*

*significance at 0.01; **significance at 0.05

Meanwhile, expected inflation that was continuously high in the long run will actually result in exchange rate depreciation. The coefficient of expected inflation effect was in accordance with the established Hypothesis 3, but the short-run coefficient was not appropriate.

This happened because rising expected inflation in the short-run will lower consumption because people are on the alert for future price increases. Consumption of products with high prices, such as imported products, is also affected. If the interest in imported products decreases, the volume of imports will also run in harmony, so the exchange rate is getting strenghten in the short run. In the theory of aggregate demand-supply, if a country does not adhere to a sticky price system, then in the long run the condition of economy will return to a balance point even though the price level is higher than before. This is due to economic improvements (policies) that encourage stability on the aggregate demand side, for example through increasing wages or reducing tax rates.

The Interest Rate (SB) variable statistically had a significant negative effect in the short and long run. From these statistical results, it can be said that an increase of interest rates will encourage exchange rate appreciation, and the amount of appreciation will improve in the long-run. The results of research on the interest rate variable in this topic were

statistically in accordance with the established Hypothesis 4. Furthermore, the Foreign Exchange Reserves (LCD) variable produced a significant negative effect coefficient for the long-run and short-run, but the foreign exchange reserved in the previous period had an insignificant influence probability. This condition can be interpreted that the higher of foreign exchange reserves held by the monetary authorities, the more exchange rate will appreciate. In the long-run, if the foreign exchange reserves increase, the exchange rate will appreciate significantly. This result is in accordance with the hypothesis that had been set (Hypothesis 5).

Next, Open Market Operations (OPT) had a negative influence coefficient with a significant probability for both the short-run and the long-run. These results indicated that the exchange rate will appreciate when the open market operation intervenes (increases the volume of rupiah in the foreign exchange market). From these results, it can be concluded that Hypothesis 6 could be accepted. The magnitude of the exchange rate appreciation in the long-run was stronger when compared to the short-run.

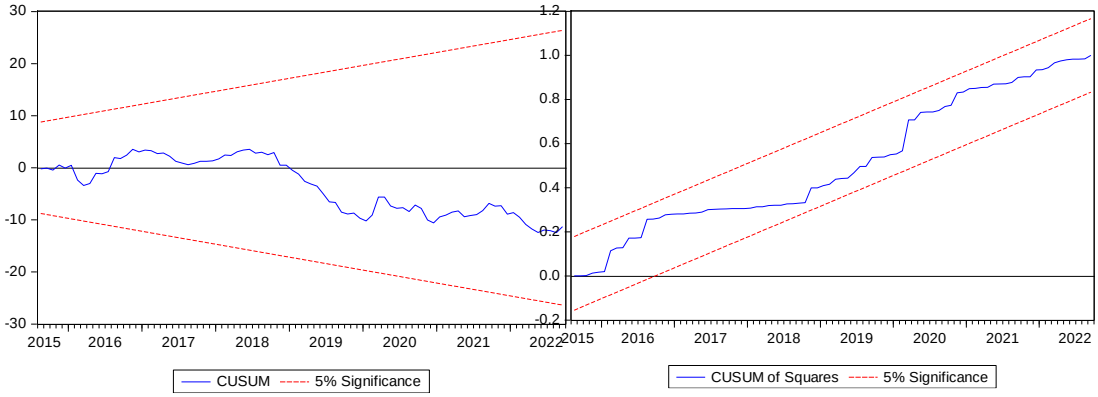

Figure 4 Result of ARDL Stability Test

The short-run model had a speed of adjustment of -0.4986. That is, the short-run model will reach a long-run balance at a rate of 49.86% per month. Next, the stability test of the ARDL model using CUSUM and CUSUM Square Test shows that the model was proven to be stable and can be used for the long-run because the CUSUM value was within the 5% significance (red line) area. From the data processing that had been done, the ARDL model produced in this study is:

$$\Delta NT_t = 6{,}291.57\,.\,\Delta INF_t + 12{,}109.77\,.\,\Delta LJUB_t - 0.81\,.\,\Delta OPT_t - 7{,}456.24\,.\,\Delta LCD_t - 1{,}894.48\,.\,\Delta LCD_{t-1} + 665.91\,.\,\Delta LEHU_t + 827.50\,.\,\Delta LEHU_{t-1} - 313.75\,.\,\Delta LEHU_{t-2} - 1{,}096.21\,.\,\Delta LEHU_{t-3} - 106.41\,.\,\Delta SB_t + 49.86\%.\,(NT - (12{,}616.80\,.\,INF + 7{,}567.23\,.\,LJUB_{t-1} - 1.62\,.\,OPT_{t-1} - 9{,}738.13\,.\,LCD_{t-1} + 2{,}948.81\,.\,LEHU_{t-1} - 213.39.\,SB_{t-1} - 18{,}888.31 + \varepsilon_t \quad (4)$$

Impacts of Exchange Rate Shocks

The Impact analysis on shocks of Exchange Rate (NT) to the variables of Expected Inflation (LEHU), Residential Property Index (PIPR), Stock Transaction Volume (LTRANS), and General Banking Credit Volume (VK) using the VAR method also began with a stationarity test. The unit root test result (Table 6) showed that every variables were stationary at the levels. This condition allowed the use of the VAR model and did not need to do the cointegration test.

Table 6 Result of Stationary Testing on VAR Data by ADF Test

Prob. Value	Variable				
	NT	**LEHU**	**PIHPR**	**LTRANS**	**VK**
Level	0.0294**	0.0078*	0.0269**	0.0000*	0.0103*
1st Difference	0.0000*	0.0000*	0.0000*	0.0000*	0.7623

*p-value <0.01; **p-value <0.05

Table 7 Result of Lag Optimum Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1,895.08	NA	71,100,000,000	39.17687	39.30958	39.23053
1	-1,522.54	698.9942	54,980,033*	32.01108*	32.80738*	32.33306*
2	-1,506.25	28.88703	66,065,494	32.19064	33.65053	32.78095
3	-1,487.45	31.3899	75,860,083	32.31858	34.44205	33.17721
4	-1,456.37	48.71270	68,237,698	32.19309	34.98014	33.32003
5	-1,432.56	34.84605	72,238,543	32.21776	35.6684	33.61303
6	-1,419.06	18.37882	96,145,436	32.45476	36.56899	34.11835
7	-1,396.78	28.01927	109,000,000	32.51089	37.2887	34.4428
8	-1,374.19	26.07925	126,000,000	32.56065	38.00205	34.76089

*selected optimum lag

After the stationarity test, the next step was to specify the optimum lag which was selected from the smallest value of AIC. Table 7 shows that the optimum lag in this model was lag 1. The stability test of the VAR model was carried out by looking at the modulus value of the Auto Regressive (AR) Root. The model can be said to be stable if the modulus value < 1. Table 8 shows that the modulus generated by AR Root ranges from 0.06 – 0.99. From these results, it can be avowed that the VAR model used was stable.

Table 8 Result of VAR Stability Model

Root	Modulus
0.998110	0.99811
0.761425 + 0.042978i	0.762637
0.761425 + 0.042978i	0.762637
0.356666 – 0.371321i	0.514869
0.356666 + 0.371321i	0.514869
0.412662 – 0.232676i	0.473739
0.412662 + 0.232676i	0.473739
-0.31297	0.312969
-0.19053	0.190532
-0.06789	0.067893

The Granger causality test showed that all variables did not have two-way connection (cause and effect), but there was one-way connection from Exchange Rate (NT) to Stock Transaction Volume (LTANS), then Banking Credit Volume (VK) to Exchange Rate, also Banking Credit Volume to Stock Transaction Volume. This conclusion was obtained from the F statistic p-value which was smaller than the 5% significance level (0.05).

After passing the stationarity test, choosing the optimum lag, and Granger causality test, the VAR model can be estimated. The estimation results of the VAR model at lag 1 can be interpreted that current condition (period) of Exchange Rate (NT_t) is formed from the positive conditions of the Exchange Rate itself in the previous period (NT_{t-1}), as well as the positive conditions of the Expected Inflation, Residential Property Prices Index, and Banking Credit Volume variables in the previous period ($LEHU_{t-1}$, $PIHPR_{t-1}$, and VK_{t-1}). In addition, the negative condition of the Stock Transaction Volume in the previous period ($LTRANS_{t-1}$)also had an impact. Among the 5 variables in the VAR model, which contributed significantly to the current condition of the Exchange Rate were the Exchange Rate itself, and Expected Inflation, and Banking Credit Volume.

Table 9 Result of Granger Causality Test

Variable	F. Statistics Prob.Value				
	NT	**LEHU**	**PIHPR**	**LTRANS**	**VK**
NT	-	0.7881	0.8068	0.0278**	0.1540
LEHU	0.6489	-	0.3933	0.4048	0.3179
PIHPR	0.9957	0.7156	-	0.5657	0.5054
LTRANS	0.1449	0.9051	0.9494	-	0.0700***
VK	0.0023*	0.8349	0.7959	0.0002*	-

*p-value <0.01; **p-va;ue <0.05; ***p-value <0,1

After passing the stationarity test, choosing the optimum lag, and Granger causality test, the VAR model can be estimated. The estimation results of the VAR model at lag 1 can be interpreted that current condition (period) of Exchange Rate (NT_t) was formed from the positive conditions of the Exchange Rate itself in the previous period (NT_{t-1}), as well as the positive conditions of the Expected Inflation, Residential Property Prices Index, and Banking Credit Volume variables in the previous period ($LEHU_{t-1}$, $PIHPR_{t-1}$, and VK_{t-1}). In addition, the negative condition of the Stock Transaction Volume in the previous period ($LTRANS_{t-1}$)also had an impact. Among the 5 variables in the VAR model that contributed significantly to the current condition of the Exchange Rate were the Exchange Rate itself, Expected Inflation, and Banking Credit Volume.

From the data processing that has been done, the formed of VAR model is:

$$NT_t = 0.74\,.\,NT_{t-1} + 527.14\,.\,LEHU_{t-1} + 470.37\,.\,PIHPR_{t-1} - 11.93\,.\,LTRANS_{t-1} + 0.74\,.\,VK_{t-1} + \varepsilon_t \quad (5)$$

After estimating the VAR model, the impact of shocks on Exchange Rate (NT) can be seen by looking at the responses of other variables to the shocks that occur to them (Figure 4). The Banking Credit Volume (VK) variable shows a negative (decreasing) response to exchange rate shocks. These results are in accordance with the established hypothesis

(Hypothesis 7). Banking Credit Volume response had been moving for 15 months, after that, the reponse looked stable and did not approach point 0, so it can be interpreted that Exchange Rate shocks had a long-run impact on Banking Credit Volume. Next, the Residential Property Prices Index (PIHPR) response to Exchange Rate shocks was negative (decreasing). From these results, it can be concluded that Hypothesis 8 was proven. This response lasted for 7 months, then in 8th to 24th month it looked close to point 0. It means that shocks in the Exchange Rate did not leave a long-run impact on the Residential Property Price Index variable.

Table 10 Result of VAR Estimation

Variable	NT	LEHU	PIHPR	LTRANS	VK
NT (-1)	0.737444	0.000006	0.000002	0.00001	-16.8799
(S.E)	(0.06887)	(0.000012)	(0.000006)	(0.000044)	(11.2122)
[t stat]	[10.7080]*	[0.49946]	[0.29499]	[0.22635]	[-1.50549]
LEHU (-1)	527.1357	0.880359	-0.017861	0.468425	12,321.85
(S.E)	(264.585)	(0.04801)	(0.02297)	(0.168160)	(43,076)
[t stat]	[1.99231]*	[18.338]*	[-0.77771]	[2.78553]*	[0.28605]
PIHPR (-1)	470.3657	0.064927	0.633724	0.553937	-62,568.12
(S.E)	(889.31)	(0.16136)	(0.07719)	(0.5622)	(144,785)
[t stat]	[0.52891]	[0.40238]	[0.78737]	[0.98003]	[-0.43215]
LTRANS (-1)	-11.93128	0.048801	0.007201	0.766728	14,076
(S.E)	(105.362)	(0.019120)	(0.00915)	(0.06697)	(17,153.6)
[t stat]	[-0.11324]	[2.55274]*	[0.78737]	[11.4496]*	[0.82059]
VK (-1)	0.737444	0.000006	0.000002	0.00001	-16.8799
(S.E)	(0.06887)	(0.000012)	(0.000006)	(0.000044)	(11.2122)
[t stat]	[10.7080]*	[0.49946]	[0.29499]	[0.22635]	[-1.50549]
R Square	0.8590	0.5037	0.4202	0.6376	0.9957

*t-stat <t-table(1.98304)

The Stock Transaction Volume (LTANS) variable showed a positive response to shocks that occurred in Exchange Rates. These results proved that Hypothesis 9 was accepted. The response movement lasted for 10 months. After that, in months 11 – 24, this response looked stable and did not approach 0 point, meaning that shocks to exchange rates left a long-run impact on Stock Transaction Volume. Expected Inflation (LEHU) showed an increasing response. From these results, it was evident that Hypothesis 10 can be accepted. The rising response from the Expected Inflation variable moved for 14 months, after that until the 24th month it tended to be stable and consistent at a positive coefficient but did not seem to be getting closer to 0 point. This could mean that shocks that occurred in the Exchange Rate left an impact (response) that lasted in the long run for the Expected Inflation variable.

After analyzing the response of each variable to shocks that occur in the Exchange Rate, the next step is to analyze changes in the composition of the variance of each variable. In other words, what will be done at this stage was to look at the variables that had the most major role in the movement of the variable itself and other variables. In the 24-month forecasting, the movement of the Exchange Rate appears to be dominated by itself, followed by Expected Inflation, Stock Transaction Volume, Banking Credit Volume, and Residential Property Prices Index. The contribution of the Exchange Rate to its own

movement over the next 24 months was seen to have decreased to 56.59% from the previous 100%. This was inversely proportional to the other 4 variables, where the contribution seemed to be increasing. The contribution from Residential Property Prices Index had seen an increase in the 12th month, but in the 24th month it had decreased compared to the 12th month.

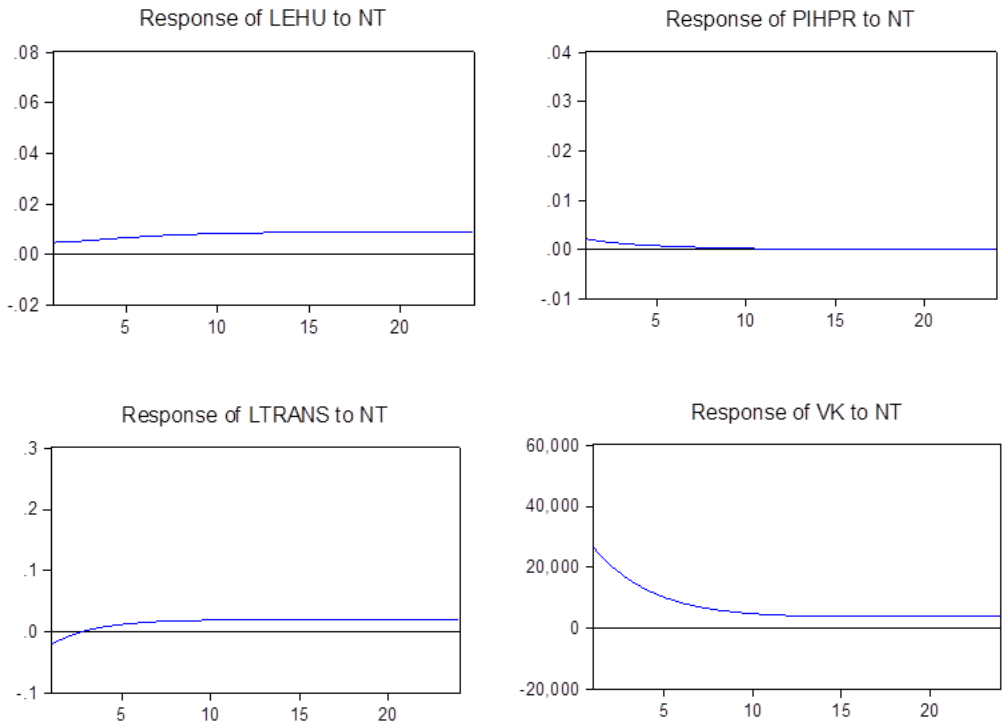

Figure 5 Graph of Impulse Response Function

Movement of Expected Inflation was also seen to be dominated by itself, followed by Stock Transaction Volume, Exchange Rates, Residential Property Prices Index, and Banking Credit Volume. Except Exchange Rate, the decreases magnitude in the contribution of Expected Inflation to itself appearred to be the most significant when compared to the contribution movement achieved by other variables. Expected Inflation's contribution to the movement remained at 69.61% from the previous 99.42% in the first forecasting period and 76.82% in the 12th forecasting period. The Exchange Rate seemed to have contributed to the movement of Expected Inflation since the first forecasted period . Next, the movement of Residential Property Prices Index was very self-dominated, even in the 24th month of forecasting, the contribution rate was still at 96.21%. However, the movement of this variable had been influenced by the Exchange Rate and Expected Inflation since the first period of forecasting. The variable that contributed the second largest after the Residential Property Prices Index was Expected Inflation, followed by Stock Transaction Volume, Exchange Rate, and Banking Credit Volume.

The movement of Stock Transaction Volume was dominated by itself, but also influenced by Exchange Rates, Expected Inflation, and Residential Property Prices Index since the first month of forecasting. In the 24th period, Expected Inflation appearred to play an

important role in the movement of Stock Transaction Volume. This can be seen from its contribution which increased dramatically to 39.20% from the previous 0.99% in 1st and 27.98% in 12th month.

Table 11 Result of Forecast Error Variance Decomposition (FEVD)

Variable	Period	S.E	NT	LEHU	PIHPR	LTRANS	VK
NT	1	348.3810	100.0000	0.0000	0.0000	0.0000	0.0000
	12	621.8607	78.2253	13.0354	0.6628	4.9624	3.1141
	24	739.2958	56.5857	22.1659	0.6315	14.4504	6.1665
LEHU	1	0.0632	0.5821	99.4179	0.0000	0.0000	0.0000
	12	0.1886	1.7510	76.8200	0.6729	20.6941	0.0621
	24	0.2583	2.3517	69.6100	1.0743	26.9213	0.0428
PIHPR	1	0.0302	0.5467	0.9218	98.5313	0.0000	0.0000
	12	0.0394	0.7961	1.8992	96.2325	1.0245	0.0476
	24	0.0394	0.7993	1.9016	96.2113	1.0267	0.0611
LTRANS	1	0.2214	0.8152	0.9916	1.7707	96.4225	0.0000
	12	0.4782	1.3386	27.9781	1.2269	68.9480	0.5083
	24	0.6174	2.0923	39.1988	1.2187	56.4057	1.0845
VK	1	56,718.41	21.9145	2.4751	0.0676	0.0579	75.4849
	12	182,716.40	5.6445	1.0113	0.5660	4.9432	87.8350
	24	254,402,00	3.2076	0.5570	0.6361	8.4086	87.1906

Changes or movements that occurred in Banking Credit Volume also appear to be dominated by itself. Unlike the other variables whose contribution was getting weaker on its own, Credit Volume actually showed strengthening. The first month of forecasting, the contribution of Banking Credit Volume to the itself movement was 75.48%, this figure had increased to 87.83% in the 12th month, and showed a slight decrease in the 24th month to 87.19%. The reverse condition was experienced by the Exchange Rate and Expected Inflation, where the longer the forecasting period, the weaker its contribution to the movement of Banking Credit Volume. After analyzing the results of data processing related to the determinants of exchange rates and the impact of shocks, a summary of the results of hypothesis testing was obtained (table 12).

Table 12 Resume of Hypothesis Testing Result

	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
Short-run	**	**	*	**	**	**	**	**	**	**
Long-run	**	**	**	**	**	**	**	***	**	**

*Accepted H0
**Rejected H0
*** No Response in Long-run

Discussion

Exchange rate stability is the main thing that must be maintained to achieve economic stability. The stronger monetary authority's ability to maintain exchange rate stability, the impact of shocks can be minimized and immediately handled. The weakening condition that occurs in the exchange rate is called depreciation. The greater nominal value of the rupiah that must be exchanged for foreign currency means that the exchange rate is

depreciating. Every discussion regarding the movement of exchange rate conditions (appreciation and depreciation) traced from any sector will focus on liquidity or the quantity of money. In this study, it appears that the variable that has the greatest influence on the appreciation (depreciation) of the exchange rate in the short-run is money supply. These results support research from Funashima (2020), Gong et al. (2022), and Yulianti (2014). In the long-run, the coefficient of money supply influence is smaller and even lower than inflation, where both of them result in depreciation. The finding that inflation also causes exchange rate depreciation is in line with the results of research from Bato et al. (2017), dan Chandrarin et al. (2022). Money supply and inflation are two variables that have a causal relationship (Sarker & Wang, 2022), so their effect on the exchange rate is also aligned.

Under the theory of money quantity, if the volume of money supply in society increases, the ability of people to pay for products (or consume) will be higher and the equilibrium price level will increase. In the long-run this can be said as inflation. When the domestic economy experiences inflation, the price of domestic goods (and services) becomes more expensive and imported products appear cheaper so that the level of demand increases. The higher demand for imported products will increase the quantity of imports. If it continues, this will have an impact on the increasing number of rupiah currency that must be exchanged into USD so that the exchange rate depreciates. In international trade, this increase in import volume has the potential to cause a defisit on Balance of Payment (BOP). The export side is difficult to encourage when there is inflation because the production costs that must be incurred are higher, so the price of the output produced also rises. The high cost of these export products has weakened Indonesia's competitiveness in the global market. Therefore, the effect of inflation in the long run is greater when compared to money supply because inflation creates a complex domino effect both domestically and internationally, while money supply tends to have more influence on the domestic side.

The changes of the money supply is also related to expected inflation. When expectations for general goods in the future rise, expected inflation will be high. In the consumer behavior theory, price is the main variable that influences preferences, given the limited budget to achieve the highest satisfaction. In the very short-run, high expected inflation will shift the pattern of shifting consumption from domestic products to imported products, thus driving the depreciation of the exchange rate. However, when the exchange rate continues to depreciate, the price of imported products becomes more expensive and people will return to consuming domestic products so that the exchange rate is getting appreciated in the short run. Moreover, an increase of expected inflation could also be caused by an increase of money supply. The high money supply will be followed by increased demand for goods and services so that production sectors will be encouraged. In the long-run, if it is assumed that there will be no additional production input factor capabilities from the domestic market, then the production sector must fulfill these input factors from the global market through imports. The increase in imports to meet the production input factors will result in a depreciation of the exchange rate. The findings in this research are in line with the results that have been researched by Herkenhoff and Sauré (2021) dan Lee & Kim (2019).

Next, exchange rate stability can be carried out by direct intervention by the Central Bank through open market operations and foreign exchange reserves. Regarding open market operations and foreign exchange reserves, the findings from this study support the results of research from Carli & Gomis-Porqueras (2021), Chanda et al. (2020), Ito & McCauley (2020), Rocheteau et al. (2018) and Uz Akdogan (2020). Open market operations will affect the exchange rate from both the regulation of Rupiah liquidity and direct intervention in the foreign exchange market. The injection of Rupiah open market operations can encourage banking power to access more funds so that the high level of demand for credit can be offset. This condition reflects the increasing ease of access to capital for the production side so that the country's ability to produce higher output. When there is an increase in output, it can be interpreted that the ability to meet domestic demand increases so that imports can be suppressed. Increased capital for production sectors has the potential to boost the ability to export as well. These two conditions make the Rupiah currency that must be exchanged into USD smaller and the international Balance of Payments (BOP) will be in surplus. This causes the strengthening (appreciation) of the exchange rate.

The surplus balance of payments will be accommodated by foreign exchange reserves. The greater surplus in the BOP, the foreign exchange reserves will increase. Foreign exchange reserves are a recapitulation of external liquid assets owned by the monetary authority and can be used whenever to intervene in exchange rates. High foreign exchange reserves reflect the great competitiveness of a country in carrying out trade and the ability to obtain capital in an international scope. On the other hand, high foreign exchange reserves also indicate the increasing power of the monetary authority to intervene in the country's currency. Therefore, the higher of foreign exchange reserves will result in an appreciation of the exchange rate both in the short and long-run. The results of data processing show that, in the long-run model, a 1% growth in foreign exchange reserves will strengthen the exchange rate by 9,738.13 IDR/USD.

Domestically, the strength of the exchange rate which is highly dependent on money supply and inflation can be interpreted as having a close relationship with the movement of interest rates. In this study, it appears that the effect of interest rates on exchange rates is negative (appreciation). These results support research from Elias et al. (2022), Kilian and Zhou (2022), and Ulm & Hambuckers (2022). Even though they both cause exchange rate appreciation, the coefficient of influence produced by interest rates is smaller when compared to foreign exchange reserves because it requires a longer time lag. Interest rates can affect exchange rate movements through the banking sector and capital markets. When the interest rate rises, people will be interested in making savings so that the collected bank's fund will increase. This implies that the ability of banks to distribute funds (to meet credit demands) also increases. The higher number of realized loans means that the production sectors have the potential going to scale up. On the other hand, the increase in production sectors will also create an improved corporate portfolio climate in the capital market. This positive sentiment in the capital market has further encouraged the production side to develop so that the ability to participate in export activities has also increased. This is what causes exchange rate appreciation.

An economy that adheres to a floating exchange rate regime means that the power of the monetary authority is not fully entitled of intervening in exchange rate stability. Therefore shocks that occur in the exchange rate still have an impact on the economy, especially for the banking, property and capital market sectors. The banking sector is most affected by the volume of credit. This study shows that the defense's duration on credit volume response to exchange rate shocks is the longest compared to other variables. Credit volumes decrease when exchange rate shocks occur. This happens because the depreciation of the exchange rate has the potential to cause inflation and the Central Bank will overcome this by increasing interest rates so that the money supply falls and the purchasing power of money is maintained (theory of money quantity). The increment in interest rates suppresses demand for credit because the amount to be paid will be higher. Interest in this low demand for credit has resulted in the volume of banking credit realization also declining. This study's results align with the findings of Fabiani et al. (2022) and Yun and Cho (2022).

Overcoming exchange rate shocks using this interest rate will also have an impact on the property sector. High interest rates and economic instability due to exchange rate shocks make people prefer to hold money with precautionary motives (liquidity preference theory). This motive is realized through an effective budget allocation where consumption will be reduced and diverted to saving. Low public interest in consumption has forced the property sector to compensate by lowering prices so that its products can still be absorbed in the market. Therefore, when an exchange rate shock occurs, property prices will respond negatively (decrease). However, many other factors (besides exchange rate shocks) affect prices in the property sector so that the impact caused by exchange rate shocks does not last in the long run. These results are in line with research from Anastasia and Hidayat (2019) and Dąbrowski and Wróblewska (2020).

Exchange rate shocks make the economy look unstable, so expected inflation will increase and negative sentiment from foreign investors in the capital market will occur. When foreign investors' interest in the capital market worsens, this creates a loophole for domestic investors to increase their portfolio investment holdings. Therefore, the volume of stock transactions has actually increased. Investors will assume that the return to be obtained in the future will be higher than the current purchase price. This assumption occurs because exchange rate shocks will certainly be handled by the Central Bank through the realization of policies to seek economic recovery. This finding is support the research result from Ding (2021), Huang et al. (2021), and Sa'adah (2020). Exchange rate shocks raise expected inflation due to unfavorable economic conditions which encourage people to assume that future prices will be more expensive due to economic instability due to exchange rate shocks. These results support research from Anderl and Caporale (2022) and Lee and Kim (2019).

Exchange rate stability should focused on controlling determinants and mitigating the impact of shocks. To control determinants, policies can be grouped into 2 sides, namely input and output. In this study, the variables that can be positioned as the input side are Open Market Operations, Foreign Exchange Reserves, and Interest Rates. In conditions where the Exchange Rate is depreciating, the injection type of Rupiah Open Market

Operations can be carried out. Some instruments that can be executed are the Repo Open Market Operations and the sale or purchase of SBN or outright SBSN. In addition to Rupiah Open Market Operations, monetary policy instruments that are more practical to implement are Foreign Currency Open Market Operations, especially by Spot intervence, Forward, Swap, and DNDF (Domestic non Deliverable Fund) transactions because they allow this to be done without an auction process. If the Rupiah Open Market Operations or Foreign Currency Open Market Operations is still insufficient to overcome the depreciation of the exchange rate, the Central Bank has the right to intervene by guaranteeing a number of Foreign Exchange Reserves to the Central Bank of the country associated with the weakening of the exchange rate, for example if the weakening occurs in the IDR/USD exchange rate enact foreign exchange reserves guaranteed to the Fed. The Central Bank will also offset this policy by controlling the macroeconomy in aggregate while maintaining the inflation rate. This condition will be controlled through regulation of interest rates. Exchange rate depreciation can be overcome by increasing interest rates because this will have an impact on reducing money supply and a maintained inflation rate.

Next, the biggest Exchange Rate shock (on the Banking Credit Volume), can be overcome by decreasing the Countercyclical Capital Buffer (CCyB) or increasing Short-run Liquidity Loans (PLJP) for banks. A decrease in CCyB and an increase in PLJP will maintain the financial system even though the economy is in a contractionary condition. The mechanism taken from the CCyB policy is to increase banking capital formation during an economic expansion. The proceeds from capital formation can be used when the economy is contracting, so that the financial system remains stable. The maintenance of financial system stability will also have an impact on maintained inflation expectations. When offset by setting high interest rates and positive morale, this decreased CCyB can also be used as a policy to overcome the impact of exchange rate shocks on stock transaction volume. The impact of exchange rate shocks on property prices can be increased by the Loan to Value or Financing to Value (LTV/FTV) ratio. The high LTV/FTV ratio allows collateral from debtors (in the form of property) to retain a high nominal value even though prices in the property sector are falling in line with the depreciation of the exchange rate. On the other hand, the high LTV/FTV ratio can also protect the production side of economic agents in the property sector. Public interest in property products will be maintained because the value of these properties remains high when used for transactions in the banking sector.

Conclusion

This study has presented a more complex analysis regarding the determinants of the rupiah exchange rate against the USD and the impact of shocks on it. The findings in this study have provided new contributions both theoretically and practically as well as able to illustrate comparisons of previews studies with the same topic. The data processing results regarding the determinants of the exchange rate using the ARDL method show that most of the effect coefficients were in accordance with the established hypothesis. The variable that had the greatest effect on the depreciation of Exchange Rate in the

short-run was Money Supply, while in the long-run was Inflation. Next, the variable that had the greatest influence on the appreciation of the Exchange Rate both in the long-run and in the short-run was Foreign Exchange Reserves. The impact of Exchange Rate shocks lasted the longest on General Banking Credit Volume, which was 15 months, followed by Expected Inflation for 14 months, Stock Transaction Volume for 10 months, and Residential Property Prices Index for 7 months. The Residential Property Prices Index were the only variable with no long-run impact due to Exchange Rate shocks.

The implication of the findings produced in this study is that a structured mechanism must be developed to maintain economic stability to balance exchange rate movements. Maintaining exchange rate stability by considering interventions through monetary policy instruments is the main thing that must be done to minimize the adverse effects of shocks. The regime that adheres to a floating exchange rate system presents the consequence that the stability of the exchange rate cannot be overcome only through the intervention of the domestic monetary authority, apart from that many other exogenous factors influence it. Therefore, the impact of exchange rate shocks must still be overcome, one of which is through macroprudential policies.

Policy recommendations (suggestions) that can be proposed are in accordance with the findings: exchange rate stability can be maintained through a maintained inflation rate. The policy taken must be in accordance with the conditions encountered. Open market operations injection can be carried out when the exchange rate depreciates. This is the most practical open market operations because open market operations is the only monetary policy that can be implemented daily. If the exchange rate is still depreciating, it can be offset by raising the interest rate and using the foreign exchange reserves intervention. However, this condition has the consequence of a decrease in the intensity of economic activity because liquidity of money supply will be absorbed. The use of foreign exchange reserves also has the consequence that the deficit in the international balance of payments must be minimized considering that the role of foreign exchange reserves is not only to exchange rates intervene, but also to finance BOP deficits. Exchange rate intervention through proper control of interest rates, foreign exchange reserves, and open market operations will have a domino effect, namely maintaining expected inflation, in the end money supply conditions and inflation can be maintained. Exchange rate shocks to property prices can be overcome with a Loan to Value or Financing to Value (LTV/FTV) ratio policy. Next, the impact on banking credit volume and expected inflation can be overcome through Countercyclical Capital Buffer (CCyB) policies and Short-run Liquidity Loans (PLJP). The impact on stock transaction volume can be pursued by setting interest rates and moral situation to influence the ability and preferences of domestic investors.

The limitations of this research situated the focus of discussion which tends to the specific scope of the monetary sector and the international economy, while the determinants and impacts of exchange rate movements are not limited to the monetary sector but the macroeconomy as a whole. Therefore, subsequent studies on similar topics will be refined by including more complete macrovariables so that the discussion and proposed policy recommendations are more comprehensive. However, the monetary authority is the

main institution responsible for exchange rate conditions, so that discussion of exchange rates sequenced through the monetary sector is a worthy topic of research.

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