The Analysis of Interdependency Macroeconomic Variables of Rupiah Exchange Rate Volatility using Vector Auto Regression Period 2008-2017

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Abstract: Understanding volatility of rupiah exchange rate very important because interdependency of macro economic variables. Fluctuation one of macroeconomic variables then rupiah exchange rate volatility certain follow moving appreciation or depreciation suspend from fast or slow fluctuation one of macroeconomic variables. Dornbusch theory state with the concept of "Overshooting" (soaring/fluctuating) with the "Monetary Sticky Price" model. The basis of this model is the uncertainty of fluctuating high rupiah exchange rate volatility. This study explores how the interdependence of macroeconomic variables on rupiah exchange rate volatility. The data used series time data were conducted that accepted from Economic and Financial Statistics Bank of Indonesia during the period of 2008-2017. The methods used in this research were Vector Autoregression (VAR). The results of the study concluded that (1) in the short term dominant cointegration towards inflation, the money supply, the export of non-oil and gas commodities (2) while the medium term cointegration towards interest rates (3) and while in the long term cointegration of gross domestic product (4) In addition, non commodity export shocks Oil and gas in the short term does not provide a dominant contribution to the volatility of the rupiah exchange rate, in the medium term interest rates make a dominant contribution to the volatility of the rupiah exchange rate, and in long-term growth (GROW) make a dominant contribution to the volatility of the rupiah. Government policy simulations emphasize interest rates to 6.5 percent so that inflation can subside after the 2008 global crisis, but not reduce the money supply and increase economic growth, the government is important to simulate other policies to better anticipate the global crisis.

1 INTRODUCTION

Economic and financial stability is currently inseparable from changes in the development of macroeconomic variables that affect the volatility of the rupiah exchange rate. One of the changes in the development of macroeconomic variables is that they are unstable, which can result in a turbulent global financial crisis that has changed the world economic order, especially Indonesia, and has a significant effect on the volatility of the rupiah (Bank Indonesia, 2016).

One of the theories of exchange rate volatility is that introduced by Rudi Dornbusch (in Pilbeam, 2016) using the concept of "Overshooting" with the "Sticky hgjsMonetary Price" model. The basis of this model is the uncertainty of soaring high exchange rate volatility. With the concept of overshooting the exchange rate, it is assumed that there are several parts of the economy that cause instability from other parties, especially the exogenous variables change, which results in short-term effects on exchange rates that can be greater or higher in long-term effects so that the exchange rate exceeds its value in the long run. One exogenous variable changes as the high interest rates affect the depreciation of the exchange rate in the short term so that the possibility of price increases can be followed by exchange rate behavior, the overshooting trend of exchange rates is in the long run.

As is known by the phenomenon that has occurred in Indonesia in 1997/1998, there was an economic crisis in which the turbulent macroeconomy which quickly affected economic fundamentals through the exchange rate channel.

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Assuming, from Dornbush's theory that there are several macroeconomic variables such as inflation, interest rates, and the money supply that affect exchange rate volatility, where price increases will create supply of goods which will increase relative prices of domestic goods as a result of exchange rates depreciated by 8,025 Rupiah/USD (Indonesian Economic Report, 1998) so interest rates were also high through behavioral balance in the money market so that the money supply increased which caused slow and depressed exchange rate movements in the short term.

From this study it can be concluded that exchange rate volatility applies to free floating systems. From this phenomenon can be presented a graph of the development of rupiah exchange rate volatility from 2008 to 2017 in Figure 1. is Volatility of Exchange Rate

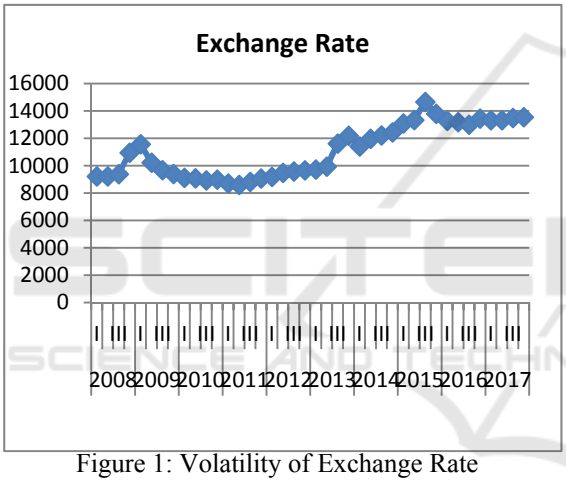

Figure 1: Volatility of Exchange Rate
Source: Bank of Indonesia

From the graph it can be seen that the rupiah exchange rate over the past ten years has fluctuated quite as much as in 2008, 2013 and 2015. However, consistent and prudent macroeconomic policies accompanied by exchange rate stabilization measures can generally reduce the pressure excessive. Despite being hit by a variety of fluctuations, the rupiah exchange rate moved steadily from 2009 to 2013 in quarter III. However, the impact of the wider global financial crisis triggered a significant amount of asset release by investors, which caused strong pressure on the rupiah exchange rate during the third quarter of 2015. In 2015 in the quarter III the rupiah exchange rate volatility experienced depreciation at the level of Rp. 14,657, but in the fourth quarter of 2015 the exchange rate volatility appreciated until the fourth quarter of 2016 which had a good impact on macroeconomic variables with 5.5 percent inflation in 2016 to 4.25 percent. In 2017, the decline caused by macroeconomic variables, the BI rate interest rate rose above inflation, triggering the growth of the real sector and declining capital costs and increasing demand for banks which could then increase economic growth.

Judging from the trend above, which causes the development of exchange rate volatility inevitably fluctuates from the impact of macroeconomic variables. Next in Figure 1.2. is inflation, interest rates, and gross domestic product

presented graphs of developments in inflation, GDP, interest rates, JUB, and commodity exports (non-oil and gas) that affect the volatility of the rupiah exchange rate in 2008-2017.

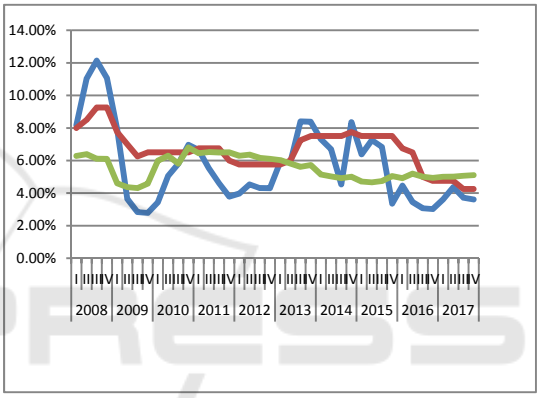

Figure 2: Inflation, interest rates, and gross domestic product

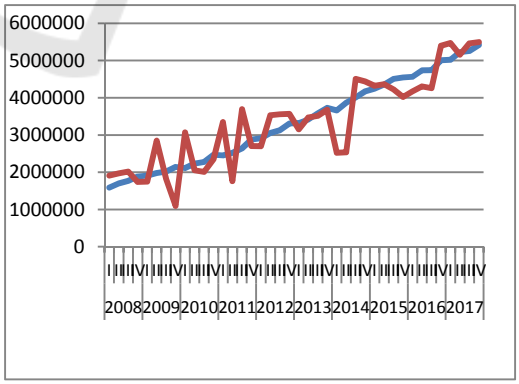

Figure 3: Money supply and commodity exports of non-oil and gas
Source: SEKI, Bank of Indonesia

When seen the volatility trend of the rupiah exchange rate in the past decade has depreciated, it shows that the rupiah has declined against the US dollar due to the global crisis. Figure 1.2 (a),

inflation shows a rising trend due to world oil prices reaching 9.2 percent so the inflation trend reaches 11.06 percent and experienced a significant economic slowdown of 6.01 percent. At the same time, BI emphasized the interest rate (BI Rate) was much lower, emphasizing interest rates would have an impact on increasing the money supply (Pohan, 2008). But from the post-global crisis BI focused its financial performance so that the economic crisis could subside which was done by emphasizing the price of oil to be cheaper and sharp enough to lower oil prices so that inflation could subside around 2.78 percent so that the inflation trend declined and returned within the target range the country especially Indonesia to emphasize lower interest rates and improve economic growth towards a positive direction.

The decline in domestic inflation, in theory is very much responded by the public to reduce the price of commodity goods, the world of work to increase employment and reduce unemployment, and rising economic growth towards a positive direction for the welfare of society. Likewise, the trend in the interest rate in 2010 began to decline due to appreciation in the rupiah exchange rate appreciation, but JUB continued to show improvement. The rupiah exchange rate during the 2011-2012 period has weakened to depreciate against the US dollar, as shown in Figure 1.2 (a) is inflation, interest rates, and gross domestic product) where the same year inflation, interest rates indicate a decline and economic growth also slowed by 6.11 percent, seen from Figure 1.2 (a) is inflation, interest rates, and gross domestic product) so trend inflation, interest rates, and economic growth intersect with JUB in fact increase as in Figure 1.2 (b) is money supply and commodity exports of non-oil and gas). Seeing the condition of the rupiah exchange rate increase, exports of goods will also increase abroad. The export price of the goods tends to be cheap compared to the prices of domestic goods, which causes the supply of goods both domestic and foreign to increase, in turn, will reduce the price of the goods so that the CPI must be able to be controlled with the target can help the inflation process towards lower long term. And it is seen that the inflation trend in 2012 has slightly increased, this indicates that a significant increase in JUB can cause the inflation rate to rise.

2 THEORICAL FRAMEWORK

2.1. Rupiah Exchange Rate Volatility

Overshooting exchange rates can occur when exchange rates adjust faster than goods and services. Dornbusch treats the exchange rate as a jump variable where the exchange rate adjusts quickly to the disruption of the economy, while other variables such as output, price, and interest rates are in adjustment to be slow to barely move. Dornbusch extends the version of the perfect capital mobility from Mundel-Fleming. Dornbusch includes exchange rate expectations to explain volatility in exchange rates and include dynamic elements (Dornbusch, 1980).

The characteristics of the Dornbusch model are sticky prices in the short term. Overshooting the model involves the process of adjusting in exchange rates and immovable prices at the same speed level. Suppose there is a monetary expansion. Short-term expansion of monetary policy causes interest rates to fall. This reduction in interest rates immediately pushes adjustments in exchange rates but prices adjust gradually. In response to a shock to the economy, the exchange rate will be overshooting the level of balance. First of all the exchange rate will move to a level above the balance then it will gradually return to the long-term balance.

2.2. Macroeconomic Variables

Macroeconomics is a branch of economics that studies the phenomenon of economic indicators in aggregate or whole, for example economic growth, unemployment, inflation, interest rates, circulation of money in an economy. Macroeconomic explanations include economic changes that affect all households, companies, and markets simultan (Mankiw, 2004: 500). And there are also four keys in the macro market, namely (1) natural resources, (2) exports of goods and services or commodities, (3) loanable funds, and (4) foreign exchange (exchange rates) (Sobel, 2009).

Inflation

Inflation is one indicator of macroeconomic variables in analyzing the economy of a country, especially related to the broad impact on aggregate macroeconomic variables. According to Lerner (Gunawan, 1995), inflation is a situation where there is an excess demand for goods and services as a whole. According to Keynesian theory, inflation is an excess of money supply compared to demand and without expansion of money supply, excess aggregate demand can occur if the increase in consumption expenditure, investment, government expenditure, and exports, thus inflation can be caused by monetary and non-monetary factors (Gunawan, 1995).

Interest rate

Interest rate stability is expected, because the stability of interest rates also encourages financial market stability so that the ability of financial markets to channel funds from people who have productive investment opportunities can run smoothly and economic activities also remain stable According to Mishkin (2008: 60) and interest rates are one indicator of macroeconomic variables in analyzing the economy of a country is mainly related to the widespread impact on macroeconomic variables in the aggregate (Gunawan, 1995). Therefore, Bank Indonesia is in charge of maintaining the stability of interest rates to create a more stable financial market.

Gross Domestik Product

According to Robert B. Barsky in N. Gregory Mankiw (2005; 15), Gross Domestic Product (GDP) is the total income from the production of goods equal to the amount of wages and profits in the upper half of the circulation of money. Gross Domestic Product (GDP) is the market value of coal and final services produced in the economy for a certain period of time. GDP is often considered the best measure of economic performance. This statistic is calculated every three months by the Bureau of Economic Analysis from a large number of primary data sources. The goal of GDP is to summarize economic activity in the value of a single currency over a long-term period.

Money Supply

The amount of money is one of the indicators of economic macro variables, which in the form of capital, which are based on the balance of the quantity of money. The amount of money is in the wild (just supply) holding the investor in the economy of a country. The amount of money that is released in the economy of a country will be able to give a boost to the exchange rate of its currency against foreign currencies. The increase in the offer of money or the amount of money will increase the price of goods which are measured by the value of money and will also increase the price of foreign exchange measured by the domestic currency (Triyono, 2008).

Exports Of Non-Oil And Gas Commodities

Countries that have implemented an open economic system will interact freely with other economies throughout the world. One of the activities of international economic interaction is by conducting commodity exports (Non-oil and gas). According to Tietenberg (2014: 149) that commodity exports (non-oil and gas) are energy resources that are endless and renewable. Resources (Non-oil and gas) do not have a limited amount at a certain time so that if the resources are depleted, this will certainly not interfere and will not hinder the sustainability of economic development. The non-oil and gas sector consists of the agriculture, mining and minerals sub-sectors, as well as the processing industry. These three non-oil and gas subsectors have important contributions to Indonesia's economic and financial growth.

3 RESEARCH METHOD

This study discusses the analysis of interdependency of macroeconomic variables on the volatility of the rupiah exchange rate. This study use the Vector Auto Regression (VAR) method to see the short and long term endogenous variables which are considered to have interdependence between macroeconomic variables towards the volatility of the rupiah exchange rate. The type of data used in this study is secondary data that is time series in the observation period Q: 1 2008 up to Q: IV 2017. The data sources used for this study are allowed from Indonesia Financial and Economic Statistics (SEKI) published by Bank of Indonesia (BI), the Indonesian Economic Report (LPI), and the Central Statistics Agency (BPS).

The Vector Auto Regression (VAR) method first proposed by Sims (1980) appears as a solution to the problem of the complexity of estimation and inference processes because of the presence of endogenous variables on both sides of the equation (variable endogeneity) which are dependent and independent. While economic theory alone as a basis for consideration of simultaneous equations will not be sufficiently complete in providing strict and precise specifications for dynamic relationships between variables (Yahya, 2017).

The VAR stage is to do stationary testing of the data used in determining the maximum lag and optimal lag that will be used to perform stationary tests, cointegration tests, estimation of the VAR model, impulse response, and variance decomposition.

Stationary Data Test (Root Test Unit / Unit Root Test)

The first step in processing time series data is by testing stationarity or unit root test. Stationary data will tend to approach average values and fluctuate around the average or have a constant range. If the data is stationary, then the method chosen is the VAR method and if it is not stationary then use the VECM method. (Ayyuniyyah, Laily and Beik, 2013). The assessment of Dickey and Fuller's methods (Gujarati, 1998) are as follows:

$$\Delta Y_t = \gamma Y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta Y_{t-1+1} + e_t$$

where:

Y = observed variable

ΔYt = $Yt - Yt - 1$

T = time trend

Cointegration Test (Optimal Lag Length)

To determine the length of lag used supporting parameters, namely: AIC (Akaike Information Criterion), SIC (Schwarz Information Criterion), and LR (Likelihood Ratio). Determination of the number of lags used from the VAR equation with AIC, SIC, or LR is the smallest amount of lag. The value of AIC, SIC, or LR is useful for choosing the best model. However, if there is a contradiction between the values of AIC, SIC, and LR, the criteria of SIC is used because the SIC criteria provide a scale that is greater than the other criteria.

According to Enders (2014) the calculations of AIC and SC are as follows:

$$\mathbf{AIC\ (k)} = TT\ \ln\left(\frac{RSS\ (K)}{T}\right) + 2n$$

where:

T = number of observations used

K = lag length

SSR = Redisual Sum of Squares

N = number of money parameters estimated

Johansen Cointegration Test

In this study the cointegration test used was the cointegration test developed by Johansen. This test can be used to determine the cointegration of a number of variables (vectors). In the Johansen cointegration test carried out with two statistical tests, the first to test the null hypothesis can use trace test statistics which require that the number of cointegration directions is less than or equal to p and this test can be done as follows:

$$\lambda\mathbf{trace(r) = -T\ i} \sum_{i=y+} p\ \ in\ \mathbf{(1-}\lambda\mathbf{i)}$$

where:

$\lambda\gamma$ + 1, ... λn declares the value of the smallest eigenvectors ($\rho - r$).

Vector Auto Regression (VAR) of Analysis Model

VAR is a system and equation with the number of endogenous variables as much as n. VAR is a multivariate time series which assumes that all variables are endogenous variables. Sims (1980) states that there is true simultaneity between all variables. Then all related variables must be treated correctly, there must be no difference in treatment between endogenous and exogenous variables. Enders (2014) formulates primitive first order bivariate systems which are written as follows:

$$\mathbf{yt = b10 – b12\ zt + \gamma 11\ yt\text{-}1 + \gamma 12\ zt\text{-}1 + \varepsilon yt}$$

Impulse Response Function (IRF)

Impulse Response is one of the important analyzes in the VAR / VECM model. This impulse response analysis tracks the response of endogenous variables in the VAR / VECM system due to shock or changes in the disturbance variable (e). The impulse response in this study was conducted to determine the interdependence response of macroeconomic variables to the volatility of the rupiah exchange rate.

Forecasting Error Variance Decomposition

In addition to the impulse response in the VAR / VECM model it also provides analysis of Forecasting Error Variance Decomposition or often called variance decomposition. In a variance decomposition, it can be seen the relative importance of each variable in the VAR / VECM system due to shock. Variance decomposition is useful for predicting the contribution percentage of each variable due to changes in certain variables in the VAR / VECM system.

Granger Causality Analysis

In economic analysis, the causal relationship between variables does not only run in one direction. So through the granger causality test in essence it can indicate whether a variable has a two-way relationship or only one direction. In regression analysis, even though we have made the influence of one variable on other variables, it is not explained the direction of the relationship of the variable. In other words, the extension of the relationship between variables does not indicate causality or direction of the relationship. Causality Test generally uses a test developed by Genger, with the Granger Causality Test method.

Equation models that can be formed from the above conditions are:

$$NTR = \propto_0 + \propto_1 \mathbf{INF} + \propto_2 \mathbf{SB} + \propto_3 \mathbf{PDB} + \propto_4 \mathbf{JUB} + \propto_5 \mathbf{EXKNM}$$

where:
Y : Dependent Variable (NTR)
$\propto\_0$: constants
$\propto\_1$: matrix parameter n x n, for every 1 = 1, 2, ... p
X_1 : INF
X_2 : SB
X_3 : GDP
X_4 : JUB
X_5 : EXKNM

To reinforce the causality model above, an F-Test can be done for each regression. To test the hypothesis, the F test is used as follows:

$$F=\frac{(RSS_R-RSS_{UR})/m}{RSS_{UR}/(n-k)}$$

where :
m = number of lags
k = number of parameters estimated in unrestricted regression

4 ANALYSIS

This research is a follow-up study from previous studies that produced a design method of analysis that produces about:

Development of Volatility in Rupiah Exchange Rates

Throughout 2008 to 2017, there were three peaks where the exchange rate volatility depreciated, namely in 2008, 2013, and 2015 where in all three years all goods needs rose continuously which resulted in a weak rupiah exchange rate. However, consistent and prudent macroeconomic policies accompanied by measures of exchange rate stabilization can generally reduce the occurrence of excessive pressure. Despite being hit by a variety of fluctuations, the rupiah exchange rate moved steadily from 2009 to 2013 in quarter III. However, the impact of the wider global financial crisis triggered a significant amount of asset release by investors, which caused strong pressure on the rupiah exchange rate during the third quarter of 2015.

In general, the volatility of the rupiah exchange rate experienced instability until the end of December 2015. It began the volatility of the exchange rate in 2008 in Q4 IV at the level of Rp. 10,950 per US dollar due to the inflation rate of 11.06 percent resulting in an increase in world prices and a drop in commodity prices which depressed the rupiah, so that the rupiah exchange rate depressed. In 2013, in Q4 IV there was volatility in the rupiah exchange rate experiencing instability at the level of Rp. 12,250 due to the interest rate (BI) rate increasing until early 2014 from 5.75 percent to 7.75 percent in the fight against the depreciating rupiah which limited the foreign exchange liquidity and balance of payments deficit.

In 2015 in the quarter III the rupiah exchange rate volatility experienced depreciation at the level of Rp. 14,657, but in the fourth quarter of 2015 the exchange rate volatility appreciated until the fourth quarter of 2016 which had a good impact on macroeconomic variables with 5.5 percent inflation in 2016 to 4.25 percent. In 2017, the decline caused by macroeconomic variables, thes BI rate interest rate rose above inflation, triggering the growth of the real sector and declining capital costs and increasing demand for banks which could then increase economic growth.

Development of Macroeconomic Variables

Macroeconomic variables used in this study are inflation, interest rates, gross domestic product, money supply, and exports of non-oil and gas commodities. This macroeconomic variable is also an endogenous variable which is considered to have an interdependence between the variable volatility of the rupiah exchange rate.

The following is briefly explained the development of macroeconomic variables used in this study, as follows:

In the fourth quarter of 2008 there was a global crisis where all goods needs increased due to world oil prices reaching 9.2 percent so the inflation trend reached 11.06 percent and experienced a significant economic slowdown of 6.01 percent. At the same time, BI emphasized the interest rate (BI Rate) was much lower, emphasizing interest rates would have an impact on increasing the money supply (Pohan, 2008). But from the post-global crisis BI focused its financial performance so that the economic crisis could subside which was done by emphasizing the price of oil to be cheaper and sharp enough to lower oil prices so that inflation could subside around 2.78 percent so that the inflation trend declined and returned within the target range the country especially Indonesia to emphasize lower interest rates and improve economic growth towards a positive direction.

The decline in domestic inflation, in theory is very much responded by the public to reduce the price of commodity goods, the world of work to increase employment and reduce unemployment, and rising economic growth towards a positive

direction for public welfare. Likewise, the trend in the interest rate in 2010 began to decline due to appreciation in the rupiah exchange rate appreciation, but JUB continued to show improvement. The rupiah exchange rate during the 2011-2012 period has weakened to depreciate against the US dollar, where with the same year inflation, interest rates indicate a decline and economic growth also slowed by 6.11 percent but the amount of money in circulation is still increasing where Indonesian banks cannot attract the amount of money in society to be reduced so that economic growth does not continue to slow down and even the volatility of the rupiah exchange rate continues to depreciate to date.

5 RESULTS

Stationarity Test

The augmented Dickey Fuller Test (ADF test) results on the NTR (Rupiah Exchange Rate), INF (Inflation), Interest Rate, GDP (Gross Domestic Product), JUB (Money Supply), the EKNM (Export of Non-oil Commodities) are presented in table 1 below:

Null Hypothesis: Unit root (individual unit root process)
Series: Y, X1, X2, X3, X4, X5
Date: 08/17/18
Time: 12:44
Sample: 2008 2017
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 3
Total number of observations: 224
Cross-sections included: 6

Tabel 1:Unit Root Test

Method	Statistic	Prob.**
ADF-Fisher Chi square	142.733	0.0000
ADF - Choi Z-stat	10.3213	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality. Intermediate
ADF test results D (UNTITLED)

Series	Prob.	Lag	MaxLag	Obs
D(Y)	0.0001	0	9	38
D(X1)	0.0000	0	9	38
D(X2)	0.0014	0	9	38
D(X3)	0.0013	3	9	35
D(X4)	0.0000	0	9	38
D(X5)	0.0000	1	9	37

All variables of the Prob value. His <0.05, it is stationary at first difference. At first different the stationary has been tested then the results are stationary so we continue with the regress VAR

Cointegration Test

Cointegration tests are conducted to see whether among the variables there are cointegrated, either randomly or irregularly, at least among the variables there is one that is cointegrated. Based on the results of the tests carried out, the results obtained as shown in table 5.2 are;

VAR Lag Order Selection Criteria
Endogenous variables: D(Y) D(X1) D(X2) D(X3) D(X4) D(X5)
Exogenous variables: C
Date: 08/17/18 Time: 20:16
Sample: 1 40
Included observations: 36

Table 2: Lag Optimal Test

Lag	LogL	LR	FPE	AIC
0	-1367.740	NA	5.62e+25	76.31887
1	-1328.157	63.77176	4.75e+25	76.11985
2	-1296.410	40.56647	7.16e+25	76.35609
3	-1236.229	56.83708*	3.10e+25*	75.01273*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC:Schwarz information criterion
HQ: Hannan-Quinn information criterion

From the results obtained, it is known that the optimum lag is 3 which is indicated by the most number of asterisks (*) in lag 3

Vector Auto Regression (VAR) of Analysis Model

VAR Model - Substituted Coefficients:
==========
D(Y)=-0.113884585481*D(Y(-1))- 0.715797471729*D(Y(-2))-0.481357171336*D(Y(-3))+ 33.4506413885*D(X1(-1))+18.9930119224*D(X1(-2))+ 172.743648182*D(X1(-3))+362.822243193*D(X2(-1))+ 25.7217477862*D(X2(-2))+233.526150069*D(X2(-3))-392.8

00381611*D(X3(-1))-508.691804752*D(X3(-2))-153.144651134*D(X3(-3))- 0.000871801654563*D(X4(-1))+0.00269698056232*D(X4(-2))+0.00369735260857*D(X4(-3))+0.000143214123963*D(X5(-1))+ 0.000139759923035*D(X5(-2))+1.88664763183e-05*D(X5(-3)) - 267.534125709

D(X1)=-0.00173481077078*D(Y(-1))-0.000777048753329*D(Y(-2))-0.000662930817514*D(Y(-3))-0.165411884068*D(X1(-1))+0.178791377505*D(X1(-2))+0.121916249943*D(X1(-3))+1.21958232882*D(X2(-1))-0.00721322599839*D(X2(-2))- 0.61870857 3721*D(X2(-3))-0.560009053009*D(X3(-1))+0.297779289534*D(X3(-2))+0.235196122872*D(X3(-3))+7.2951499098e-06*D(X4(-1))+8.64014501021e-06*D(X4(-2)) + 1.5361745813e-06*D(X4(-3)) + 2.01008955641e-07*D(X5(-1))-1.65476499611e-07*D(X5(-2))- 2.87129019645e-07*D(X5(-3))-1.39391241196

D(X2)=-0.000294444597221*D(Y(-1))-0.000119120145977*D(Y(-2))+0.000107270155489*D(Y(-3))+0.133710901718*D(X1(-1))+0.125197005184*D(X1(-2))+0.0217702739235*D(X1(-3))+0.255648641462*D(X2(-1))+0.00532231118813*D(X2(-2))-0.379958150987*D(X2(-3))-0.521702148326*D(X3(-1))-0.0216829604442*D(X3(-2))-0.156936321447*D(X3(-3))+7.28529712477e-07*D(X4(-1))+1.0713054295e-06*D(X4(-2))+4.97909411856e-07*D(X4(-3))-1.16515023832e-07*D(X5(-1)) - 2.56920654825e-07*D(X5(-2))-2.84626707384e-07*D(X5(-3))-0.227443958008

D(X3)=-0.000229917029967*D(Y(-1))+7.17425816281e-05*D(Y(-2))+5.16065758101e-05*D(Y(-3))+0.0321609063049*D(X1(-1))-0.0789446848571*D(X1(-2))-0.0999994252515*D(X1(-3))+0.300218933817*D(X2(-1))-0.0709165261706*D(X2(-2))-0.332571 98949*D(X2(-3))-0.31249217219*D(X3(-1))+0.285855540212*D(X3(-2))+0.326354270847*D(X3(-3))+8.22758211697e-07*D(X4(-1))+6.82195109183e-07*D(X4(-2))-1.10069273157e-06*D(X4(-3))-1.5955 3449912e-07*D(X5(-1))-3.546078514e-07*D(X5(-2))-7.63279338794e-08*D(X5(-3)) - 0.00504545026802

D(X4)=-1.70235905047*D(Y(-1))-80.1823108979*D(Y(-2))+8.86455520077*D(Y(-3))+49.9353057396*D(X1(-1))-6560.99747326*D(X1(-2))+16468.6650153*D(X1(-3))+10390.4618753*D(X2(-1))+25386.5269739*D(X2(-2))-31101.0652128*D(X2(-3))-87566.2012359*D(X3(-1))-6235.22666368*D(X3(-2))+34898.1710327*D(X3(-3))-0.273319709328*D(X4(-1))+0.27146650924*D(X4(-2))-0.13153409842*D(X4(-3))+0.0278535342473*D(X5(-1))+0.00053566869689* (X5(-2))-0.000746748146813*D(X5(-3))+116880.907627

D(X5)=165.144332798*D(Y(-1))-304.438625026*D(Y(-2))-759.527707087*D(Y(-3))-28620.0527944*D(X1(-1))-145331.046896*D(X1(-2))- 25190.1328579*D(X1(-3))-103953.334722*D(X2(-1))+77174.709886*D(X2(-2))+4002.79856279*D(X2(-3))-464150.95668*D(X3(-1))-333513.070251*D(X3(-2))+617552.944775*D(X3(-3))+0.33810791237*D(X4(-1))+2.73511 0 30442*D(X4(-2))+4.47193062324*D(X4(-3))-0.688887054718*D(X5(-1))-0.570856084071*D(X5(-2))- 0.314729222488*D(X5(-3))-419939.528885

6 CONCLUSIONS

The VAR estimation test results show variable endogen, are inflation, interest rates, gross domestic product, money supply, and non-oil commodities during the past period have an interdependence on the current volatility of the exchange rate, where one variable contributes to the other variables and contribute to the variable itself.

The integrated macroeconomic variables in the long-term universe in the short and medium term are only directly related variables that contribute according to existing random surprises.

In the short-term dominant cointegration of inflation, the money supply, exports of non-oil and gas commodities while medium-term cointegration of interest rates and long-term cointegration of gross domestic product

In addition, short-term export shocks of non-oil and gas commodities do not make a dominant contribution to the volatility of the rupiah exchange rate, in the medium term interest rates make a dominant contribution to the volatility of the rupiah exchange rate, and in long-term growth (GROW) make a dominant contribution to volatility rupiah exchange rate. Government policy simulations emphasize interest rates to 6.5 percent so that inflation can subside after the 2008 global crisis, but not reduce the money supply and increase economic growth, the government is important to simulate other policies to better anticipate the global crisis.

Based on the results of the study, it is known that related and cointegrated macroeconomic variables in the long run are therefore in determining policies so that the authorized parties see the effects of macroeconomic variables in the short, medium and long term.

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