sciendo

Imam Mukhlis [*] *, Isnawati Hidayah* [**] *,*
Nora Ria Retnasih [***]

Interest Rate Volatility of the Federal Funds Rate: Response of the Bank Indonesia and its Impact on the Indonesian Economic Stability

[*] Faculty of Economics, Universitas Negeri Malang, Indonesia

E-mail:
imam.mukhlis.fe@um.ac.id

[**] International Development Studies, Wageningen University & Research, The Netherlands

E-mail:
isnawati.isnawatihidayah@wur.nl

[***] Faculty of Economics and Islamic Business IAIN Tulungagung, Indonesia

E-mail:
rhaarianto@gmail.com

Abstract: This research aims to analyse the response of the Bank Indonesia (BI rate) to the Indonesian economic stability. The data analysis is stationarity test, model stability test, lag determination, Structural Vector Autoregression (SVAR), Impulse Response Function (IRF), and Variance Decomposition (VD). The research data is obtained from the publication provided by the Federal Reserve Data (FRED), the Bank Indonesia, and the Central Bureau of Statistics. The data used is since the third quarter of 2005 to the first quarter of 2017. The research results showed that the variable of the federal funds rate (FFR) significantly influences the exchange rate and the Consumer Price Index (CPI), but it does not significantly affect the BI rate, the amount of the money supply (M2), and Gross Domestic Product (GDP). The result of the IRF test showed that the BI rate, the amount of money supply, exchange rate (IDR/USD), GDP, and CPI positively and negatively respond the FFR change. The result of VD test indicated that the variation of the BI rate, the currency exchange rate, and CPI are mostly caused by the FFR variation.

Keywords: Federal Funds Rate, BI Rate, Money Supply, Exchange Rate, Structural Vector Autoregression

JEL Classification: C58, E58

1. Introduction

The favourable outcomes of economic development are indicated by the level of economic work achievement in a certain country. In fact, the economic condition is not continually stable. Many factors can influence it, including internal factors of the country and external factors from the other country. Internally, Samuelson and Nordhaus (2005) explained the measurement of macroeconomic work wholistically includes the short-term fluctuation in the output, job opportunity, and the prices. The indicators that are used namely interest rate, the amount of money supply, exchange rate, inflation, economic growth, and unemployment. Meanwhile, externally, the condition of the international economy that stably works will contribute to the rapid economic growth in many countries. On the contrary, the uncontrolled international economic fluctuation can result in instability of the economy and economic crisis. In this case, there is a close relationship between economic crisis and constellation happening in the global economy. The economic crisis can quickly spread to many countries due to the economic globalisation. Meanwhile, the globalisation process is influenced by the economic crisis (Tuca, 2014).

The financial crisis in the United States (US) in 2008 is one of the examples of the change of global economic condition impacting on the global economic performance. Moreover, the hegemony of the U.S. to the world economy is extremely big. Akalin and Prater (2015) indicate that the case of the U.S. crisis expected a decrease of the U.S. dollar value against other currencies. This case can be indicated by the use of USD as the foreign currency globally accepted in international economic transactions. In the context of trade between countries, the American market still becomes the reference for exploring for many countries. Even the index of the share price in America (Down John Index in Wall Street) still becomes the reference for the monetary authority in many countries in determining the monetary policy. Similarly, the development of interest instrument of U.S. Federal Reserve still becomes the reference for the monetary authority and world economic policy makers in their activity. In such situation, the global financial market is suppressed in the turbulence period. Therefore, the economic growth and the process of economic recovery are interrupted (Apostolakis, 2016).

The economic crisis happening in America can result in contagion effect on the global economy. This global economic interaction causes the economic dependency between countries (Mankiw, 2009). The economic hegemony of the United States can bring about international spillover. This international spillover can give rise to the suppression in the financial market and the uncertainty of policy done by each country (Liow et al., 2018).

Monetary fluctuation in the financial market of America responded by the Fed through the FFR instrument can implicate in the economic stability in many countries. The openness era of the world economy has caused the economic interdependence between countries. Various studies have been conducted to analyse the effect of monetary fluctuation in America on the world economy. Bluedorn and Bowdler (2006) in their research concluded that the interest rate of FFR has an effect on the exchange rate of US$ currency and interest rate in G-6 countries. Lee (2006) in his study concluded that there was a relatively significant response in the form of interest rate volatility because of the monetary policy of U.S. Federal Reserve through the instrument of the FFR interest rate. Meanwhile, Garg (2008) in his empirical study concluded the positive relationship between the share price and the FFR interest rate. In line with such research, Chandan and Rajat (2017) also believe that the monetary policy can affect output, exchange rate, and inflation.

In facing the situation of instability of the global economy, the proper policy response is necessary. In this case, the monetary policy plays an essential role in maintaining the stability of a state economy. For instance, macroprudential instrument to increase the system resilience to shocks (i.e. exchange rate and interest rate, sectoral vulnerabilities to asset prices, excessive credit growth) (Dumičić, 2017). In Mundell Fleming theory (Mankiw, 2009), it is stated that in the small open economy, the determination of interest rate is influenced by the world interest rate. Therefore, to adjust the global economic change and keep the domestic condition remains stable the Fed can play its role in adjusting the interest rate. The interest rate change will finally influence the real sector through transmission of monetary policy.

In the transmission mechanism, monetary policy can be done in two steps. The first stage is that monetary policy change is transmitted through money market to the market that directly influences the decision of spending of individual or companies, namely obligation market and bank loan market. The interest rate of short-term money market will influence the interest rate of long-term obligation and credit interest. The second phase, the monetary policy mechanism is transmitted from the financial system to the real economy. In this stage, the monetary policy fluctuation directly gives effect to the real production and aggregate price of Petursson (2001). Thus, companies need to decrease their sales because of risky economies caused by depreciation of local currency which potentially decrease the profits of companies (Brůna & Blahová, 2016).

Indonesia is a country categorised as an emerging market dependent on a developed country`s economy. Such dependency is related to export-import activities

and foreign capital flow. The instability that happens in the developed countries can bring about the declaration of national economic activity. Thereby, the condition of a national economy still shows the ability of the country to tackle the impact of global economic instability. In this case, the national economic growth performance that reaches the mean of 5%-6% per year in some periods proves the trust of world economic policy makers to the condition of the national economy. As a result, the capital flow entering the financial market in Indonesia significantly increases. The infiltration of international finance into the domestic economy of Indonesia gives multiplier effects in the expansion of national economic activities. This expansion also happens in the form of monetary policy to reduce the global economic fluctuation. In this case, the national economic development in the global economic constellation during the period of 2005-2017 shows stability. When the world experiences deceleration of economic growth, decrease in the oil price and world share prices, and China currency strengthens against US$, the national economy still can upgrade the economic growth. This case cannot be separated from the response of the Bank Indonesia in anticipating the impact of global economic fluctuation through the relevant monetary policy instrument.

This research aimed to analyse the response of the Bank Indonesia, the amount of the money supply, the exchange rate of IDR/US$, Gross Domestic Product and Consumer Price Index as a result of change of the Fed`s FFR.

2. Theoretical Review

The FFR interest rate is determined by the Board of Governors of the Federal Reserve System through the Federal Operation Market Committee (FOMC) in anticipating the dynamic of world economic development for the economy of America. In this case, the FED can control the economic stability through three instruments of monetary policy namely open market operation, discount rate, and reserve requirement. Through the three policy instruments, the FED can influence the financial liquidity in the money market of United States and also in the world money market.

As the monetary instrument, the FFR interest rate always undergoes the volatility in line with the response of the FED toward the economic dynamic. The more significant the escalation of the economic crisis, the greater the response of central bank in mitigation and recovery of the economy as well. Subsequently, the FFR interest rate will determine the supply of reserve asset. In other words, the interest rate volatility of the FFR can influence the availability of financial liquidity, inflation, and currency exchange rate. The determination of the FFR interest

rate will be fastly responded by financial market and economic agents. Hence, the monetary policy is needed to anticipate the fluctuation in the economy through the money market, the capital market, and the forex market.

Vidakovic (2002) added that the primary purpose of the monetary policy in a small open economy is to maintain the real exchange value is stable in the long-term to stimulate the export and suppress the import. Therefore, inflation is still kept at an acceptable level the monetary system and banking economy. The monetary policy is designed to protect the economy of the specific country from the uncertainty happening in the global economy. This case is essential since the uncertainty will result in the marketer's negative expectation. If such thing is addressed by improper monetary policy, it will disturb financial liquidity in the economy. Regarding this thing, Levin (2016) stated that the unexpected monetary policy gives more significant impact on the short-term financial market outcomes. The liquidity management involves planning the inflow and outflow of funds, liquidity monitoring and the adoption of measures that would help prevent or resolve insolvency of the bank (Županović, 2014). The condition of uncertainty of an economy usually occurs in the economy with high capitalisation that is vulnerable to shocks happening in the global economy.

In the perspective of macro economy, the equilibrium of economy in the specific country is formulated into the equation of national income equilibrium. According to Mankiw (2009), informing the Mundell Fleming model, the equilibrium equation is as follow.

$$Y = C (Y - T) + I (r) + G + NX (e) \tag{1}$$

$$M/P = L(r,Y) \tag{2}$$

$$r = r^\star \tag{3}$$

Equation (1), (2), and (3) describe some equilibrium conditions. The first is the equilibrium in the good market. The aggregate income (Y) is the summation of consumption (C), investments (I), government spending (G), and net exports (NX). The netto export has a negative relationship with the exchange value e. In this model, the price assumed does not change so the change of exchange rate is proportional to the real exchange rate. Second is the equilibrium in the money market. The offer of the real money equilibrium is similar to the demand (L). The money demand in the open economy under the flexible exchange rate system is determined by the monetary authority. Meanwhile, the money demand has a negative correlation with the interest rate (R) and positive relationship with the income (Y). The notation P reflects the price rate. The money demand (M) is the

exogenous variable controlled by the central bank. The third is the balance of payments. This balance is influenced by the factors affecting the trade and capital scale namely, domestic income, real exchange rate, and the difference in the interest rate where the international interest rate (r*) determines the interest rate in the economy. The three equations in that national income equilibrium show that macro economy is vulnerable to dynamic happenings in the economy. The economic crisis occurring in other countries can quickly influence the condition of the economy between countries. In this case, the work of export, import, capital flow, and the interest rate can be disturbed as the result of instability of the economy.

Numerous researches have been conducted in analysing the effect of monetary policy and volatility of the FFR interest rate to the economic stability of the specific country. Bluedorn and Bowdler (2006) in their study concluded that the FFR interest rate that is independent and unpredicted more dramatically influences the U.S. exchange rate with G-6 countries and the interest rate in G-6 countries than the influence given by the actual FFR. Besides, the output of G-6 countries and the price rate also respond to the change of FFR interest rate that is independent and unpredicted.

Chandan and Rajat (2017) in their study concluded that monetary policy can affect output, exchange rate, and inflation. In this case, price and exchange rate increase initially in response to a contractionary policy shock. Meanwhile, Kontonikos et al (2016) in their research concluded that there is a negative response in the obligation fluctuation happening in the FFR interest rate in America.

In the case that occurred in Pakistan, the research conducted by Nizamani et al (2016) showed that the effectiveness of monetary policy was limited in stabilising the domestic variable. In this case, the mechanism of monetary policy through the interest rate was only effective in the short-term. Meanwhile, the credit gives effect on the stability of domestic price in both short and long-term. This finding can ensure the State Bank of Pakistan to prioritise the mechanism through the interest rate in controlling inflation and utilising credit to increase the long-term output.

The research conducted by Vinayagathasan (2013) identified the indicator of a monetary policy that thoroughly explains the mechanism of transmission of monetary policy of Sri Lanka. This research also predicted the fluctuation coming from the foreign monetary policy and the oil price influencing the variable of the domestic macro economy. The empirical finding showed that the fluctuation of interest rate have a significant role in explaining the monetary policy trans-

mission mechanism. Second, targeting of the reserve money was a better strategy for the domestic economy. The third, the fluctuation of foreign monetary policy and the fluctuation of the oil price seem not to influence the domestic economy.

The research results provide the global conclusion that the monetary policy holds an essential role to anticipate any fluctuations happening in the economy. The volatility occurring in the FFR interest rate can impact on the instability of the macro economy of specific country. As the effort of anticipation and recovery in the economy, the instrument of monetary policy can be chosen by the faced problem. In this case, the interest rate is the instrument having the short-term orientation to create and expand the financial liquidity in the economy.

3. Research Method

The data used is the secondary data in the period of the third quarter of 2005 to the first quarter of 2017. The data of FFR interest rate were obtained from the report published by the Federal Reserve Data (FRED). The data of interest rate of BI and IDR/US$ exchange rate were attained from the Indonesian Economic and Financial Statistics published by the Bank Indonesia. Meanwhile, the data on Consumer Price Index (CPI) and Gross Domestic Product (GDP) were gained from the report published by the Central Bureau of Statistics.

Meanwhile, the methods of data analysis employed in this study are:

a. The data stationarity test; this test was conducted to test whether the data used have the unit root or not by using Augmented Dickey-Fuller test (ADF test) with the following equation.

$$\Delta y_t = (\rho - 1)y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta y_{t-i} + u_t \tag{4}$$

b. SVAR test; this test is the part of VAR system extricated and used as the predicting model. According to Nezky (2013), the stable model of SVAR will influence the validity of the result of Impulse Response Function (IRF) test and Variance Decomposition (VD) test.

The SVAR method was selected when doing ADF test; the result was that the data was stationary in the level that it is called SVAR model for the level. Besides, if the data are not stationary in the level, the difference is then made so that the data become stationery at the first difference level (1), so SVAR model with the

different model can be used. The specification of SVAR model that was used is as follows (Nezky, 2013).

$$A_0 X_t = A(L)X_{t-1} + B\varepsilon t \qquad (5)$$

Explanation: Xt is the vector with six variables used (FFR, BI RATE, Money Supply (M2), Exchange Rate (ER), GDP, CPI); A_0 is the intercept vector between variables (n x 1); An (L) is the coefficient matrix with the operator of lag L (n x n); ε_t is the vector of disturbance variable (n x 1); and B is the matrix with diagonal, not zero. SVAR was used since this test provides the appropriate framework to check the fluctuation transmission. The research can identify the relevant fluctuation and describe the response of the system to the fluctuation by analysing impulse response function and its variance decomposition (Desroches, 2004).

c. Determination of lag was carried out by using Lag Order Selection Criteria test so that the estimation result can reflect the real condition.

d. Impulse Response Function (IRF)

Impulse response function represents the mechanisms through which shock spread over time. Besides, that impulse response functions can be interpreted as the impact that a shock in one variable has on another variable. The IRF is used to evaluate the effectiveness of a policy change, say increasing rediscount rate (Lung Lin, 2006).

e. Variance Decomposition (VD)

Based on Boonyanam (2014) variance decomposition shows the fraction of the h-step ahead forecast error in yi,t attributed to its own innovations (εi,t) and innovations in other variable (εj,t), which imply the relative importance of each innovation in affecting the forecast error of variables in the VAR or VECM.

4. Result and Discussion

4.1 Stationarity Test

The results of The Augmented Dicky Fuller (ADF) test indicate that the variables used in this research are not stationed in the level degree. Table 1 shows that the variables of FFR, M2, Exchange, GDP, and CPI have the unit root proven by the probability value which is more than 5 percent ($p > 0.05$) or ADF t-statistic value is smaller than mac Kinnon critical value at level 5 percent.

Table 1. Augmented Dickey-FullerTest

Variable	Level			1st Difference		
	t-statistic	*critical value*	Prob.*	t-statistic	*critical value*	Prob.*
FFR	-0.415642	-3.510740	0.9840	-3.678665	-3.513075	0.0342
BI *Rate*	-4.269085	-3.513075	0.0078	-4.488232	-3.515523	0.0044
M2	-0.488308	-3.510740	0.9807	-7.210473	-3.513075	0.0000
Exchange	-2.391880	-3.513075	0.3787	-5.198483	-3.515523	0.0006
GDP	-2.964274	-3.518090	0.1538	-58.86640	-3.518090	0.0000
CPI	-2.482974	-3.510740	0.3347	-5.800131	-3.513075	0.0001

The existence of unit root in some variables used will impact on the less good model that will be estimated. Hence, to obtain the stationer result, the data differentiation should be done. Table 1 is the result of differentiation showing that the six variables that have been stationer or free from the unit root. The probability value of each variable is less than 5 percent significance ($p < 0,05$) and the value of ADF t-statistic result is more significant than the Mac Kinnon critical value at the 5 percent value.

4.2. Lag Determination

Lag determination used is Lag Order Selection Criteria, by seeing the value from the sequentially modified LR test statistic (each test at 5% level), Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn information criterion (HQ) resulted in each estimation done with the different lag. The optimal la is shown in the smallest value of every criterion.

Table 2. Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-138.0627	NA	3.27e-05	6.700589	6.946337	6.791213
1	193.4993	555.1735	3.57e-11	-7.046479	-5.326237	-6.412107
2	255.1592	86.03712	1.20e-11	-8.239964	-5.045229	-7.061845
3	360.8606	117.9922*	6.15e-13	-11.48189	-6.812658*	-9.760019
4	412.5490	43.27407	5.43e-13*	-12.21158*	-6.067861	-9.945968*

Table 2 recommends lag 3 and lag 4 as the alternative of optimal lag. This case is shown by the smallest value of LR and SC in lag 3 while the smallest value of FPE, AIC, and HQ was obtained in lag 4. To gain the result that only refers to one

choice of lag, the comparison of adjusted R Squared value was done in the result of Vector Autoregressive (VAR) in the following lag 3 and lag 4.

Table 3. Lag and Adjust. R Squared

	Adjust. R Squared				
Lag 3	0.981661	0.947760	0.999547	0.963307	0.963932
Lag 4	0.989666	0.929090	0.999636	0.971992	0.968843

Table 3 shows the result optimal lag from the highest Adjust. R Squared value. The comparison oh both lag values indicate that the Adjusted. R Squared value in lag 4 is higher than that of lag 3. It can be concluded that the optimal lag in this research is using lag 4.

d. Structural Vector Auto-Regressive (SVAR) Test

The results of SVAR test are explained in some following equations:

$$@e_{BIRATE} = -0.087880*@e_{FFR} + 0.372636*@u_{BIRATE} \tag{6}$$

$$@e_{M2} = -0.001856*@e_{FFR} \quad 0.000868*@e_{BIRATE} + 0.007991*@u_{M2} \tag{7}$$

$$@e_{EXCHANGE} = -0.058879*@e_{FFR} + 0.025143*@e_{BIRATE} + 0.779938*@u_{M2} + 0.021472*@u_{EXCHANGE} \tag{8}$$

$$@e_{GDP} = 0.521107*@e_{FFR} - 0.155092*@e_{BIRATE} \quad 2.322470*@u_{M2} + 2.563432*@e_{EXCHANGE}$$
$$+ 0.381120.*@u_{GDP} \tag{9}$$

$$@e_{CPI} = -0.096678*@e_{FFR} - 0.042754*@e_{BIRATE} + 0.170705*@u_{M2} +$$
$$0.820795*@e_{EXCHANGE} - 0.007744*@e_{GDP} + 0.042628*@u_{CPI} \tag{10}$$

The equations above show that the FFR variable significantly influences the exchange rate (Exchange) and the CPI, but it does not significantly affect the BI rate, money supply (M2), and GDP. Similarly, the BI rate variable only significantly influences the exchange rate and CPI, but it does not significantly influence M2 and GDP. These significance levels were based on the resulted probability that was less than 5 % ($p < 0.05$).

The estimation result of SVAR above explains that the FFR interest rate does not significantly influence the interest rate of the Bank Indonesia (BI rate). This case is because of many factors considered internally and externally in the determination of monetary policy primarily through the interest rate (BI rate). The absence

of the external variable effect indicates that the monetary policy is specified to keep the domestic stability that is the stability of the exchange rate and prices.

This case refers to Article 7 verse (1) of the Act Of The Republic Of Indonesia Number 3 Of 2004 stating that the final purpose of monetary policy is reaching and maintaining the stable value of Rupiah. According to the Bank Indonesia (2017) there are two aspects of the stability of Rupiah, namely, the stability of currency to the good and service represented by the inflation development and the stability of the currency of the other country represented by the change of the exchange rate of Rupiah to the currency of the other country. In this case, it does not mean that the FFR interest rate is ignored in determining the BI rate. As long as the prediction of influence of FFR fluctuations to the internal stability can be still minimised, the change of the FFR will not significantly influence the determination of the BI rate; furthermore, during the period of research, the FFR was constant at the range of zero percent.
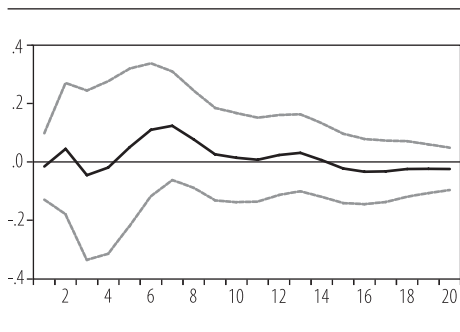
Chandan and Rajat (2017) in their study concluded that the monetary shocks affect output, inflation and exchange rate. The monetary shock that is represented by the change of the FFR interest rate becomes the warning for the global economy to adapt to the happening dynamic soon (Kalivitis and Skotida, 2008). The change of the FFR interest rate will be responded by the economic actors in the international money market so that it results in the capital flow and people's purchasing power.

Subsequently, when the exchange rate of domestic currency is depreciated, the price of the goods imported from the other country will increase. This case will cause the high economic cost for the importers. The high economic cost will be reflected in the prices of a domestic commodity that tend to increase. The results of this research also support the finding of the research conducted by Kalivitis and Skotida (2008) that the monetary shocks policy done by United States impact on the flow of the currency exchange rate. The effect faced by the developed countries is the delayed overshooting in some tested currency (sterling/yen, yen/mark, and mark/sterling). This case indicates that basically, the response of the policy of the Fed through the FFR instrument closely relates to the currency exchange rate between countries. In the country with a more open economy, the forex market actors are getting faster so that it influences the currency exchange rate. Therefore, the intervention of central bank is necessary to ensure that the currency exchange rate is not excessively overvalued and undervalue.

4.3. Impulse Response Function Test

The IRF test uses Structural Decomposition method to see the response of the BI rate, the number of money supply (M2), exchange rate, GDP growth, and CPI to the value change of the FFR. In Figures 1, 2 and 3 showing the IRF test results, the centre line is the response of one variable to the other variables. Meanwhile, two lines which are above and under the centre line are the limit of two standard errors. The IRF test result of each variable is described as figure below (the complete table contains of IRF test results can be seen in attachment).
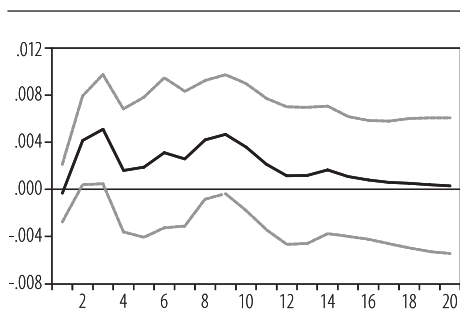
Figure 1: Response of BI Rate to FFR

In the first period, BI rate responded the change of the FFR value with -0.01 point basis. Subsequently, the response of BI rate tended to increase, but in some specific periods, it still fluctuated. The lowest response happened in the 3rd period with -0.04 point basis, and the highest response occurred in the 7th period that was 0.12 point basis. The equilibrium condition happened in the 4th period where the value of BI rate responded with 0.005 point basis to the FFR or approached the equilibrium line. In the 15th to 20th periods, the response of BI rate changed to negative reaching -0.02 point basis at the end of the period.

The value of BI rate responded the FFR interest rate below ten percent in twenty periods after the change of FFR value. This was because the FFR is not the only indicator used in determining the BI rate. Moreover, BI rate is also important to keep the domestic stability. The response to FFR interest rate is generally used to maintain the capital flow entering and leaving the country; this case relates to the international cooperation of both countries. This result is in line with Mundell-Fleming theory in Mankiw (2009) that principally states that Indonesia is a country involved in the world economic activity in the world trade and financial market and thus the interest rate of Indonesia is more or less influenced by the world interest rate (FFR).

Figure 2: Response of M2 to FFR

In the first period, the number of money supply (M2) responded the change of FFR value of -0.0003 point-based. This negative response only happened in the first period. After that, M2 fluctuated, but it was still in positive value until the last period of the research. The highest response occurred in the third period that was 0.005 point-base. Subsequently, M2 continually moved to the equilibrium condition happening in the 20th period where M2 responded with 0.0003 point-based to FFR, or it approached the equilibrium line.

During the period of the research, M2 responded to the change of FFR in the very small amount that was in the range of below 5 percent. This case shows that FFR change does not significantly influence M2, but also through transmission from the change of internal monetary policy (BI rate). Theoretically, the main target of the determination of interest rate is to influence the amountof the money supply.

**Figure 3: Response of Exchange Rate to FFR**
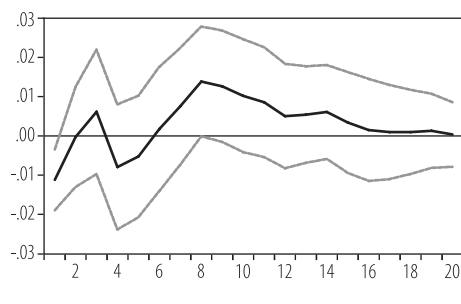
In the first period after the change of FFR value, the Rupiah responded with -0.01 point basis, and it was the lowest response during the observation. This negative response occurred until the second period. In the third period of IRF, the exchange rate showed the positive value namely 0.006 point basis (currency depreciation), but it was back to negative until the fifth period which was -0.005 point basis. In the next period, it positively responded until the 20th period that gave highest response which was 0.0003 point basis. The highest response happened in the eighth period, 0.013 point basis. This positive value indicates that the Rupiah still depreciates to the USD as the result of the FFR change.

In the short-term, the Rupiah negatively responded (appreciation); this case happened since the change of FFR indicates the economic condition of the United States is being disturbed is that the value change is an effort of the monetary authority to reduce the happening shocks. Instability of the economic condition of the USA will result in the high number of capital outflow. The investor tends to choose the emerging market country since it is regarded more secure and it will give high return. The bigger the capital flow entering the country, it will result in appreciation to the Rupiah. However, this case is not applied in the long-term where the Rupiah positively responded (currency depreciation) to FFR change. The high value of the FFR will attract the investors back to investing their capital in the USA so that the capital outflow can be redrawn, including the internal

(domestic) capital. This case becomes one of the factors causing long-term depreciation of the Rupiah.

**Figure 4: Response of GDP Rate to FFR**
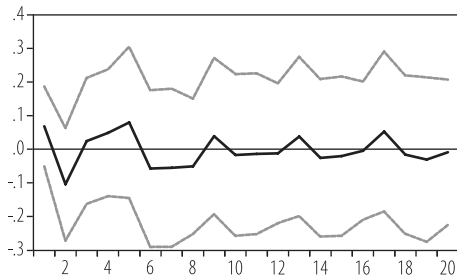
Theoretically, the influence of the FFR value change on the domestic variable cannot occur directly. This influence happens through the transmission ways; one of them is through the BI rate. This result is also in line with the theory of the International Fisher Effect in Khawaga et al (2013), where the theory explains that the difference of interest of two countries closely relates to the expectation of exchange rate change of both countries. Thus, the Fisher effect validity may depend on the exchange rate regime (Bayat et al, 2018).

In the first period, GDP positively responded the change of FFR value that was 0.06 point basis. In the second period, the response changed to negative which was -0.1 point basis, and it was the lowest response to the observation. Subsequently, GDP positively and negatively fluctuated until 20th period. The highest response happened in the fifth period after the change of FFR value which was 0.07 point basis. The response of GDP approached the equilibrium line in some periods namely 9th and 13th periods that was 0.03 point basis.

Nizamani et al (2016) explained that the slow growth in the developing state would force the IMF to decrease the global growth outlook. The fluctuation that always happens in the global economy causes the contraction in the range of business cycle. A developing country`s dependency on the international trade makes it vulnerable to the global fluctuation. As the result of the global economic imbalance, the decision of developed countries can influence the economic activity of the developing country. In line with the available theory and the previous explanation, the effect of the FFR value change to GDP can occur through the BI rate that becomes the transmission way. In the short term, GDP negatively responding to the value change is happening to the FFR. Meanwhile, the middle-term response shows the result that is contra with the existing theory that GDP positively responded the FFR value change. This case is because the single target of the monetary policy in Indonesia is price stability.

In the first period, after the change of value, the value of CPI was -0.02 point basis, and it was the lowest response during the observation. This negative trend occurred until the second period that was -0.002 point basis. In the third period, the CPI positively responded 0.02 point basis, and it was the highest response. Subsequently, the CPI continually and positively responded until the 6th period which was 0.0001 point basis. In the 7th period, the CPI negatively responded with -0.008 point basis. In the next period, the CPI still moved to the equilibrium line in the 17th period that was 0.0004 point basis.

Figure 5: Response of CPI to FFR
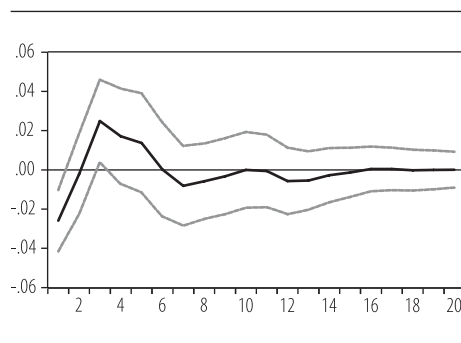
4.4. Variance Decomposition Test

The results of Variance Decomposition (VD) analysis explain the role of each variable to the other variables to know which variable contributes more to explaining the change of specific variable in the economy. The explanation of VD test result is explained as well.

Table 4. Variance Decomposition of BI Rate

Variance Decomposition of BIRATE:						
Period	S.E.	FFR	BIRATE	M2	EXCHANGE	GDP	CPI
1	0.372969	0.178793	99.82121	0.000000	0.000000	0.000000	0.000000
5	1.060739	0.641371	93.07122	0.465862	2.105410	3.047511	0.668624
10	1.118678	3.303522	87.58137	1.102181	2.723999	3.351263	1.937669
15	1.139403	3.345654	86.72183	1.470382	2.873811	3.303623	2.284697
20	1.144453	3.618176	86.16569	1.497571	3.096355	3.281673	2.340535

In the first period, the BI rate contributed in forming the variable which was 99.8 percent, and it decreased until the 20th period to 86.1 percent. The FFR contributed to the BI rate in the first period which was 0.17 percent; it increased to 86.1% until the 20th period. The FFR contributed to the BI rate in the first period which was 0.17 percent; it increased 0.44 percent in the second period and still increased until the 20th period, reaching 3.6 percent. Subsequently, M2 contributed in the second period with the value of 0.01 percent, and it still increased 1.49 percent until the 20th period. The exchange rate contributed 0.2 percent since the second

period, 2.1 percent in the 5th period, and 3 percent in the 20th period. GDP contributed 0.8 percent in the second period, and it still increased 3.2 percent until the second period. Finally, the CPI contributed 0.8 percent to the BI rate in the second period, and then it decreased 0.6 percent in the 5th period and it increased 2.3 percent again until 20th period.

Caceres et al (2016) explained that the shocks of a monetary policy strongly impact on the condition of the global economy that will give effect to the condition of the domestic economy in the small open economy. If the central bank follows the rule of independent policy, it will soon customize the domestic rate as long as inflation prospect and domestic output are influenced by the condition in the foreign country. The FFR, the BI rate, and the exchange rate theoretically correlate with each other. According to the Mundell-Fleming model, as a country with an open economy, the interest rate in Indonesia will be influenced by the world interest rate (Mankiw, 2009). Besides, the International Fisher Effect model also states that the difference in the interest rate of two countries can be used to predict the change of future exchange rate (Khawaga et al, 2013). As a country that cooperates with the USA, the BI rate will be very influential on the FFR. This case is an attempt to maintain the internal stability regarding the activity of trade and capital transactions between two countries, and it will impact the exchange rate and the advance in the real sector (GDP). The great contribution of CPI in the long-term generally caused by the price stability is the main purpose of monetary policy determination in Indonesia which is inflation targeting.

Table 5. Variance Decomposition of M2

Variance Decomposition of M2:						
Period	S.E.	FFR	BIRATE	M2	EXCHANGE	GDP	CPI
1	0.008004	0.159191	0.163435	99.67737	0.000000	0.000000	0.000000
5	0.020900	11.33621	6.461575	24.07860	40.62797	1.498982	15.99666
10	0.029498	13.59089	8.205510	15.31621	41.73777	3.901615	17.24800
15	0.035953	10.01426	12.04950	11.69110	44.87178	5.563746	15.80962
20	0.042061	7.400584	15.32669	10.22551	45.02141	5.892669	16.13313

The variable of M2 contributed 99.6 percent in the first period; it decreased to 62% in the second period, and it continually reduced 10 percent until the end of the period. FFR contributed 0.15 percent to M2 in the first period; it increased 12 percent in the second period; it then decreased to 11.3 percent in the 5th period, and it still fluctuated 7.4 percent until the 10th period. The BI rate contributed 0.16 percent in the first period; it increased 9 percent in the 2nd period and decreased 8.2 percent until the 10th period, and it continually increased 15.3 percent until

the 20th period. The exchange rate contributed 6 percent since the second period, and it continually and drastically increased to 45 percent at the end of the period. GDP contributed 0.002 percent in the 2nd period, and it continually increased 5.8 percent in the 20th period. The CPI also contributed 10.6 percent since the 2nd period; by the 4th period increase was 19%. Moreover, it continually fluctuated 16 percent until 20th period. In this case, the CPI has the second big contribution to M2, after the exchange rate.

Table 6. Variance Decomposition of Exchange Rate

Variance Decomposition of EXCHANGE:						
Period	S.E.	FFR	BIRATE	M2	EXCHANGE	GDP	CPI
1	0.026622	17.73644	11.72728	5.480688	65.05559	0.000000	0.000000
5	0.057970	7.547193	44.49308	4.517568	34.39583	6.842907	2.203421
10	0.070953	15.25602	41.26385	8.168567	27.34552	5.310316	2.655731
15	0.077768	15.60884	45.61392	7.418685	22.92528	4.583573	3.849705
20	0.081317	14.36315	47.28640	6.882500	23.09132	4.365171	4.011465

During the observation period, the contribution of the exchange rate was more dominant to the variable that was 65 percent in the first period, and it tended to reduce 23 percent until the last period. After that, the FFR greatly contributed 17.7 percent and decreased 7.5 percent until the 5th period and increased 14.3 percent until the 20th period. The BI rate contributed 11.7 percent in the first period and still increased 47.2 percent until the 20th period. M2 also contributed 5.4 percent in the first period, but subsequently, the value continually fluctuated and reached 6.8 percent at the end of the period. The GDP growth contributed 1.8 percent since the 2nd period and increased 5.3 percent in the 10th period. The period after it still decreased, going down to 4.3 percent at the end of the period. Lastly, the CPI also contributed 0.54 percent since the 2nd period and increased afterwards 4 percent in the 20th period.

According to the monetary theory after a shock of monetary policy, the output, price, and money demand are expected decrease while the exchange rate and the interest rate will increase. Money and exchange rate must react more quickly to the shock while the price tends to respond more slowly. This mechanism is based on the assumption that the monetary authority used the number of liquidity in the economy to control the interest and stimulate investment and the other components from the aggregate demand (Salmanov et al, 2016).

Table 7. Variance Decomposition of GDP

Variance Decomposition of GDP:						
Period	S.E.	FFR	BIRATE	M2	EXCHANGE	GDP	CPI
1	0.392481	2.998513	0.736006	0.004329	1.966839	94.29431	0.000000
5	0.717253	4.814215	3.509912	2.726995	11.79576	75.49538	1.657737
10	0.998349	3.567860	5.516581	3.113711	10.69461	73.06429	4.042946
15	1.170588	2.804596	4.875734	2.982595	11.27350	73.78644	4.277129
20	1.328858	2.407966	4.681800	2.860151	12.37095	72.78482	4.894308

The most significant contribution that formed GDP was the variable which was 94.2 percent in the initial period and decreased to 72.7 percent at the end of the period. The FFR contributed 2.9 percent in the first period, and it continually increased 4.8 percent in the 5th period. At the end of the period, the contribution decreased 2.4 percent. Subsequently, the BI rate contributed 0.73 percent in the first period, and it continually increased to 4.6 percent in the 20th period. M2 contributed 0.04 percent in the first period, and it increased 2.8 percent at the end of the period. The exchange rate contributed 1.9 percent in the early period and increased to 12.3 percent in the 20th period. The contribution of CPI since the 2nd period was 0.0002 percent and it continually increased during the observation period with the last period value of 4.8 percent.

Theoretically, it has been explained in Taylor Rule model that stabilising the inflation and output gap can be done through the optimal monetary policy (Woodford, 2001). If the GDP growth is below the determined rate, the interest rate will be decreased so that the investment and consumption enhance and finally strengthen the output.

Table 8. Variance Decomposition of CPI

Variance Decomposition of LCPI:						
Period	S.E.	FFR	BIRATE	M2	EXCHANGE	GDP	CPI
1	0.054539	22.60819	2.431303	1.411527	10.44290	2.016005	61.09007
5	0.087539	23.17015	30.19564	5.770045	7.994508	2.657501	30.21215
10	0.099210	19.17987	38.13283	4.601628	6.601309	2.949897	28.53447
15	0.102613	18.61536	39.04686	4.769990	7.264808	3.013542	27.28944
20	0.104705	17.88247	41.02976	4.589777	7.087684	3.070746	26.33956

The CPI gave the most significant contribution in forming the value of the variable that was 61 percent in the first period and it decreased to 26.3 percent at the end of the period. The FFR contributed 22.6 percent in the first period, and it

decreased to 17.8 percent in the 20th period. The contribution of BI rate was small enough in the early period, 2.4 percent, and then it became consistent until 41 percent at the end of the period. LM2 contributed 1.4 percent in the first period, after that it continually upgraded and remained consistent at 4 percent value until the last period. The exchange rate contributed 10.4 percent in the first period, but after that it degraded until 7 percent at the end of the period. Ultimately, GDP growth contributed 2 percent in the early period, and it was consistent with 3 percent value until the 20th period.

The role of a price index (CPI) in the economy is very significant. This case is because when the monetary authority attempts to suppress inflation, the economic growth will decrease. Therefore, keeping GDP value at the specific range will significantly influence the stability of price rate. Besides, Taylor Rule model by Fernandez and Nikolsko-Rzhevskyy (2007) also explained that when the enhancement of CPI is more than the target, the interest rate will be upgraded so that it will reduce the investment and consumption. As a result, the aggregate demand will decrease and the economy will be back to its equilibrium condition.

5. Summary and Recommendation

The result of the IRF test showed that the BI rate, M2, the exchange rate, GDP, and CPI positively and negatively responded the change of the FFR value during the observation period. The balance condition of the BI rate, money supply, and the exchange rate is reached in the long-term while GDP and CPI are reached in the middle-term. However, in the long-term (at the end of the period) the response of each variable approached the equilibrium condition. Theoretically, the response of money supply, the exchange rate of the currency, GDP, and CPI might happen in transmission way, namely the BI rate. This unstable result showed that the interest rate is only effective to a domestic variable in specific time.

Meanwhile, the result of VD test indicates that short-term GDP mostly influenced the variations of the BI rate while in the long-term it was influenced by the FFR. The variation of the money supply was dominantly caused by the exchange rate in the significant percentage as well. Moreover, the variation of the exchange rate in the short term was greatly influenced by the FFR, while in the middle and long term it was influenced by the BI rate. Meanwhile, the variation of GDP was mostly influenced by the exchange rate during the research period than the other variable. Finally, the variation of the CPI in the short-term was dominantly caused by the FFR, while in the middle and long terms it was influenced by the BI rate.

The conclusion of this research implies that the effect of FFR change may cause instability of the Indonesian economy. The Bank Indonesia as the monetary authority is expected to be more responsive to change of world monetary policy primarily through the flow of interest rate. The effectiveness of monetary policy depends on the monetary policymaker`s ability to accurately assess the impact of monetary policy on the stability of prices and economic activity. The principle of caution should accompany this responsive attitude. This is because the interest rate can determine the number of capital outflow in Indonesia, influence the amount of the money supply so that the Rupiah is becomes susceptible to depreciation and finally give effect on the economic condition holistically. After that, the Ministry of Trade is expected to support the recovery of production and service performance to be able to compete globally because the fluency of the production flow within the country will influence the economic growth and price rate. The favourable economic conditions will be able to attract investors to invest their capital in the real sector in Indonesia; this will ultimately also impact the Rupiah exchange rate.

References

1. Akalin, G. I. and Prater, E. L. (2015). The Global Crisis of the Late 2000s and Currency Substitution: a Study of Three Eastern European Economies Russia, Turkey and Ukraine. *Journal of Central Banking Theory and Practice*, (2), 5-22.

2. Apostolakis, G, (2016). Spreading Crisis: Evidence of Financial Stress Spillovers in the Asian Financial Markets. *Int. Rev. Econ. Finance*, (43), 542–551.

3. *Bank Indonesia, (2017).* Monetary Policy Objectives, downloaded from https://www.bi.go.id/id/moneter/tujuan-kebijakan/Contents/Default.aspx.

4. Bayat,T., Kayhan, S., and Taşar, I. (2018). Re-Visiting Fisher Effect for Fragile Five Economies. *Journal of Central Banking Theory and Practice*, (2), 203-218.

5. Boonyanam, Nararuk, (2014). Relationship of Stock Price and Monetary Variables of Asian Small Open Emerging Economy: Evidence from Thailand. *International Journal of Financial Research*, 5(1), 52-63.

6. Bluedorn, John C. and Bowdler, C.(2006). The Open Economy Consequences of U.S. Monetary Policy. (online) downloaded from www.economics.ox.ac.uk/../paper265.pdf, December 15th 2015.

7. Brůna, K. and Blahová, N.(2016). Systemic Liquidity Shocks and Banking Sector Liquidity Characteristics on the Eve of Liquidity Coverage Ratio Application - the Case of the Czech Republic. *Journal of Central Banking Theory and Practice*, (1), 159-184.

8. Caceres, C., Swallow, Y. C., and Gruss, B.(2016). Global Financial Conditions and Monetary Policy Autonomy. *International Monetary Fund*, Working Paper downloaded from https://www.imf.org/external/pubs/ft/wp/2016/wp16108.pdf July 20th 2017.

9. Chandan, Sharma and Rajat, S.(2017). Effects of Monetary Shocks on Exchange Rate: Empirical Evidence from India. *Studies in Business and Economics*, 12(2),206-2019.

10. Desroches, Brigitte (2004) The Transmission of World Shocks to Emerging Market Countries: an Empirical Analysis. *Bank Of Canada Working Paper*, 2004-44, downloaded from www.bankofcanada.ca/wp-content/uploads/.../wp04-44.pdf July 11th, 2017.

11. Dumičić, M. (2017). A Brief Introduction to the World of Macroprudential Policy. *Journal of Central Banking Theory and Practice*, (1), 87-109.

12. Fernandez, Adriana Z. and Nikolsko-Rzhevskyy, A. (2007). Measuring the Taylor Rule's Performance. Insights from the Federal Reserve Bank of Dallas. *Economic Letter*, 2(6), June,1-8.

13. Garg, Kunaey, (2008). The Effect of Changes in the Federal Funds Rate on Stock Markets: a Sector-Wise Analysis. *Undergraduate Economic Review*, 4 (1), 1-35.

14. Kalivitis, Sarantis and Skotida, I. (2008). Some Empirical Evidence on the effects of U.S. Monetary Policy Shocks on Cross Exchange Rrates. *Working Paper Economic Research Department – Special Studies Division Bank of Greece* downloaded from http://www.bankofgreece.gr/BogEkdoseis/Paper200865.pdf 20th March 2018.

15. Khawaga, Abla El, Esam, M. and Hammam, R. (2013). Exchange Rates and Interest Rates: an Empirical Investigation of International Fisher Effect Theory - the Case of Egypt (2003-2012). *International Research Journal of Finance and Economics* downloaded from http://www.internationalresearchjournaloffinanceandeconomics.com) accessed by February 2th 2016.

16. Kontonikos, Alexandros, Maio, P.,and Zekaite, Z.(2016). Monetary Policy and Corporate Bond Rreturns. Article downloaded from https://www.gla.ac.uk/media/media_441563_en.pdf, January 25th 2017.

17. Lee, Jim, (2006). The Impact of Federal Funds Target Changes on Interest Rate Volatility. *International Review of Economics & Finance*, 15 (2),241-259.

18. Levine, Brian, (2016). The Short-Term Effect of Monetary Policy on Financial Markets. *Fusio,* 1(1), Fall,1-24.

19. Liow, Kim Hiang, Liao, Wen-Chi, and Huang, Y.(2018). Dynamics of International Spillovers and Interaction: Evidence from Financial Market Stress and Economic Policy Uncertainty. *Economic Modelling*, (68),96-116.

20. Lung Lin, Jin, (2006). Teaching Notes on Impulse Response Function and Structural Var. *Institute of Economics.* Article Academia Sinica Department of Economics National Chengchi University downloaded from http://faculty.ndhu.edu.tw/~jlin/files/impulse.pdf 6th April 2018.

21. Mankiw, N. Gregory, (2009). *Macroeconomics.* Seventh Edition, New York: Worth Publisher.

22. Nezky, Mita, (2013). Pengaruh Krisis Ekonomi Amerika Serikat terhadap Bursa Saham dan Perdagangan Indonesia. *Buletin Ekonomi Moneter dan Perbankan,* downloaded from www.bi.go.id/id/publikasi/jurnal-ek... Desember 17th 2015.

23. Nizamani, A. R., Karim Z. A., Zaidi M. S., and Khalid N. (2016). The Effectiveness of Monetary Policy in Small Open-Economy: an Svar Study for Pakistan. *International Journal of Economics and Management*,10 (2) downloaded from (http://www.econ.upm.edu.my/ijem July 15th 2017.

24. Petursson, Thorarinn G, (2001). The Transmission Mechanism of Monetary Policy: Analysing the Financial Market Pass-Through. *Central Bank of Iceland, Working Papers,* No 14 (online) (http://www.sedlabanki.is) January 9th 2016.

25. Salmanov, O. N., Zaernjuk V. M., Lopatina O. A., Drachena I. P., and E.V Vikulina, (2016). Investigating the Impact of Monetary Policy Using the Vector Autoregression Method. *International Journal of Economics and Financial Issues,* downloaded from http://www.econjournals.com0 July 14 th 2017.

26. Samuelson, Paul A. and Nordhaus, William D.(2005). *Macroeconomics.* 18th Edition New York: McGraw Hill-Irwin.

27. Tuca, Sabina, (2014). The Relationship Between Globalization and the Economic Crisis. *The USV Annals of economics and public administration*, Volume 14, Issue 1 (19), 1-7.

28. Vidakovic, Neven, (2002). Application of the Mundell-Fleming Model on a Small Open Economy. *Economics,* 11(3),392-423.

29. Vinayagathasan, Thanabalasingam, (2013). Monetary Policy and Real Economy: a Structural VAR Approach for Sri Lanka. *National Graduate Institute For Policy Studies Discussion Paper* 13-13. downloaded from www.grips.ac.jp/r-center/wp-content/uploads/13-13.pdf July 16th 2017.

30. Woodford, Michael, (2001). The Taylor Rule and Optimal Monetary Policy. downloaded from www.columbia.edu/mw2230/taylor.pdf February 21st 2016.

31. Županović, I. (2014). Sustainable Risk Management in the Banking Sector. *Journal of Central Banking Theory and Practice*, (3), 81-100

Website:
Act Of The Republic Of Indonesia Number 3 Of 2004 Concerning Amendment To Act Of The Republic Of Indonesia Number 23 Of 1999 Concerning Bank Indonesia, downloaded from https://www.bi.go.id/en/tentang-bi/uu-bi/Contents/Default.aspx