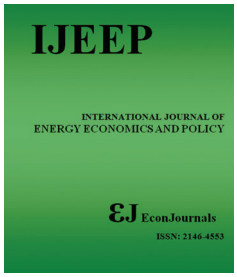

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The Response of Bank of Indonesia's Interest Rates to the Prices of World Crude Oil and Foreign Interest Rates

Pasrun Adam*

Department of Mathematics and Economics, Universitas Halu Oleo, Kampus Bumi Tridharma Anduonohu, 93232 Kendari, Indonesia. *Email: adampasrun@gmail.com

ABSTRACT

This research aimed to investigate the response of interest rates set by Bank of Indonesia (BI) to the prices of world crude oil and foreign interest rates. It analyzed monthly data which spanned from July 2005 to October 2015. The tool of analysis used was the difference equation model. Result of the test showed that there was a positive response of the interest rate determined by BI to the price of world crude oil and foreign interest rates. The interest rates maintained by BI increased (decreased) by 0.135% in response to each 1% increase (decrease) in the price of world crude oil. The interest rates also increased (decreased) by 0.081% in response to each 1% increase (decrease) in foreign interest rates.

Keywords: World Crude Oil Price, Foreign Interest Rates, Domestic Interest Rates, Difference Equation Model
JEL Classifications: C540, E430

1. INTRODUCTION

Oil is one of the main raw materials in a production process. Oil is needed to run machines, transportation, and power plants (Rafiq et al., 2009; Adam et al., 2015). Oil is also a major commodity in derivative trading, that is, as an underlying asset. Changes in oil prices, therefore, can affect all economic activities (Nazarian and Amiri, 2014).

Economists have studied the channels of the relationship between oil prices and macroeconomic variables, especially interest rates. Among the channels that can be identified in the literature are supply shock effect, wealth effect, real balance effect, and monetary policy effect. In terms of supply shock effect, the rise in oil prices is an indication of oil scarcity which can reduce production output. The fall in production output reduces real wage growth and increases the level of unemployment, which can then encourage the emergence of inflation. If consumers expect a temporary rise in oil prices, and if they expect that its effects on the output is greater in the short term than it is in the long term, then they will be encouraged to increase their consumption, and this will negatively affect their willingness to save. This will raise the level of equilibrium in real interest rate (Rasche and Tatom, 1977; Brown and Yucel, 2002).

In terms of wealth effects, a shock in oil price can affect interest rates through transfers of wealth from oil importing countries to oil exporting countries (Cologni and Manera, 2008; Sotoudeh and Worthington, 2015). A rise in the wealth of oil exporting countries will increase household expenditure, causing savings to go down, and eventually increases interest rates (Dohner, 1981; Cologni and Manera, 2008; Abel et al., 2014). The opposite applies to oil importing countries. Balance real effect can be explained through the channels of money demand, in which the rise in oil prices can increase the demand of money. If the monetary policy makers failed to raise the money supply, the increase in money demand may raise interest rates (Pierce and Enzler, 1974; Brown and Yucel, 2002; Dogrul and Soytas, 2010).

A country's domestic markets can be affected by international markets. In an open economy, an increase in foreign interest rates, for example, can cause the exchange rate of domestic currency to be depreciated against the foreign currencies, which ultimately makes domestic goods highly competitive in the international market, resulting in a rise of exports and a fall of imports. An increase in exports will lead to a shortage of goods supply in domestic market, which in turn can raise the price of the goods. A country's central bank may try to raise interest rates to maintain

price stability (Celik and Deniz, 2009). Another channel that can explain the relationship between foreign interest rates and domestic interest rate is the interest rate parity theory. The theory postulates that domestic nominal interest rates in a country is the sum of the international interest rate, exchange rate, and risk premium. Furthermore, the real interest rate is equal to the international interest rate (Levi, 2009). Thus, since, interest rates are positively correlated with higher domestic interest rates, higher interest rate will encourage capital outflow, which in turn causes domestic interest rates to rise (Dua and Pandit, 2002).

There has been a number of studies on the relationship between oil prices, foreign interest rates, and domestic interest rates. For example, research on the relationship between oil prices and interest rates and other macroeconomic variables have been conducted by, among others, Papapetrou (2001), Balke et al. (2002), Killian and Lewis (2011), Alom et al. (2013), Ratti and Vespignani (2014), Khan and Ahmed (2014), Zhou and Wang (2014), and Malhotra and Krishna (2015). Furthermore, studies on the relationship between the international interest rate and domestic interest rates has been carried out by, among others, Hartman (1980), Kneeshaw and Bergh (1985), Bhattacharya, et al. (2008), Oguanobi (2015), and Alawin and Al-As'ad (2013). Interestingly, these studies came up with different results. For example, while Malholtra and Krishna (2015) found no association between oil prices and interest rates, Khan and Ahmed (2014) reported that such relationship does exist. Furthermore, Kneeshaw and Bergh (1985) found that there is an association between oil prices and interest rates, whereas Alawin and Al-As'ad (2013) found no association between these two variables. Such research is generally carried out in developed countries, and researchers generally use the vector autoregressive (VAR) model to analyze the relationship between economic variables. Thus, they are still less attention to how big the influence of oil prices and foreign interest rates on domestic interest rates.

Basically, monetary policy is implemented by a government to stabilize prices and to achieve sustainable economic growth. Therefore, instruments of monetary policy used by the government must be able to function properly in order to protect the country's economy from external shocks, such as oil price (Razmi et al., 2015). As a net importer of crude oil since 2005 (Wang, 2013), Indonesia has developed a monetary policy instrument to protect the country's economy not only from external shocks but also from internal influences. One of Indonesia's monetary policy instrument is the Bank of Indonesia (BI) rate, with its main objective being to stabilize prices and exchange rates. Therefore, in the event when an internal or external shock occurs and can trigger inflation, BI would respond to such increases by raising interest rates. Interest rates are also meant to respond to changes in international interest rates. An increase in the BI rate, for example, will push up the difference between Indonesia interest rates and foreign interest rates. With the widening difference in the interest rates, foreign investors will be prompted to invest in financial instruments in Indonesia as they will expect to get higher return rates. The flow of foreign capital will eventually cause the currency exchange rate of rupiah to be appreciated (BI, 2015). However, the increase in the BI rate can also reduce the investment, so that when foreign interest rates decrease and the inflation rate is considered to have become stabilized, BI may lower its interest rates in order to attract investment in Indonesia. Historically, the fixing of the interest rate is reflected in the trend of BI interest rates (or BI rate) development, where at the beginning of the period 2005-2015, BI-rate trend increased from 8.5% on July 2005 to 12.75% on April 2006. In the next period, the rate of BI-rate fluctuated and eventually fell to 7.5% on October 2015. The trend in the BI rate was not much different from the trend of crude oil prices and foreign interest rates. For example, the trend of the price of Brent crude oil rose in the period 2005: 7-2006:4 to reach $70.26 per barrel on April 2005, then in the next interval time the foreign interest rates fluctuated before eventually dropped to $48.43 per barrel on October 2015. Similarly, the interest rate of US funds rate increased in the beginning of the period and then plunged to 0.12% on October 2015.

This research aimed at investigating the response of BI rates to changes in world crude oil prices and foreign interest rates, as well as to determine the extent of the response. Also, this research aims to find out how big the response of the BI rates to changes in crude oil prices and changes in foreign interest rates. For these purposes, the study analyzed monthly data of July 2005:7-2015:10. Econometric model used to analyze the response of BI rates to changes in crude oil prices and changes in foreign interest rates is the difference equation model proposed by Enders (2015). This model was used based on an assumption that a certain time lag is required by domestic interest rates to respond to changes in world crude oil prices and foreign interest rates. Referring to how that is done by Adam (2014) and Adam et al. (2015), then in the subsections results of the study are given a graph illustrating the response of BI rates to changes in world crude oil prices and changes in foreign interest rates.

2. REVIEW OF LITERATURE

Research on the effect of oil prices, foreign interest rates, and other macroeconomic variables on domestic interest rates have been done by economists, both in terms of theory and empirical. In theory, the influence of oil prices, foreign interest rates on domestic interest rates have been described in the introductory section. The following literature review is a review of the findings of several empirical studies conducted in various countries, and in different time periods.

Orr et al. (1995) examined the determinants of long-term interest rates of OECD countries. The results of the data analysis showed that interest rates are influenced by inflation, current account balance, and goverment deficit. Knot (1995) studied the determinants of interest rates in the countries of the European Community in the period of 1959-1990 with an assumption that capital flow was high in the European capital markets. Result indicated that the interest rates in European countries were ridden by oil price movements, inflation expectations, investment, money growth, and temporary income.

Sen (1991) investigated the effect of increased oil prices on the interest rate of some countries in which it was assumed that there

was no flow of capital. Test results showed that the rise in oil prices lowered the current account, as well as interest rates. Lowinger and Wihlborg (1985) studied the effect of OPEC oil prices on interest rates in international financial markets. They found that the higher oil prices affected foreign interest rates. Cologni and Manera (2008) conducted a study on the relationship between oil prices, inflation and interest rates in G7 countries including the UK, the USA, Canada, France, Germany, Italy, and Japan. Result of VAR test indicated that oil prices affected inflation, and inflation shock increased interest rate. Reicher (2010) examined the relationship between oil prices and the long-term interest rates in the United States in the period from 1955:1 to 2009:3. Using VAR models to test the relationship, the study found that oil prices had a very strong influence on the interest rates. Eryigit (2012) looked into the causal relationship between the price of crude oil, stock prices, exchange rate, and interest rates in Turkey in the period from 07.01.2005 to 10.31.2008. VAR test result indicated that the market price of oil affected stock prices, exchange rates, and interest rates.

A number of researchers have also investigated the relationship between oil prices and monetary policy. Bernake and Watson (1997) studied this issue in the US within 1965-1995 period. They used the VAR to test the effects of oil price shocks on interest rates, real gross domestic product (GDP), GDP deflator, and the spot commodity price index. The study revealed that oil shocks affected all of these economic variables. Kormilitsina (2011) investigated the relationship between oil price shock and the optimality of monetary policy in the period from 1954:3 to 2006:4. Employing the structural VAR (SVAR) model to test the relationship, the researcher found that the oil price shock affected both inflation and interest rates. Bleich et al. (2012) investigated the effects of oil price expectations on the interest rates set by Bank of Canada, Bank of England, and European Central Bank. Results showed that price expectations affected all of the interest rates determined by the three banks, where each 1% increase in the oil price expectations increased interest rates by about 11 basis points. Liu et al. (2015) conducted a study in China to test the response of monetary policy to oil price shock. They discovered that when oil prices rose by 100% and the target of inflation was below 2%, the government increased interest rates by 2.5%.

Blejer and Diaz (1986) examined the determinants of the real interest rate as reviewed from domestic and external factors in Uruguay in 1997-1981 period. The study focused on the determinants of price and interest rates where capital flows in and out freely, and domestic financial market was liberalized. Therefore, the external variables in their study included international interest rate and the price of imported goods that can be traded, whereas the internal factors were the exchange rates and the price of domestic goods. They found that the interest rates were influenced by foreign interest rates and the prices of imported goods. In addition, the effect of exchange rates on domestic interest rates was very weak.

Cumby and Mishkin (1986) investigated the relationship between the US interest rates and the interest rates in several industrialized countries including Canada, the UK, Italy, Netherlands, France, West Germany, and Switzerland in the period between June 1973 and December 1983. Test results showed a positive association between the interest rates in the US and the European countries under investigation. Kim and Sheen (2000) examined the relationship between the US and Australia interest rates in the period from 1987 to 1995. The US interest rates was proxied with a 3 months treasury bills, while the Australian interest rate with a 10 years government bonds. The study analyzed daily data using the generalized bivariate exponential autoregressive conditional heteroscedasticity model. Frankel et al. (2004) investigated the relationship between interest rates in 48 countries, comprising of 18 industrial countries and 28 developing countries, and the US interest rates that were proxied as international interest rates. Analyzing data from the period of 1975-1996, the study reported that long-term interest rates in all developed countries, except Australia, did not react to international interest rate. In contrast, in countries where floating exchange rate regime occurred, domestic interest rates were highly reactive to the US interest rates.

Kari and Winston (2008) examined the co-movement between the foreign interest rates and the interest rates in the Eastern Caribbean Currency Union (ECCU) on a fixed exchange rate regime, that is, in period from March 1980 to December 2005. Data of domestic interest rate used was the average rate of weighted lending in the ECCU countries, whereas foreign interest rates referred to the US 90 days T-bill rate and the Federal funds rate. All of the time series data were quarterly data. To test the co-movement, the researchers used the VAR analysis. Empirical results showed that in the long term interest rate parity condition was met. Furthermore, in the short term the interest rate in ECCU countries responded to the US interest rates.

Eruygur (2004) examined the effect of foreign interest rates on the performance of several macroeconomic variables including real exchange rate, consumer price index, domestic interest rates, and the rate of capacity utilization in private sectors in Turkey from 1991:2 to 2004:12. The foreign interest rate was proxied by US funds rate and the London Interbank Offer Rates (LIBOR). The study period was divided into two sub periods, namely a sub period prior to 2001:6, and a sub period after 2001:6. Results of testing using the SVAR model showed that in the sub period prior to 2001:6, a positive shock in the foreign interest rate caused the exchange rate of the real, lower inflation rates, domestic interest rates, and earnings to rise. In sub period after 2001:6, however, a shock in foreign interest rate encouraged the exchange rate, inflation rates, domestic interest rates, and income to fall, although this effect was very small. Ceylan and Berument (2010) investigated the effects of the American Federal both anticipated and unanticipated funds rate on domestic interest rates in Austria, France, Italy, New Zealand, Norway, Portugal, Sweden, Switzerland, Spain, the UK, and Australia. The test results showed that the US bank rate had a positive impact on the rate set by the banks of the countries under investigation. Celik and Deniz (2009) examined the effect of federal funds rate of US on the interest rates maintained by Bank of England and the European Central Bank in the period between January 1991 and December 2008. Result of testing using the autoregressive distributed lag (ARDL) models indicated that the interest rates set by Bank of England

and European Central Bank were highly dependent on the funds rate determined by the United States.

The relationship between foreign interest rate and monetary policy in Romania has been examined by Goczek (2015). The variable of foreign interest rate was the EURIBOR of England, while Roman monetary policy referred to LIBOR. Both of the interest rates played a very important role in financial system, especially on interest rates and interest rate of derivative contracts. It was found in this study that a one-on-one relationship existed between both of the interest rates. Frankel et al. (2004) examined the relationship between interest rates in the United States and interest rate of the German state. Also they examined the relationship between German interest rates and European interest rates in the countries that are in a zone of the Deutsche mark-European Monetary Union (EMU-DM). US interest rates and German interest rates as a proxy of international interest rates, while the European interest rate is proxied as domestic interest rates. Dynamic estimates show that interest rates of countries with more flexible regimes adjust more slowly to changes in international rates, implying some capacity for monetary independence.

3. DATA AND METHODOLOGY

3.1. Data

The present study analyzed three types of time series data including the prices of world crude oil, foreign interest rates, and domestic interest rates. The prices of world crude oil was referred to the price of European crude oil, which was the European Brent oil price future, measured in units of $ per barrel. The data of the Brent crude oil prices was taken from the Energy Information Administration, EIA (www.tonto.eia.gov). Foreign interest rates were referred to the interest rates set by Bank of the United States, which was the funds rate, in percentage points. The funds rate has been chosen based on a consideration that the US interest rates represents the global interest rate (Ratti and Vespignani, 2015). Data of fund rate were taken from the Federal Reserve, which is the Central Bank of the United States (www.federalreserve.gov). Domestic interest rates was referred to BI rate, and was obtained from BI (www.bi.go.id).

All of these time series data were monthly time series of data spanning from July 2005 to October 2015. The time series data of the price of crude oil is expressed as *OIL*, the time series data of foreign interest rates as *FIR*, and the time series data of BI rate as *DIR*. These three time series data, i.e. *OIL*, *FIR*, and *DIR*, were in a logarithmic form of raw data that were collected from the above mentioned sources.

3.2. Method of Analysis

This study aimed to investigate the response of the interest rate set by BI, which was BI rate (*DIR*), to the changes in the world price of crude oil (*OIL*), as well as to foreign interest rates (*FIR*). In analyzing the data, the study assumed that the domestic interest rates (*DIR*) require a certain time lag to respond to changes in prices of world crude oil (*OIL*) and foreign interest rates (*FIR*). For this reason, it employed the difference equation model proposed by Enders (2015). This model of econometric form is as follows:

$$DIR_t = a_0 + \sum_{i=1}^{n} a_i DIR_{t-i} + bOIL_{t-p} + cFIR_{t-q} + \epsilon_t \quad (1)$$

where a_i (i=1, 2, 3,…,n), b, and c are the regression parameters with $|a_i| < 1$. Next, n, p and q are time lag, whereas ϵ_t is white noise where $E(\varepsilon_{ti}\epsilon_{tj})=0$ for i≠j, $E(OIL_t\varepsilon_{t-i})=0$ and $E(FIR_t\varepsilon_{t-i})=0$. In Model (1) the three time series data of *OIL*, *FIR*, and *DIR* are stationary. However, if all the data time series *OIL*, *FIR*, and *DIR* integrated order one, *I* (1), and not cointegrated then the model used is as follows:

$$D(DIR_t) = a_0 + \sum_{i=1}^{n} a_i D(DIR_{t-i}) + bD(OIL_{t-p}) + cD(FIR_{(t-q)}) + \epsilon_t \quad (2)$$

where $D(DIR_t)=DIR_t-DIR_t$ is the first difference form of *OIL*. Enders (2015) states that the difference equation Model (1) is a special form of the autoregressive distributed lag model, namely the ADL model. Meanwhile, Agung (2009) considers Model (1) as a special form of the lagged-variable autoregressive model, namely the LVAR model.

In an equilibrium condition, the variable of domestic interest rates in Model (1) meets the condition of $DIR_t=DIR_{t-1}=DIR_{t-2}=...=DIR_{t-n}$ therefore Equation (1) becomes:

$DIR_t=\alpha+\beta OIL_{t-p}+\gamma FIR_{t-q}+\epsilon_t$

where $\alpha = \frac{a_o}{(1-\sum_{i=1}^{n} a_i)}$, $\beta = \frac{b}{1-\sum_{i=1}^{n} a_i}$ and $\gamma = \frac{c}{1-\sum_{i=1}^{n} a_i}$. The parameters of β and γ are called the long-term multiplier effect (Heij et al, 2004). A positive value of multiplier effect indicates a positive effect, whereas a negative value means a negative effect.

Since some requirements need to be fulfilled by the three time series data in Model (1), it is necessary to firstly run a test on the stationarity and the cointegration of the time series data. The Augmented Dickey Fuller (ADF) test is used as a measurement tool to examine the stationarity of the time series data. To test the stationarity of the time series data about foreign interest rates (*OIL*), for example, we have to examine the significance of parameter ρ in Equation (3).

$$D(OIL_t) = \delta_o + \delta_1 t + \rho OIL_{t-1} + \sum_{i=1}^{n} \theta_i D(OIL_{t-i}) + \varepsilon_t \quad (3)$$

Hypothesis H_0: ρ=0 shows that the time series data of *OIL* have an unit root, indicating that it is not stationary. Further, *OIL* is said to be stationary if the the absolute value of ADF statistic is higher than the absolute value of ADF critics. The level of significance used is either 1% or 5%.

Engle–Granger two-step test is performed to examine the cointegration of the three time series data of *OIL*, *FIR*, and *DIR*. In the first step, the multiple regression is estimated, and then set up the following Equation (4).

$$RES=DIR-\tau_o-\tau_1 OIL-\tau_2 FIR \quad (4)$$

where τ_o, τ_1, and τ_2 are the regression parameters, whereas *RES* is residual. *RES* is a time series data that is constructed from (4). The second step is to test the order of integration of *RES*. If *RES* is stastonary, then the three time series data of *OIL*, *FIR*, and *DIR* are said to be cointegrated.

To test the response, we need to estimate Model (1) or (2) and determine the significant regression parameters. In this case, a regression parameter is significant at level 1% or 5%, if the P-value of the statistical test (t-test or F-test) is lower than 5% or 1%. The value of time lag *n*, *p* and *q* is determined by using Akaike information criterion criteria. The statistical value of R^2 and Durbin Watson (DW) are also needed in this estimation, to ensure that the model obtained is not a spurious regression. According to Rosadi (2012), a regression model is said to be non-spurious if the statistical value of R^2 is lower than statistical value of DW.

4. RESULTS OF THE RESEARCH

4.1. Stationarity Test

Table 1 summarizes the results of estimating the ADF statistics and the ADF critics of the three time series data of the prices of world crude oil (*OIL*), foreign interest rates (*FIR*), and domestic interest rates (*DIR*), as follows:

As can be seen in Table 1, all of the time series data of *OIL*, *FIR*, and *DIR* are not stationary, because, at a significance level of 1% and 5%, the absolute value of ADF statistics is lower than the absolute value of ADF critics. Meanwhile, *D*(*OIL*), *D*(*FIR*), and *D*(*DIR*) are all stationary, because, the absolute value of ADF statistics is higher than absolute value of ADF critics. Therefore, all the data time series world crude oil prices, foreign interest rates and domestic interest rates are integrated of order one, *I* (1).

Table 1: Results of estimation related to stationary test

Variable	ADF statistics	1% critical value	5% critical value	P*
OIL	−2.540108	−3.485115	−2.885450	0.1086
D (*OIL*)	−7.623565	−3.484653	−2.885249	0.0000
FIR	−1.289601	−3.484653	−2.885249	0.6329
D (*FIR*)	−7.287614	−3.484653	−2.885249	0.0000
DIR	−2.033687	−3.484653	−2.885249	0.2722
D (*DIR*)	−4.426205	−3.484653	−2.885249	0.0004

*MacKinnon (1996) one-sided P values, ADF: Augmented Dickey Fuller

Table 2: Cointegration test

Variable	ADF statistics	1% critical value	5% critical value	P*
RES	−2.569806	−3.487046	−2.886290	0.1021

*MacKinnon (1996) one-sided P values. ADF: Augmented Dickey Fuller

4.2. Cointegration Test

RES is the time series data that is developed based on the Equation (4). The results of estimating the value of ADF statistics and the value of ADF critics are summarized in Table 2. The absolute value of ADF statistics is 2.569806, which is lower than the absolute value of ADF critics at the significance level of 1%, which is 3.487046. Thus, *RES* is nonstationary. Therefore, all of the three time series data of the prices of world crude oil, foreign interest rates, and domestic interest rates are not cointegrated.

4.3. Response Test

Since, the three time series data of world crude oil prices, foreign interest rates, and domestic interest rates are not cointegrated, it is necessary to use Model (2) to test the response of domestic interest rate to the prices of world crude oil and foreign interest rates. Results of estimating the significant regression parameter and the P-value of t-statistics are summarized in Table 3.

As is shown in Table 3, the coefficient $D(FIR_{t-7})$ is significant by 1%, whereas the coefficient of $D(OIL_{t-1})$ is significant by 5%. This indicates that the interest rates determined by BI did show some responses to the prices of world crude oil and to foreign interest rates. The BI rates required a 1 month time lag to respond to the changes in the prices of world crude oil, and a 7 months time lag to respond to changes in foreign interest rates.

Furthermore, the long-term multiplier effect of the prices of world crude oil on the interest rates is 0.135. This means that after a period of 1-month, the prices of world crude oil changed, the interest rates of BI increased(decreased) by 0.135% to respond to each 1% increase (decrease) in the prices of world crude oil. The long-term multiplier effect of the foreign interest rates is 0.081. Thus, the foreign interest rates changed after a period of 7-month, where BI's interest rates rose (fell) by 0.081% to respond to each 1% increase(decrease) in the foreign interest rates.

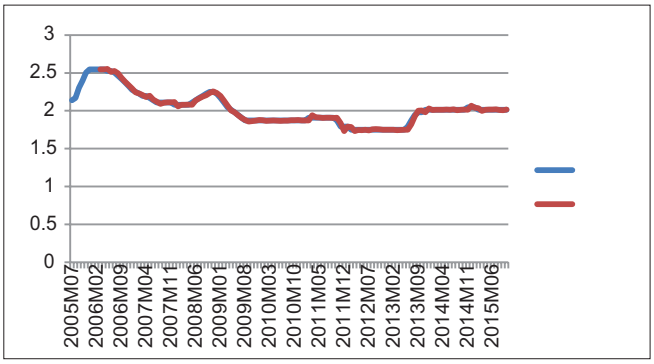
The decision to set domestic interest rates in response to changes in the price of crude oil on the world and foreign interest rates, the BI still refers to the previous interest rate, because the determination of domestic interest rates will also have an impact on other economic activities. It can be seen from the results of the regression parameter estimates as shown in Table 3. The BI rates in the previous month remains a reference for the BI to set domestic interest rates in the next months. In aggregate, the amount of BI's response to past BI rates, crude oil prices and foreign interest rates is $R^2 \times 100\% = 52.575\%$ of every 1% increase (decrease) in each of these economic variables. The positive response of domestic interest rates on world crude oil prices and foreign interest rates

Table 3: Results of estimating response test

Variable	Coefficient	Standard error	t-statistic	P	Others statistics
$D(DIR_{t-1})$	0.706864	0.064169	11.01572	0.0000	R^2: 0.525745
$D(OIL_{t-1})$	0.039445	0.016971	2.324312	0.0219	DW: 2.035874
$D(FIR_{t-7})$	0.023693	0.008527	2.778712	0.0064	AIC: −5.327184

DW: Durbin Watson, AIC: Akaike information criterion

Figure 1: The response of BI interest rates to the prices of world crude oil and foreign interest rates based on the Equation (6)



is 0.216% of every 1% increase (decrease) in each of the world crude oil prices and foreign interest rates. Thus, the reduction in the BI rate in the period 2005:7 - 2015:10 is the response of decision makers from the BI to the decline in world crude oil prices and US interest rates in that period.

Based on the results of the estimation above, the following difference equation model is developed, as follows:

$$D(DIR_t)=0.706864D(DIR_{t-1})+0.039445D(OIL_{t-1})+0.023693D(FIR_{t-7}) \quad (5)$$

Because, $D(DIR_t)=DIR_t-DIR_{t-1}$ then Equation (5) can be changed into the form of Equation (6), which is:

$$E(DIR_t)=DIR_{t-1}+0.706864D(DIR_{t-1})+0.039445D(OIL_{t-1})+0.023693D(FIR_{t-7}) \quad (6)$$

The estimated value of domestic interest rates, $E(DIR_t)$ in the period of 2005:7 - 2015:10 can be determined from Equation (6). The trend of $E(DIR_t)$ and DIR_t is illustrated in Figure 1. The $E(DIR_t)$ trend shows a signal indicating a response exhibited by the interest rates set by BI to the prices of world crude oil and foreign interest rates.

5. CONCLUSION

The stability of prices of goods and the rupiah currency relative to foreign currencies is the main target of monetary policy in Indonesia. To achieve this goal, one of the instruments of monetary policy of the Indonesian government has been implementing since 2005 is the use of BI-rate to determine domestic interest rates. The BI-rate is set by BI and is aimed to respond to changes in the prices of goods, or inflation caused by shocks that occur in both external and internal factors. This research aimed to examine the response of BI's interest rates to changes that occurred in external factors, particularly in the prices of world crude oil and changes foreign interest rates.

To achieve the above objectives, the study analyzed time series data of world crude oil prices, foreign interest rates, and BI's interest rate in the period from July 2005 to October 2015. The crude oil prices was proxied by the price of crude oil in Europe, namely Brent Crude Oil Futures Price. Foreign interest rate was proxied by US bank interest rates, which was the funds rate. A difference equation model was used to test the response showed by BI's rate to the changes in the prices of world crude oil and foreign interest rates.

Statistical inference test results showed that all the time series data of world crude oil prices, foreign interest rates and the interest rate of BI are integrated of order one, $I(1)$ and also not cointegrated. Furthermore, by testing the response indicates that there is a significant response from BI's interest rate to the world crude oil prices as well as to the foreign interest rates. The interest rate set by BI rose by 0.135% in respond to each 1% increase in the prices of world crude oil. It also increased by 0.081% in respond to each 1% rise in the foreign interest rates.

The results of this study can serve as an information for BI that it can use to maintain the stability of prices of goods production. The results of this research can also give information to the BI to stabilize the exchange rate of the rupiah against foreign currencies.

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