Jakarta Interbank Spot Dollar Rate (JISDOR) as The Reference Rate: Is It Effective?

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This study analyze the influence of non-deliverable forward (NDF) and the spot rate of USD/IDR against Bank Indonesia reference rate, Jakarta Interbank Spot Dollar Rate (JISDOR). NDF which came earlier than JISDOR is used by the market participant as the reference rate. The simple method of NDF determination had a great impact on the volatility of the rupiah currency, pushing the Bank Indonesia to issue its own reference currency. JISDOR is an indication of the rates issued by Bank Indonesia as the reference rate for the foreign exchange market in domestic and overseas. The method of creating the reference rate is by weighting the average rate of real transactions through a monitoring system which is managed by the central bank. However, the question arises: what should be done by the monetary authority when there is a party outside the jurisdiction issued the NDF rate as a benchmark that may affect the domestic exchange rate of rupiah in accordance with the desired agenda of the party. We use OLS and ARCH/GARCH to see if independent variables have an influence on dependent variable. Granger Causality test is also used to observe whether there are any relations among the variables.

Introduction

The exchange rate is important because of its effect on the economy and daily life. When a currency is relatively diminished its value against another currency then the cost of imported goods and overseas travel will become more expensive. The financial crisis that ever happened has increased the awareness of how important the role of the exchange rate. Based on the experiences of some of these crises, Henderson (2002) says that a country's exchange rate is not only affecting solely economic issue but can also affect other aspects of life such as social aspects and political aspects.

Considering the importance of the exchange rate, the central bank as a monetary authority uses a variety of instruments of a policy to keep the exchange rate movements controllable and at stable moves. Hence, we need to identify the factors that affect the movement of the exchange rate as the basis for the determination in a variety of monetary policies. Those factors include the strength of the supply and demand for foreign exchange, the purchasing power of the currencies against the same goods and

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Table 1. On-shore and off-shore USD/IDR transaction data

	ONSHORE	OFFSHORE
Average daily spot volume	USD500 million	
Spot transaction	USD2 million	
Bid/ask spread	3-5 pips (3-5 IDR)	
Average daily forward/NDF volume	USD200-300 million	USD0.7-1.3 billion
Forward/NDF transaction	USD10 million	USD5 million
Forward/NDF spread	10 pips (10 IDR)	10 pips (10 IDR)
Implied option volatility spread	3 vol	1 vol

Source: HSBC (2011: 24-29)

services in various countries and the presence of nominal interest rate difference which exists between one country and another. Foreign exchange trading in the global financial markets significantly increased almost 36% from USD3.9 trillion in 2010 to USD5.3 trillion in 2013 (Bank for International Settlements. Triennial Central Bank, 2013).

A stable exchange rate is needed to ensure the continuity of economic growth, the investment climate and the certainty of repayment of foreign obligations. Therefore, upon some consideration such as the country's economic scale is relatively still low, foreign currency demand and supply imbalance for various purposes of payments abroad then some countries apply capital control, namely in the form of a ban on the country's currency traded freely overseas (off-shore). Capital control policy is one of the problems faced by some foreign parties like a multinational corporation, investors or the importers/exporters to meet theirforeign currency needs. As long as capital control policy is still applied, the non-resident will always have currency exchange rate risk against business partner country. The market of non-deliverable forward (NDF) is the answer to meet the needs of the currency in the off-shore market. Besides being used to hedge exchange rate risk, the NDF is also used for speculation in the off-shore market. According to Misra and Behera (2006), 60%-80% of NDF trading volume comes from speculation activities.

The problems of NDF exchange rate determination is usually performed not by the currency issuer countries but by the banking association outside of the jurisdiction of the countries that impose capital control. As a result, it opens the opportunity of speculation and even more dangerous to control the country's exchange rate directly in accordance with the desired agenda, e.g. by appreciating or depreciating the currency exchange rate of a given country. Given the exchange rate NDF is marked as the reference to the strengthening (appreciation) or weakening (depreciation) of the currency; therefore, the exchange rate is strongly affected by exchange rate NDF indications. This happened in 2001 which Argentina was having intense pressure to abandon the fixed exchange rate regime in which one peso equals one USD while NDF market quoted Ps1.05/USD and Ps 1.10/USD which reflected the devaluation of the peso's value against USD (Eiteman, 2010).

Given the importance of the role of the exchange rate, then some countries such as India, Brazil, Malaysia, and Indonesia are trying to issue a reference exchange rate on its own because it does not want its currency exchange rate direction dictated by other country, which has a range of specific motives. According to Bank Indonesia (2013), exposure to the manipulation of the determination of the London Interbank Offered Rate (LIBOR) by the Banking Association of the United Kingdom and also the manipulation of the exchange rate determination of NDF currency of Malaysia ringgit by Singapore's Banking Association is the reason how importance of publishing the official reference exchange rate of the currency itself. One of the problems for the monetary authority to issue the reference exchange rate officially is whether market participants will make the official exchange rate as the official reference or still renders the exchange rate NDF as a benchmark.

Market makers are arguing that the creation of NDF market is a result of market distrust to-

wards the determination of the exchange rate by the monetary authority and assume the official exchange rate do not reflect the actual banking transactions. This is because of the intervention of the central bank through a variety of monetary policy instruments in influencing the exchange rate level is quite significant. Therefore, in order to maintain the trust of the market participants against the reference value, it needs a reference rate which is credible, transparent and reflects the real transactions.

Bank Indonesia tried to answer the market participant needs by creating the transparant reference rate which is called JISDOR (Jakarta Interbank Spot Dollar Rate). The reference rate is published by the central bank as a reference to the market participants of foreign currency transaction. Prior the issuance of Bank Indonesia reference rate, NDF rate is assigned by the Association of Banks in Singapore to become one of the reference rates of spot USD/IDR. This is because the market participants assume that exchange rate issued by the monetary authority solely based on the exchange rate of the domestic banking indications which does not reflect the real market liquidity. The other reason is the strength of the monetary authority to influence the direction of exchange rates in accordance with the desired agenda through a variety of activities such as policy instruments of intervention. According to Bank Indonesia (2013), JISDOR rate is the spot rate of USD/IDR which is actually transacted by interbank foreign exchange transactions in real time. The data source of the JISDOR reference rate comes from a system which is called SISMONTAVAR (Monitoring System of Foreign Exchange Transactions against Rupiah).

Based on research conducted by Misra and Behera (2006) against the influence of the NDF to exchange rate Indian Rupee (INR), mentioned that the NDF rate indirectly affects rates of spot and forward currency Indian Rupee in the domestic market, while the NDF market volatility affecting the domestic market directly. The question is whether a similar thing happened also in the case of Indonesia, where the currency exchange rate NDF influence indirectly the IDR spot and forward rate. Therefore, it needs to be substantiated the influence of NDF rate of USD/IDR whether indirectly or directly affect the spot USD/IDR.

Literature Review

The Theory of Exchange Rate

The exchange rate according to Henderson (2002: 17) can be done with some approximation theory, i.e. Purchasing Power Parity (PPP), The Monetary Approach, The Interest Rate Approach, and The Balance of Payment Approach.

Law of One Price is a simple theory to understand how an exchange rate occurs. This theory explains that the price of an item will be the same in any parts of the world with the assumption identical goods produced, low transport costs, and trade barrier relatively minimum. Purchasing Power Parity is a further application of the theory of the Law of One Price as described earlier. PPP is based on principles that exchange rates between one country and another country will be adjusted so as to reflect the level of mutual equilibrium price in both countries.

$$E = \frac{P}{P^*} \tag{1}$$

where E is the PPP exchange rate in the long term, P is the price of domestic goods, and P^* is the price of the goods abroad. The equation shows that the equilibrium exchange rate in the long run is the ratio of the price of the same goods between the two countries.

The Monetary Approach explained that exchange rate changes occur through the transmission mechanism through prices and interest rates. Based on the classical theory, the price level of a country is a function of the amount of money in circulation, but based on the theory of the PPP exchange rate is always correspond with the price of goods trade between the two countries. It can therefore be inferred that when monetary factors can determine price that in the end will also affect the exchange rate.

The next theory was the interest rate approach that describes two approaches, namely

interest rate parity theory which describes that the percentage of the premium or discount from a forward exchange rate is a reflection of the interest rate differential. In fact, the premium/discount rate forward are not always appropriately describe the interest differential between the two countries so as to open up opportunities for financial market participants to conduct arbitration through the mechanism of covered interest rate arbitrage. The other theory is international fisher effect that explains the difference in interest rate is always equal to the estimates to changes in exchange rates. The currency of a country with the level of nominal interest rates higher is going to depreciate against the currencies of other countries that face interest rates lower. This is because the level of nominal interest rates higher tends to cause the onset of inflation.

Finally, the theory of the balance of payment approach which tells us that the change of national income will affect the current and capital accounts so as to affect the reaction to the exchange rate because it will create balance of payment equilibrium. An easy way to prove this is through the transmission mechanism that occurs from changes in national income to reaction rate equations are based on the classical economic adjustments to accounting, namely:

$$S\text{-}I = Y\text{-}E = X\text{-}M \qquad (2)$$

where S is saving, I is investment, Y is income, E is the expenditure, X is exports at one time, and M is imports.

Factors That Affect Exchange Rates

There are several factors that can influence the magnitude of exchange rates. Those factors are divided into two parts, a factor changes in exchange rates in the long term and factor changes in exchange rates in the short run (Mishkin, 2010). Changes in exchange rates in the long term is affected by four factors, the relative price levels, trade barriers, preferences between domestic products and foreign products, and the level of productivity.

On the relative price level, everything that causes a rise in demand for domestic products than foreign products will cause the domestic exchange rate to appreciate due to high domestic product sales. On the contrary, everything that leads to higher foreign demand than domestic products, then it will cause the domestic exchange rate to depreciate. The restriction of free trade, such as tariffs and quotas of imported goods tax can affect exchange rates. It can therefore be concluded that the application of trade barrier by a country can lead the currency appreciation in the long term.

Preferences among domestic products and foreign products will affect the exchange rate of a country. The growing demand for export products will cause the currency of the country concerned experienced an appreciation in the long term, otherwise, once the demand for imported goods in the country increased then this will cause a corresponding country exchange rates depreciate. Domestic high productivity usually associated with a decrease in the cost of production so that prices of domestic goods relatively cheaper than foreign products. Therefore, the demand for domestic goods will cause the exchange rates to appreciate. If cost of production of domestic goods is higher when the relative price of domestic goods is more expensive compared with foreign product, this will lead the exchange rate to depreciate.

Changes in exchange rates in the short term are influenced by three factors, namely the domestic interest rate, foreign interest rate, and exchange rate expectations in the future. Rising domestic interest rates in a country will cause people to invest in assets in those countries because it will give higher yields.

The Technique Analysis of Exchange Rate

Analyzing the movement of the exchange rate for the foreseeable future by market participants is for a variety of purposes, either in order to take a good position to take advantage of exchange rate movements or to hedge against the current portfolio position. Madura (2001: 413) divide the analysis of exchange rate movements on the four analysis, i.e. technical forecasting, fundamental forecasting, market based fore-

casting, and mixed forecasting.

Technical forecasting is done using historical data to predict the direction of the exchange rates movement in the future by ignoring the economic and political factors. In this technique, the pattern of movement of exchange rates is historically in the form of graphs as an indication movement direction of the exchange rate. This technique has many weaknesses because it is very speculative in nature and tends to apply only in the short term so that transaction costs will be greater due to higher transaction frequency. The system is also more time-consuming because currency movements should be monitored continuously to get a systemic pattern.

Techniques for predicting the direction of exchange rate movement on a future date with the fundamental relationship between basing on economic variables and the exchange rate is referred to as fundamental forecasting. Economic variables include interest rates, inflation rates, unemployment rates, economic growth, and production numbers. This technique has drawbacks, among others, in the selection of the variables which are fundamentally more correct including how big these variables affect the direction level of exchange rate movement in the future. This is because the fundamental has some factors so that one another mutually affect the movement of the exchange rate of either the same direction or in the opposite direction. Other weaknesses that need to be taken into account are the variable that cannot be anticipated in advance, such as labor strike and its impact on the economy.

In market-based forecasting, prediction of exchange rate direction in the future is done based on observation of spot exchange rates and forward. Through spot indication, the direction of the exchange rate movement will be predicted towards appreciation or depreciation in the short term. While the forecast exchange rate for a longer period of time such as a month, three months or six months can be done through exchange rate forward indicators corresponding to the desired tenor. For example, at the moment the exchange rate against the USD to IDR currency spot is IDR10,500 per USD and one

month forward rate is IDR11,000. Based on the indicative exchange rate forward were then in general it can be concluded that the IDR within one month ahead will be weakened against the USD.

In practice, there is no prediction technique of exchange rate movement direction that is really reliable because each has strengths and weaknesses. Therefore, in some multinational companies usually applied a method called mixed forecasting. These methods perform weighted average some of the techniques of analysis and give greater weight to one of the engineering analysis that are considered more reliable.

Understanding NDF

According to Higgins and Humpage (2005), the growing magnitude of the NDF market beginning with the capital flow to emerging markets that occurred during the period of the 1980s and 1990s. Forward domestic markets in the emerging countries which is characterized by limited access to domestic forward market by the non-resident will give rise to speculation, money market volatility, and monetary control. Therefore, since the 1990s, several international banks offer the NDF contract to investors as a means of hedging their exposure in currencies of emerging markets. The development of a fairly rapidly from NDF transactions resulted in the transaction is used by the trader for the purpose of speculation.

The main difference between regular forward transactions with the NDF is at the settlement date. In an ordinary forward transaction, both parties transferred the currencies at the settlement date whereas in the NDF only requires that one of the two parties to the transaction to pay the net amount. The amount payable is the difference between the NDF rates approved in early deals with the determination of the exchange rate (the fixing rate) at the settlement date. Although the payment can be done by converting multiple currencies, generally the payment obligations of the NDF made in USD.

Forward pricing on a formula calculated based on interest rate parity that measures the

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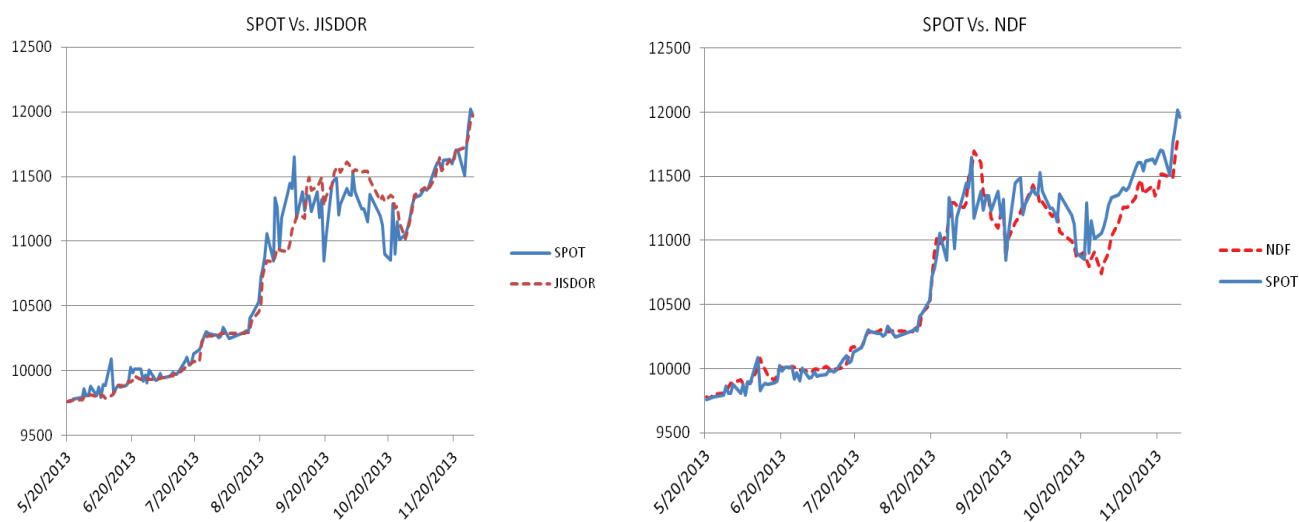
Data Source: Bloomberg (2013)

Figure 1. Spot Rate, JISDOR, and NDF

rate of return within a certain period based on the level of interest rates and the price of the spot of the two currencies. However, there are also other things that affect the pricing of this like NDF trading flows, liquidity, and counterparty risk. The relationship between the market on-shore and off-shore can be described from covered interest parity as follows:

$$F = S(1 + r)/(1 + r^\$) \qquad (3)$$

where F is the forward rate, S is the spot rate, r is the interest rate of home currency, and $r^\$$ is USD interest rate.

NDF transactions mechanisms are carried out directly over the counter (OTC), namely between the bank and the customer as market makers through electronic media such as telephone, Reuters Dealing, or other media. In addition, transactions can also be made through the services of a broker who acts as an intermediary between the bank and the customer as market maker.

One of the things that stand out from the NDF transactions is the existence of NDF trading center which is outside the jurisdiction of the monetary authorities. NDF trading centres are located in Hong Kong, Singapore, South Korea, Taiwan, Japan, London (for the currencies of the countries of Eastern Europe), and New York (for the currencies of the countries of Latin America). The existence of trade centres

outside the country's monetary authority jurisdiction will open opportunities to speculators to keep doing the speculation without the fear of the threat of sanctions.

Fixing rate is the exchange rate that will be the benchmark for determining the amount that is paid or the amount received on the settlement date. Before August 6, 2013, the mechanisms fixing rate for currency IDR was done by the Association of banks in Singapore based on surveys of the average exchange rate of IDR against the USD quotations by some banks which recorded on Reuters screen every day at 11.30 AM Singapore time.

A quote provided by the banks are price indication of IDR to USD exchange rate and does not reflect the real transaction from the banks. This mechanism is very detrimental to the country's currency because some banks can plot with giving an indication of the likely depreciation or appreciation according to the desired direction.

Following the fixing scandal that involves 20 banks in Singapore, the Monetary Authority of Singapore punished the banks that do a conspiracy and changed fixing rate mechanism becomes benchmarking system that is associated with the rate that actually transacted. Fixing rate mechanism changing came into effect on August 6, 2013 against the NDF rate currency THB, SGD, and USD.

Table 2. Dependent and Independent Variables

Group	Dependent variables	Independent variables
Mean equation	Return of Spot USD/IDR rate at observation time	Return of spot USD/IDR rate for previous period
		Return of NDF rate
		Return of JISDOR rate
Varians equation	Variance of USD/IDR rate which is formed by time series model using ARCH/GARCH asymmetric model	Consist of errors and variances for previous period which is formed by time series model using ARCH/GARCH asymmetric model.

Source: Researcher (2013)

Understanding JISDOR

JISDOR is an indication of the rates issued by Bank Indonesia as of May 20, 2013 as the reference rate for the foreign exchange market in domestic and overseas. The method of creating the reference rate is by weighting the average rate of real transactions through a monitoring system which is managed by the central bank. JISDOR rate is based on interbank rates that are really transacted so the rate can be considered more credible and transparent for the market. Since its launch, JISDOR rate shows an increasingly positive trend in the eyes of the foreign exchange market trader. It can be seen from Figure 1 that shows the narrowing spreads between the spot rate and JISDOR (left graph). While on the right graph shows the widening spreads between the spot exchange rate and NDF.

Research Methods

Variables

The three variables consist of NDF rate and JISDOR rate as independent variables whereas spot USD/IDR rate as dependent variable. Dependent and independent variables are closely related to time series models using ARCH/GARCH as follows (Table 2).

Stationarity Data Test

The data used in this research is the primary data that is processed further into a secondary data. Such data is a daily financial data with a period since the release of Bank Indonesia JISDOR on May 20, 2013 until November 30, 2013. In this case, we use the daily rate of NDF

USD/IDR, Spot USD/IDR, and Bank Indonesia JISDOR sourced from Bloomberg. For the purpose of simplification, we use the closing middle rate on a daily basis.

Exchange rate data cannot be used directly in the calculation of autoregressive and moving average since such data is not stationary. It needs to be done through a process of differentiation which is called difference stasionarity process (DSP). According to Nachrowi and Usman (2006), this is done by comparing the difference in the exchange rate today with closing rates of the previous day and the result divided by the exchange rate of the previous day's closing. The data is analyzed using a stationary test done a few methods such as correlogram graphics and statistical tests so that the resulting regression models become better and more efficient.

After stationary testing, further analysisis carried out in regression by using the method of Autoregressive Heteroscedasticity Conditionals (ARCH) and General Autoregressive Heteroscedasticity Conditionals (GARCH). Next step, the data is analyzed to see the strength of the relationships between the parameters of the Granger Causality. We use some methods to detect any data that is composed of several heteroscedasticity such as graphics, correlogram, and unit root test which is also known as Augmented Dickey Fuller (ADF) test.

In doing regression, there is the possibility of a false regression (spurious regression). This can result from the presence of bound variables and free variables which are used to form non stationary regression or variables formation are not correlated substantially (Nachrowi & Usman, 2006). A regression is suspected to be spurious regression if $R^2 >$ Durbin-Watson Statistic. When a false regression is interpreted,

the analysis can yield wrong or does not correspond to the real facts so that may result in wrong decision making.

ARCH and GARCH Test

Method of Autoregressive Conditionals Heteroscedasticity (ARCH) and General ARCH (GARCH) are used to analyze the exchange rate volatility of NDF and JISDOR against dependent variables which are spot and forward exchange rate. GARCH equation in general is as follows:

$$GARCH\ (P,Q) \tag{4}$$

where P is the order of the GARCH and Q is the order of the ARCH. Therefore, when $P = 0$, then the process will be an ARCH(Q). Variance function next to ARCH is shown by the following equation:

$$h_t = \alpha_0 + \alpha_1 e_{t-1}^2 \tag{5}$$

More generally, it can be stated as follows:

$$h_t = h(y_{t-1}, y_{t-2}, ..., y_{t-p}, \alpha) \tag{6}$$

where P is the order of the ARCH and α is the vector of unknown variables.

While the simple GARCH Model and GARCH models are widely used, GARCH(1,1) can be described by the following equation:

$$h_t = \alpha_0 + \alpha_1 e_{t-1}^2 + \beta h_{t-1} \tag{7}$$

In general, financial data such as stock price index, inflation, exchange rates, or interest rates often have variant error which is not constant. In that case, when we made through OLS estimator it will be inefficient because the variance of the estimator is not the minimum so that the t test, confidence interval and a variety of other sizes to be imprecise (Nachrowi & Usman, 2006). To resolve this, using model Autoregressive Conditionals Heteroscedasticity (ARCH) and the Generalized Autoregressive Conditionals Heteroscedasticity (GARCH) can

make use of heteroscedasticity within the error appropriately so that more efficient estimator is obtained.

ARCH and GARCH models analyze two things in the regression equation the middle values (conditional mean) and variants (conditional variance). Establishment of a model for the middle value is done first followed by the model for the variant. This is because in the event of an error in the determination of the variance will not affect the estimation of the central value while errors in the estimation of the central value will affect the determination of the variance estimation.

Granger Causality Test

We test variables whether having two-way directions or just one direction only by using Causality Granger test (Nachrowi & Usman, 2006). Testing by using this method will show how big the influence of the past against the present condition and the data used is the time series data. Granger Causality test can be done by making a hypothesis as follows:

$$H_0 = X \text{ does not cause } Y$$

The next was F-test which is based on the Sum of Square Error (SSE) with a formula as follows:

$$F = \left(\frac{N - k}{q} \right) \left(\frac{SSE_{limited} - SSE_{full}}{SSE_{limited}} \right) \tag{8}$$

where N is the number of observations, K is the number of parameters of full model, and Q is the number of parameters of the limited model. If H_0 is rejected, it means that X affects Y. In contrast, the same way can be made to see the influence of Y against X.

Results and Disscussions

Descriptive Analysis

During the first quarter of year 2013, Indonesia's economy grew sluggishly that is only of 6.02%. The source of the growth slowdown

stems from declining domestic demand amid recovering export performance. In the meantime, increasing fuel consumption amid the status of Indonesia who has become a net oil importer has forced the Government to release some fuel subsidies to maintain fiscal sustainability and reducing the current deficit. Until November 2013, inflation has exceeded the target and reached a level of 8.37% (yoy).

The pressure on IDR is also affected by external factors because of worsening conditions in the global economy as the impact of the economic crisis of 2008. The continuing economic problems in the United States and Europe affected the economy in the emerging markets. China's economic which grew at a rate of 10.4% in 2010 is predicted to decline to 7% by 2013. China's economic decline is results of the decline in demand for goods from the United States and Europe who have not fully recover yet. Because some Chinese production raw materials come from Australia, the decline of production level in China resulted the Australia's economy also suffered a downturn. As a result of pressure from both internal and external, up to the end of November, in a point-to-point exchange rate depreciates amounted by IDR 18.14% to IDR 11,965 per USD compared to IDR9.795 per USD at early 2013.

Some of the NDF market exchange rate for the baht Thailand (THB) and ringgit Malaysia (MYR) has begun to diminish its activity caused by several factors such as the publication of the reference rates and persuasive policy strictly from the respective central banks against the NDF domestic market participants. NDF market of USD/IDR is still actively traded on the Singapore interbank market that affects the spot and forward in the domestic market.

According to Bank Indonesia (2013), when compared to the exchange rate fluctuations of the spot USD/IDR in the domestic market, the NDF rate tend to depreciate against IDR by as much as 1%-2%. NDF rate issued by the Banking Association of Singapore for the rupiah currency against the USD was also generally higher by IDR50 – IDR150 compared to the official rate issued by Bank Indonesia.

Stationarity Data Test

Based on grapic test, NDF data, JISDOR, and spot rate all show a trend of increasing. That means increasing the time (t) is getting higher the value of observations (Y). This pattern will result in an average increase in systemic or not constant. The data also has not shown a normal distribution which is generally accepted so it can be concluded the data is still not stationary. Based on correlogram test, it shows that time series data of the NDF, JISDOR, and spot rate are also not stationary because the patterns showed a continuously descending on ACF and spike in the ACF over the limit allowed.

Test unit root test which aims to ensure that a data time series is stationary and there is a trend in the data time series. Based on the testing methods used with Augmented Dickey-Fuller test (ADF) against NDF data, JISDOR, and spot, then it can be concluded the data are not stationary. Therefore, to make these data to become stationary it needs a differentiation against the level data. As for the test result graphics, descriptive data, and unit root test of the differentiation for the first order that has been done by using descriptive statistics test showing the third data has been differentiated with normal distribution.

Correlogram test against the first data order of JISDOR, NDF, and spot showed that all of the time series data has been stationary since spike pattern that emerged was not over the interval limit allowed. The results of the unit root test with the method of first order differentiation of ADF's showing that the data has been stationary.

The Regression Modeling

After concluding that the data is stationary then it will proceed to the stage of the modeling. The first step is to make the equation model to see how big the influence of NDF and JISDOR against SPOT with the model as follows:

$$SPOT = b_0 + b_1 NDF + b_2 JISDOR \qquad (9a)$$

Based on the output of the ordinary least square it can be concluded that the results of the above regression shows a good statistical figures with the Durbin-Watson of 2.910916. It means that there is autocorrelation. In addition, upon examination of correlogram test showed statistical probability Q is still statistically significant, so that the error can be concluded with containing autocorrelation. Because modeling with OLS still shows error containing autocorrelation as seen in the above correlogram the analysis is continued by the method of ARCH/GARCH.

ARCH/GARCH

Regression test results by using the ARCH/GARCH showed that all the dependent variables are not significant because the probability above 5%. The test using the following equation:

$$SPOT = 0.000799 + 0.1696\ NDF$$
$$+ 0,4157\ JISDOR \qquad (9b)$$

With the equations (var e_t):

$$\sigma_t^2 = 7.84 + 0.567622\sigma_{t-1}^2 + 0.470479d_{t-1} \quad (10)$$

However, having checked back Q statistics from a regression ARCH/GARCH above using correlogram, it still shows a significant probability of error or still contain autocorrelation. Therefore, the test is continued by the next model of the ARCH/GARCH models i.e. TARCH by entering each of the dependent variables into the model variant errors. The equation for both models TARCH above is as follows. For TARCH Regression to the Spot with a variance JISDOR, the mean equation become:

$$SPOT = 0.0005 + 0.2438\ NDF$$
$$+ 0.3296\ JISDOR \qquad (11a)$$

With the equations (var e_t):

$$\sigma_t^2 = 1.14 + 0.4672\sigma_{t-1}^2 + 1.1288d_{t-1}$$
$$+0.0002\ JISDOR \qquad (11b)$$

Moreover, TARCH Regression to the Spot with a variance of the NDF leads to mean equation as follow:

$$SPOT = 0.0005 + 0.2438\ NDF$$
$$+ 0.3296\ JISDOR \qquad (12a)$$

With the equations (var e_t):

$$\sigma_t^2 = 2.02 + 0.3930\sigma_{t-1}^2 + 1.4389d_{t-1}$$
$$-0.0032\ NDF \qquad (12b)$$

After using the model of TARCH by adding each variance with the independent variable, it still shows error containing autocorrelation. However, by observing Q probability, its statistics already show improvements because most of them are already above 0.5%.

The next step is to conduct a regression back using regression ARCH/GARCH namely by incorporating elements of AR(1) to eliminate autocorrelation using a TARCH model with Akaike criterion and Schwarz criterion is lower therefore we use TARCH for Spot with JISDOR variance with the following equation:

$$SPOT = 3,68 + 0,2755\ NDF$$
$$+ 0,3679\ JISDOR + 0,0748\ \sigma_t \qquad (13a)$$

With the equations (var e_t):

$$\sigma_t^2 = 1.30 + 0.172\sigma_{t-1}^2 - 0.39\sigma_{t-2}^2 + 0.41\sigma_{t-3}^2$$
$$+0.15d_{t-1} + 0.30d_{t-2} + 0.24d_{t-3}$$
$$-0.001\ JISDOR \qquad (13b)$$

Based on the output from the last equations, it can be summed up as follows. On the mean equation, we find that, statistically, with the probability of 95%, spot USD/IDR is influenced by NDF and JISDOR. However, since the coefficient of JISDOR greater than NDF, the influence of JISDOR has higher sensitivity. While at variance equation, statistically, on the probability of 95%, a variance on the spot USD/IDR at period t is influenced by variance in the previous period. In addition, a variant on the spot USD/INR in the period t is affected by the error in the previous period.

Based on correlogram test results, the error is not correlated in any lag. It can be seen from the autocorrelation column which does not show a sharp spike, and all are in the normal range. All data has been stationary since there is no continuously descending pattern. Beside that, it can be seen that the spike on the AFC are already in the area of normal boundaries.

Statistics Jarque-Bera result shows probability of 6.8% or above 5%, so it was decided to accept the hypothesis that the error term follows a normal distribution. This can be seen also from the displayed graph that shows a form of bell (bell shaped). As such, based on a regression test that was done then it can be concluded that both the NDF and JISDOR significantly affect spot USD/IDR where JISDOR had a higher sensitivity in affecting the spot USD/IDR.

Granger Causality Test

Granger Causality test results to see the relationship NDF rate and the spot show the probability value is smaller than the value of α used, i.e. 5%, so it was decided to reject the hypothesis. Or in other word, that the variables of NDF and spot influence each other. While the test of causality between Granger for JISDOR and spot rate is concluded to reject a hypothesis or spot rate is affected by JISDOR and accept the hypothesis that JISDOR is not affected by the spot rate.

The pattern of relationships that interplay between the NDF and the spot USD/IDR is in accordance with the results of research conducted by Misra and Behera (2006) that studied the influence of NDF market against Indian Rupee (INR). Results of the study indicated that the NDF market in general is affected by the market spot and forward and whereas the spot and forward market are also influenced by the NDF market.

Conclusions

Granger Causality test shows the NDF and spot USD/IDR has a relationship of mutually influencing each other. On the other hand, the spot of USD/IDR rate movements is influenced

by JISDOR but not vice versa.

The existence of JISDOR reference rate does not change the relationship that interplay between the NDF market and the spot market. JISDOR rate which is a reference rate based on the actual transaction turns out to have a higher sensitivity in influencing the USD/IDR spot rate in comparison to NDF. It means that the spot USD/IDR rate movements in domestic market is more influenced by JISDOR rather than NDF rate. The results of this analysis are good news to convince market participants using JISDOR as a reference rate which is based on real transaction data than NDF rate which is only based on price quotations from a handful of banks.

JISDOR rate shows an increasingly positive trend as the spread between spot and JISDOR is narrowing while the spread between spot and NDF is widening.

For the next study, a wider analysis should be done by adding other variables such as forward rate with various maturities both offshore and onshore. It also need to be taken into account the influence of factors of market liquidity of NDF and spot USD/IDR rate to see whether the market is more influenced by conditions of market liquidity that is actually the case or simply by virtue of the non market factor.

The regulators need to establish regulation more firmly as carried out by other central banks in the region against the bank which conduct NDF transactions such as prohibiting domestic banks to conduct NDF transactions with the overseas banks. It needs to be considered to ease restrictions on foreign currency conversion policy (foreign exchange convertibility restrictions) as long as the transactions are carried out based on the transparent underlying. The central bank also needs to reduce intervention/sterilization in the forex market directly and let the exchange rate mechanism in accordance with the strength of demand and supply.

For investors/bankings, they need to take into account company policies related to currency exposure by observing indications of the NDF rates as well as JISDOR and propose to the Government so that the NDF transactions between onshore and offshore is only done when the underlying can be proven.

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