



Determination of Equilibrium Exchange Rate Rupiah Against US Dollar and its Volatility: Application of Asset Approach

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Abstract: The prevailing exchange rate and volatility have always been an important issue in an open economy and freely floating exchange rate system, such as in Indonesia. In this system, the exchange rate fluctuates based on the interaction between demand for and supply of foreign currency in the foreign exchange market. Its fluctuation may influence many economic activities and can be transmitted to the inflation rate. This shows that the prevailing exchange rate and its volatility become a crucial variable that must be taken into account by all economic actors. This paper aims to describe the application of the asset approach in determining the equilibrium exchange rate Rupiah against US\$ and analyze the factors that influence its volatility. The analysis method used is the applied method based on the theory of Uncovered Interest Parity (UIP) condition. The result shows that the actual exchange rate is completely different from the equilibrium exchange rate where Rupiah is undervalued towards US\$. It reflects that the demand for US\$ is greater than its supply which means that the foreign exchange market is not in equilibrium. When all else equal, a decrease in the Rupiah interest rate, an increase of the US\$ interest rate and a rising in the expected future exchange rate, respectively, will depreciate Rupiah against US\$. The changing of these three factors can show and describe clearly its effect on the volatility of the exchange rate. This paper has shown the application of the asset approach to determine the equilibrium exchange rate Rupiah against US\$ and how it could be fluctuating based on the UIP condition.

Keywords: Exchange rate, foreign exchange market, asset, interest rate, depreciation

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INTRODUCTION

Every open economy has international economic relationships, such as trade and finance. These relationships will raise international transactions that involving residents of two countries with different currencies. The transactions will involve the exchange of one currency for another. When one currency is exchanged for another, it will create a price of one currency to another that called exchange rate (Czinkota, Ronkainen, & Moffet, 2015).

In a freely or flexible floating exchange rate system, as applied in Indonesia, the exchange rate is allowed to fluctuate according to the mechanism of foreign exchange market. The fluctuation is based on the interaction between the demand for and supply of foreign currency. By this mechanism, the exchange rate of domestic currency (Rupiah) against foreign currency (US\$) will be highly volatile and difficult to predict. The effects of volatility exchange rate are negative in countries with flexible exchange rate regimes, whereas they are not significant in countries with fixed regimes. In economies with flexible exchange rate regimes, exchange volatility is relatively high. The volatility is more harmful when countries adopt flexible exchange rate regimes and financial openness (Achouak, Ben-Salha, & Zmami,

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2018).

In fact, the prevailing exchange rate in an open economy has ability to influence economic activities, such as trade, investment and foreign debt payment. Moreover, it can be transmitted to the fluctuation of inflation rate and economic growth. The fluctuation of exchange rate can affect the economy to the positive or negative end. Exchange-rate volatility affects several macroeconomic variables, such as exports, employment growth, inflation, investment, and overall economic growth (Asghar, Asif, Aslam, Bahadur, & Mahmood, 2020; Alagidede & Ibrahim, 2017). It is also indicated by Moses et al. (2020) that the exchange rate volatility had a negative effect on the countrys GDP growth. Furthermore, their results showed that the exchange-rate volatility exhibited short-term unidirectional causality on economic growth. Indonesia itself and some other countries have ever had an unforgotten experience that brought their economies to the deep crisis as domestic currencies depreciated against US\$. This fact shows that exchange rate becomes one of the crucial variables in an open economy, such as Indonesia, that must be taken into account by all economic actors, such as bankers, exporters, importers, investors, consumers, producers and government.

Taking into account that the exchange rate movement is quite volatile and the impacts are quite extensive to the economy, then the efforts to maintain exchange rate stability become a challenge for the Bank of Indonesia in the midst of an open economy within a free foreign exchange system and a floating exchange rate regime. Rupiah stability turns out to be increasingly crucial in association with the inflation target achievement (Avdjiev, Bruno, Koch, & Shin, 2019; Liu & Lee, 2020; Sugeng, Nugroho, Ibrahim, & Yanfitri, 2010).

The mandate of most central banks, especially in emerging economies, still emphasizes around the maintenance of macroeconomic stability (Alatrash, 2018; Binici, Kara, & Özlü, 2019; Egea & Hierro, 2019; Tran, 2018). Specifically, the stability of exchange rate in Indonesia is a main concern of Bank Indonesia as central bank. Bank Indonesia has a mandate from constitution which said that the objective of Bank Indonesia is to maintain the stability of Rupiah value. It can be explained that as a national currency, Rupiah can be exchanged for another foreign currency. The Rupiah value when it is exchanged for another foreign currency is shown by exchange rate. Thus, it is important for Bank Indonesia to maintain the stability of exchange rate since it has to do directly with its objective as monetary authority. Monetary policy conducted by central bank plays an important role in stabilizing the exchange rate. As Mayandy (2019) suggests that the central bank must react to nominal exchange rate depreciation by tightening monetary policy.

Bambi, Eugeni, et al. (2020) provided a theory of exchange rate determination where the value of the nominal exchange rate at any given period is affected by the expected purchasing power of the two currencies in units of the respective domestic goods. At the monetary steady state, the prices of the two goods are a function of the fundamentals of the respective economies. Hence, the nominal exchange rate is itself a function of the fundamentals. Empirical evidence indeed suggests that the link between exchange rates and fundamentals is stronger at longer horizons.

Golit, Salisu, Akintola, Nsonwu, and Umoren (2019) found in their research that based on the theoretical perspective which informing the a priori expectation of the exchange rate and interest rate differential. It states that an increase in the interest rate differential favoring the domestic economy will lead to more foreign currency chasing the domestic currency, thereby leading to foreign capital inflows that will ultimately lead to appreciation of the domestic currency. This effect indicates a negative relation between the exchange rate and the interest rate differential. Furthermore, Nwosu et al. (2019) found that in some countries, the monetary policy is influenced more by exchange rate since those countries target monetary aggregates and perform active role in the foreign exchange market.

The exchange rate is determined in the foreign exchange market as the price of one currency in term of another currency (Cecchetti & Kermit, 2015). When people buy a currency, they must pay it with another currency. The action of buying a currency can be considered as holding an asset. So, exchange rate manifests the price of asset in the form of currency. Asset itself is a form of wealth where people can transfer their purchasing power from the present to the future. By holding an asset as a wealth, someone can transfer his present consumption to the future with the expectation that the price of asset will increase in order to have profit. This research assumes that bank deposits in domestic and foreign currency denomination are as asset.

If someone holds a currency as an asset, he expects that the price of asset will increase so that he can gain from the difference between buying price and selling price. The changing of currency price as asset held will be seen on the fluctuation of exchange rate. Therefore, this paper has some objectives to achieve. First, to explain how the equilibrium exchange rate Rupiah against US\$ is determined by applying asset approach. Second, to analyze how the equilibrium exchange rate can change based on the asset approach.

LITERATURE REVIEW

The Demand for Foreign Currency Assets

As other prices in the economy that are determined by the interaction of buyers and sellers, exchange rate is determined by the interaction of financial institutions, firms and households that buy and sell foreign currency to make international payments for their activities such as trade, investment and foreign debt payment. Those activities will raise a need to exchange or trade currencies for one to another. This trading furthermore will be settled in the foreign exchange market where the foreign exchange transaction is cleared and the exchange rate is quoted. Most of the foreign exchange transactions are implemented in the form of bank deposit transfer as the biggest value of foreign exchange transaction. As a consequence, the activity of foreign exchange transaction will involve the role of bank and be supported by banks business to expedite the transactions.

As international competitiveness increases, the demand and supply for foreign exchange also increases in the same magnitude. It will increase the volume of foreign exchange transaction that also translates to increase in the volume of banking sector activities as they remain the major player in foreign exchange market (Juttner, 1998).

People may hold their wealth in many various forms such as stocks, bond, property, gold, cash and many other forms. Bank deposit in foreign currency denomination is also one of the asset forms that are traded in the foreign exchange market. The demand for bank deposit in foreign currency denomination is basically influenced by the same considerations as the demand for any other asset. The main consideration is related to what the value of bank deposit will be worth in the future. A foreign currency deposits future value depends on two factors: the interest rate it offers and the expected change of exchange rate.

Cesa-Bianchi, Sokol, and Thwaites (2019) stress two key features of financial sector assets and liabilities. First, financial sector liabilities serve an important role in facilitating payments, both in payments for real goods and services and in payments for purely financial transactions, either directly or as collateral. As a result, bank deposits are demanded both for their financial or investment yield and for their liquidity or monetary convenience yield, where the latter depends on the quantity of deposits outstanding. Second, deposits in either currency are predominantly created (and destroyed) through the creation (and repayment) of loans in that currency, and also, but to a much lesser extent, through the purchase (and sale) of securities. This means that not only the demand for deposits by non-banks to hold deposits in different currencies, but also the supply of deposits by banks.

As in other asset market, the actors of foreign exchange market base their demands for deposits of different currencies on a comparison of expected rate of return from these deposits. Bank deposits play an important role in an economy because of the special function of banks as financial intermediaries that collect funds from the society and launch it as loans. To compare the returns of each deposit, the market actors need two kinds of information. First, how the money value of deposits will change over a certain period of time. Second, how the exchange rate will change so that the rate of return from each deposit can be calculated into the comparable term (Krugman & Obstfeld, 2009).

The first information needed related to the changing of money value is the currency's interest rate. The interest rate is the price of money as a consequence of lending it from one party to others over a certain period of time. The interest rate plays an important role in the foreign exchange market because the deposit traded in the market must pay interest according to its currency denomination. The bank deposits pay interest because the depositors lend their money to the bank. When the depositors lend their money, they are holding an asset denominated in a currency it deposits instead of using it for current expenditure. So, the interest rate offered by any currency's bank deposit will show how much the money value of each currency will change over a certain period of time. Selvanathan and Selvanathan (2019) shows that market actors may shift regularly their type of deposit from one to another depend on the fluctuation of interest rate. Therefore, the bank managers need to understand the level of substitutability from one type of deposit to another.

The second information needed to compare the rate of return for each currency deposit is how much the exchange rate is expected to change for a certain period. In this case, it needs a prediction or assumption about the expected exchange rate in the future whether the domestic currency will depreciate or appreciate against foreign currency and how much the changing.

Based on these two pieces of information, the market actors will try to find out the bank deposit which has the higher expected rate of return. There are two options for the market actors. Those are using the domestic currency to buy foreign currency deposit or using the domestic currency to buy domestic currency deposit. Each option will gain its own rate of return. So, the market actors must calculate the expected domestic currency rate of return in foreign

currency deposit as gain of the first option and the expected domestic currency rate of return in domestic currency deposit as gain for the second option. The market actors finally will come to the decision to buy the bank deposit that offering the highest expected rate of return.

The decision to buy a bank deposit with the highest expected rate of return is based on the assumption that all other things are being constant. In fact, there are some other factors that can influence the decision to buy a bank deposit other than expected rate of return it offers. The market actors also consider about other main characteristics of asset such as risk and liquidity.

Risk is the variability of an asset value from time to time. The bigger the fluctuation of an asset value, the higher the risk contained in that asset. A high risk asset has an uncertainty on the expected rate of return. The market actors commonly do not like this uncertainty factor and tend to choose an asset which has a certainty in return. So, a bank deposit with high expected rate of return can be an undesirable asset when the market actors know that the asset has highly fluctuation return.

Liquidity of an asset is shown by how easy and fast an asset can be transformed into goods or services. The most liquid asset is cash as it is directly acceptable to pay for goods or services. The market actors commonly prefer to hold some liquid assets for precautionary reason when unexpected expenses must be incurred. So, they will also consider the liquidity of asset in taking decision to hold an asset.

Based on the explanation above, it can be said that demand for foreign currency asset in the form of bank deposit is influenced by the expected rate of return, risk and liquidity of the asset. In order to simplify the analysis, it is assumed that the market actors base their demand for bank deposits in any currency denomination on comparison of the expected rate of return that generated by each asset. Other things such as risk and liquidity are being constant. This assumption will be utilized to explain the determination of equilibrium exchange rate in the foreign exchange market.

The Condition of Equilibrium Exchange Rate

The understanding of demand for foreign currency assets will be used to describe how exchange rate is determined. This part explains how the equilibrium exchange rate is determined based on the interest parity condition. In its application, interest parity condition can be applied as Covered Interest Parity (CIP) and UIP condition. CIP uses forward exchange rate as a future exchange rate where this forward rate is the exchange rate that agreed at the present time for the future delivery or transaction. So, the future transaction is no longer referring to the future spot rate but at the rate that already determined before. It will provide a covering on the certainty of transaction value. Meanwhile, UIP uses the expected future spot rate as the result of market actors forecasting. So, the transaction will not have a covering on its value.

Hypothesis CIP explains the relationship of spot exchange rate (S) and forward exchange rate (F), domestic interest rate (i) and foreign interest rate (i^*). This theory states that when the foreign exchange risk is covered in the forward market, the rate of return on domestic asset must equal to the rate of return on foreign asset with the same characteristics. If its not, there will be arbitrage action by the market actors that will cause changes in demand for and supply of those asset in order to direct the market into the equilibrium condition as implicated by CIP. All this deals with fully flexible exchange rates. This approach implicates that the short run is only a temporary disequilibrium that leads after some time to a general macro equilibrium. The short-term disequilibrium is healed eventually by market forces (Priewe, 2017).

Arbitrage plays a critical role in the process of reaching the equilibrium in the foreign exchange market. Arbitrage may be defined as an action to buy and sell the same asset simultaneously in order to earn a certain profit. As long as there is chance to do a profitable arbitrage, the market will not be in equilibrium. The market equilibrium will establish when there is no more possibility to do a profitable arbitrage. Agus (2017) said that the disequilibrium of foreign exchange market reflects a market distortion in relative prices associated with domestic policy. The signs of distortion can be used as a disequilibrium analysis to determine the causes and consequences that arise so that policy makers can attempt to make the necessary adjustments. The management of the exchange rate at a wrong level would cause an increase in welfare costs. It means the level of well-being may fall. This situation can generate false information to the economic actors and economic instability.

Theory of CIP has some important implications in various things. First, CIP can be used to measure the degree of capital mobility internationally. In this case, the less mobility is indicated by the degree of distortion from market equilibrium condition as implicated by CIP. Second, from the policy perspective, CIP is considered very important

because it implies that when the market forces are allowed to function freely, the financial resources will be allocated to all over the world optimally. The empirical failure of CIP implies a failure of market forces to allocate the resources. Third, from the business perspective, CIP is very important because it has implications on the short run investment and financing decision (Eun & Resnick, 2018).

Moosa (2004) explained about the derivation of equilibrium condition of CIP. For instance, an investor has initial capital as much as K and faces two options of investing. First is a domestic option where this investor buys domestic asset and will receive domestic interest income, i . Second is foreign option where this investor must convert domestic currency into foreign currency in order to buy foreign asset and will receive foreign interest income, i^* . It is assumed that both investments have the same maturity date.

For domestic option, the capital invested will be added as much as domestic interest rate, i . So, at the maturity date, the investor will receive his initial capital (K) plus domestic interest income (i) that calculated as $K + Ki$ or $K(1 + i)$. This domestic option has no need currencies conversion so that there will be no foreign exchange risk.

For foreign option, the initial capital (K) must be converted to a foreign currency by quoting the spot exchange rate (S) and obtain K/S unit of foreign currency that will be invested by buying a foreign asset. This foreign asset will be added to the maturity date as much as foreign interest rate. The value of foreign asset will be worth at the maturity date as much as $K/S + K/S(i^*) = K/S(1+i^*)$. This foreign asset value needs to be converted into the domestic currency value by multiplying it with forward rate (F). So, the result can be calculated as $F(K/S)(1+i^*)$. The forward rate is used to cover the foreign asset from the foreign exchange risk exposure.

The equilibrium condition will be reached when those two options generate the same value of profit. If it is measured by domestic currency, those options will generate the same value in domestic currency. The equilibrium condition can be stated as follow:

$$K(1 + i) = K/S(1 + i^*)F$$

When the equilibrium condition is expressed in one unit of domestic currency, the result will be shown as follows:

$$(1 + i) = F/S(1 + i^*) \text{ or}$$

This equilibrium condition states that gross domestic return in the left side of equation is equal to gross foreign covered return in the right side of equation. The foreign return is covered because it is converted by forward exchange rate so that avoiding it from the exposure of foreign exchange risk.

This equilibrium condition can be rearranged to obtain another form of CIP condition that shows equilibrium in foreign exchange market. The rearrangement of the equilibrium equation has result as follows:

$$i - i^* = f$$

where f denotes for forward spread that can be calculated as $(F - S)/S$. It implies that a currency that offers higher interest rate must be sold with forward discount ($F > S$), vice versa. So, if i is higher i^* , it will make f higher than 0 which means that foreign currency with lower interest rate is sold at forward premium. Meanwhile, domestic currency with higher interest rate is sold at forward discount.

Furthermore, the CIP equilibrium condition has an important implication related to the determination of equilibrium exchange rate. By modifying the equilibrium condition to find out the spot exchange rate (S), it is obtained the following result:

$$S = (1 + i^*)/(1 + i)F$$

The equilibrium exchange rate (S) clearly depends on the relative interest rates at a given level of forward rate. If other things are constant, an increasing of domestic interest rate (i) will decrease the spot exchange rate or domestic currency will appreciate against foreign currency. This result may happen because the market actors will buy more domestic bank deposit asset since it offers higher interest rate. So, there will be an increasing in demand for domestic currency or decreasing in supply of foreign currency in the foreign exchange market which is directing the exchange rate to fall. On the contrary, a decreasing of domestic interest rate (i) will push the market actors to sell their domestic bank deposit asset and buy foreign bank deposit asset. So, demand for foreign currency will rise or supply of domestic currency will fall which is directing the exchange rate to rise or domestic currency will depreciate against foreign currency. The changing of foreign interest rate (i^*) will happen in the opposite direction. When it increases, then the exchange rate will fall, otherwise, the exchange will rise.

Another important variable for exchange rate determination is forward exchange rate (F). Under any circumstances, forward exchange rate can be viewed as an expected future spot rate based on all relevant information available. It can be stated as follows (Eun & Resnick, 2018):

$$F = E(S_{t+1}|I_t)$$

where S_{t+1} is a future spot rate when the forward contract ends. It denotes as a set of information available at the present time. This set of information includes money supply, balance of payment, interest rate and other information that can affect exchange rate. Based on this information, the spot exchange rate can be stated in another expression as follows:

$$S = (1 + i^*) / (1 + i) E(S_{t+1}|I_t)$$

This expression shows that expectation (E) plays a key role in determining exchange rate. The movement of exchange rate will be directed by events or issues in the economy. The market actors will form their expectation based on the set of information they got. By receiving the information continually, they will also renew their expectation continually. As the consequence, the exchange rate will tend to show a short run dynamic and volatile movement as a respond toward events happening in the economy. In the real life, all events in the economy are the things that uneasy to predict so that a forecasting of future exchange rate is difficult to do (Mishkin, 2007).

When the forward exchange rate is substituted for the expected spot exchange rate in the future ($E(S_{t+1})$), the rearrangement of equilibrium equation can be expressed as follows (Pugel, 2016):

$$i - i^* = E(e)$$

where $E(e)$ is the expected rate of domestic currency against foreign currency that calculated as $((E(S_{t+1}) - S_t) / S_t)$. This equation shows that the interest rates different between two countries is equal to the expected rate of domestic currency against foreign currency. By using the expected exchange rate ($E(S_{t+1})$) that is uncovering to the risk exposure of exchange rate movement then the equilibrium equation above is called UIP condition. By modifying the equation, it can be derived another form of UIP condition as follows:

$$i = i^* + E(e)$$

The left hand side of equation is the expected rate of return from bank deposit asset in domestic currency denomination. It is the interest rate of bank deposit in domestic currency (i). The right hand side is the expected rate of return from bank deposit asset in foreign currency denomination. It consists of the interest rate of bank deposit in foreign currency denomination (i^*) and the expected rate of domestic currency against foreign currency $((E(S_{t+1}) - S_t) / S_t)$. The UIP condition shows that foreign exchange market will be in equilibrium when the bank deposits of all currencies offer the same expected rate of return. According to this condition, when domestic currency asset offers a higher return than foreign currency asset, then domestic currency will appreciate against foreign currency because the market actors will try to switch their foreign currency asset to domestic currency asset. Otherwise, when foreign currency asset offers a higher return than domestic currency asset then domestic currency will depreciate against foreign currency because the market actors will try to switch their domestic currency asset to foreign currency asset. As long as the returns of all currency assets are still different, then the market actors will always have tendency to change their assets composition. They will have no longer tendency to change when the returns of all currency assets are already the same. When this situation exists then foreign exchange market will be in equilibrium that results an equilibrium exchange rate (Blanchard & Johnson, 2013).

Kremens and Martin (2019) argued that UIP is worth because it represents such an enduring benchmark in the foreign exchange literature. The UIP forecast has three appealing properties. First, it is determined by asset prices alone rather than by infrequently updated and imperfectly measured macroeconomic data. Second, it has no free parameters which mean that no coefficients to be estimated in-sample or calibrated. So, it is perfectly suited to out-of-sample forecasting. Third, it has a straightforward interpretation as the expected exchange rate movement perceived by a risk-neutral investor.

METHODOLOGY

This research utilizes secondary data from Indonesian Economic and Financial Statistics published by Bank Indonesia for annual domestic interest rate of bank deposit in Rupiah denomination and annual foreign interest rate of bank deposit in US\$ denomination. The expected exchange rate for the year 2020 is taken from the macro economy assumption in the design of Indonesia state budget 2020. The spot exchange rate Rupiah against US\$ uses the data from Jakarta Interbank Spot Dollar Rate (JISDOR) as transaction rate published by Bank Indonesia in its website.

The unit of analysis of this research is foreign exchange market for US\$ in Indonesia. This research is conducted to explain how the equilibrium exchange rate is determined by applying asset approach. The analysis method used to answer and discuss the research objectives is applied method based on the theory of UIP condition. The method of

analysis is implemented in some following steps (Krugman & Obstfeld, 2009):

1. Find out the spot exchange rate at current time.
2. Use foreign interest rate (i^*) to calculate the amount of foreign money will be received at the maturity date when buying a bank deposit in foreign currency denomination today.
3. Use the expected exchange rate ($E(S_{t+1})$) to calculate the rate of depreciation or appreciation domestic currency against foreign currency ($(E(S_{t+1}) - S_t)/S_t$).
4. Calculate the expected domestic currency rate of return in foreign currency bank deposit. The result is calculated as $i^* + (E(S_{t+1}) - S_t)/S_t$.
5. Compare the result with the expected rate of return in domestic currency bank deposit. The comparison can be stated as follows:

$$i = i^* + (E(S_{t+1}) - S_t)/S_t$$

or can also be expressed as follows:

$$i - i^* + (E(S_{t+1}) - S_t)/S_t$$

If the result is positive then domestic currency bank deposit has a higher expected rate of return than foreign currency bank deposit. By assuming that other things are constant, the market actors will prefer to hold a bank deposit asset in domestic currency denomination. On the contrary, if the result is negative then the market actors will prefer to hold a bank deposit in foreign currency denomination because it offers a higher expected rate of return. If the result is zero then the market actors will be indifferent in holding a bank deposit asset in domestic or foreign currency denomination because both of them offer the same expected rate of return. This situation is called the interest parity condition that shows the foreign exchange market is in equilibrium. The market actors have no longer tendency to change their financial position. This condition will result an equilibrium exchange rate in the foreign exchange market.

6. Change the domestic interest rate to find out the new equilibrium exchange rate.
7. Change the foreign interest rate to find out the new equilibrium exchange rate.
8. Change the expected exchange rate to find out the new equilibrium exchange rate.

RESULTS AND DISCUSSION

Data and its Sources

This research uses some relevant data to proceed in order to describe the research objectives. The domestic interest rate (i) is the average interest rate of Rupiah deposit offered by Indonesia commercial banks for one-year maturity date. It is 6% per year. The foreign deposit interest rate (i^*) is the average interest rate of US\$ deposit offered by Indonesia commercial banks. It is 1,2% per year. These interest rates are taken from Center for Indonesia Money Market published by Bank Indonesia on September 2019. The expected exchange rate ($E(S_{t+1})$) is the exchange rate Rupiah against US\$ taken from the macro economy assumption in the design of Indonesia State Budget 2020. It is Rp. 14.400/US\$ for the year 2020. The spot exchange rate Rupiah against US\$ (S_t) is taken from Jakarta Interbank Spot Dollar Rate (JISDOR) as transaction rate published by Bank Indonesia. It is Rp. 14.190/US\$ per September 2, 2019.

The Result of Foreign Exchange Market Situation

Based on the relevant data collected, the following procedure will be applied to find out which bank deposits offering the higher expected rate of return for one-year maturity. The procedure is based on the application of UIP condition that implemented as follows:

1. The spot exchange rate Rupiah against US\$ prevailing (S_t) at the current time on September 2, 2019 is quoted at the level Rp. 14.190/US\$.
2. One year interest rate bank deposit for US\$ currency in Indonesia commercial bank on September 2019 is quoted at the rate 1,2% or 0,012 from Center for Money Market Information, Bank Indonesia. So, each US\$ 1 bank deposit will yield an amount as much as US\$ 1 (1 + 0,012) = US\$ 1,012 after one year.
3. The expected exchange rate at the maturity date is assumed at the level Rp. 14.400/US\$. So, the percentage change of exchange rate will be as much as (Rp. 14.400/US\$ - Rp. 14.190/US\$)/Rp. 14.190/US\$ = 0,0147 or 1,47%. It means that Rupiah is expected to depreciate against US\$ as high as 1,47% for one year.
4. If Rupiah is used to buy US\$ bank deposit today for one year maturity, then the Rupiah value that will be received after one year is in amount as much as US\$ 1,012 X Rp. 14.400/US\$ = Rp. 14.572,8. It can be said that the rate of Rupiah return in US\$ deposit is as much as 1,2% + 1,47% = 2,67%. So, the value of Rupiah money will

rise 2,67% from today to one year if it is saved as bank deposit asset in US\$ denomination. The rise stems from US\$ interest rate (1,2%) plus the rate of depreciation Rupiah against US\$ (1,47%).

5. The result of previous step will be compared to the rate of Rupiah return that saved in the Rupiah bank deposit. If the Rupiah money as much as Rp. 14.190 is saved in Rupiah bank deposit with the interest rate 6% per year, then Rupiah amount for one year will be received as much as Rp. 14.190 (1 + 0,06) = Rp. 15.041,4. By comparing the result of Rupiah deposit and US\$ deposit, it is solved that the rate of Rupiah return in Rupiah bank deposit (6%) is in fact higher than the rate of Rupiah return in US\$ bank deposit (2,67%). The difference between them is (6% - 2,67%) = 3,33%. This result shows that the bank deposit in Rupiah currency offers the rate of return 3,33% higher than the bank deposit in US\$ currency.

The result solved from the previous steps conclude that when other things are being constant such as risk and liquidity, then the market actors should prefer to hold bank deposit asset in Rupiah denomination rather than holding it in US\$ denomination. The previous procedure of calculation is summarized in the Table 1.

Table 1 *THE RATE OF RETURN COMPARISON BETWEEN RUPIAH AND US\$ BANK DEPOSITS*

Expected Exchange Rate (E(St+1))	Spot Exchange Rate (St)	Rupiah Interest Rate (i)	US\$ Interest Rate (i*)	Percentage Change of Exchange Rate ((E(St+1) St)/St)	The Difference of Rate of Return between Rupiah and US\$ (i - i* + (E(St+1) St)/St)
Rp.14.400/US\$	Rp.14.190/US\$	6%	1,2%	1,47%	3,33%

The positive difference of rate of return between Rupiah and US\$ bank deposit as high as 3,33% reflects that the foreign exchange market is not in equilibrium. When the foreign exchange market is not in equilibrium, then as its consequence, the spot exchange rate prevailing Rp. 14.190/US\$ is not an equilibrium exchange rate. This situation will direct the market actors to change their financial position until foreign exchange market reaching the equilibrium. The market actors can apply arbitrage action to exploit profit by selling and buying currencies simultaneously. As long as the market actors can still exploit profit by doing arbitrage, then the foreign exchange market will not reach equilibrium yet. The market will reach the equilibrium when the market actors have no longer tendency to change their financial position. In this situation, holding asset in any currency will gain the same rate of return for the market actors so that there is no longer possibility to do arbitrage.

As the rate of Rupiah return is higher than the rate of US\$ return, the market actors will buy more Rupiah bank deposit and sell US\$ bank deposit. These actions will cause an increasing demand for Rupiah and increasing supply of US\$ in the foreign exchange market. As the consequence, the price of US\$ in term of Rupiah will fall, which means that Rupiah appreciates against US\$. The decreasing exchange rate will increase the rate of return of US\$ bank deposit until equaling to the rate of return of Rupiah bank deposit. When it happens, the market actors are no longer willing to buy Rupiah bank deposit and sell US\$ bank deposit because both of them have offered the same rate of return. In this situation, the foreign exchange market will be in equilibrium and yield an equilibrium exchange rate.

The Determination of Equilibrium Exchange Rate

After showing that the prevailing spot exchange rate Rp. 14.190/US\$ is not an equilibrium exchange rate, then the next step is to determine the equilibrium exchange rate. By allowing the spot exchange rate to change, then the percentage change of exchange rate can be recalculated. The amount of spot exchange rate changing is set for Rp. 50 and its folds.

If the changing of Spot Exchange Rate (St) is increasing or Rupiah is depreciating against US\$, then the expected rate of return in US\$ bank deposit ($i^* + (E(St+1) St)/St$) is getting smaller. On the contrary, if the changing of spot exchange rate is decreasing or Rupiah is appreciating against US\$, then the expected rate of return in US\$ bank deposit is getting greater. It is surely happening when the expected exchange rate (E(St+1)) and US\$ deposit interest rate (i*)

have no changes. Table 2 shows the relationship between the spot exchange rates and the expected rate of return in US\$ bank deposit as mentioned above.

Table 2 *DETERMINATION OF EQUILIBRIUM EXCHANGE RATE RUPIAH AGAINST US\$*

Rupiah Interest Rate (i)	US\$ Interest Rate (i*)	Expected Exchange Rate (E(St+1))	Spot Exchange Rate (St)	Ex-Change Rate ((E(St+1) St)/St)	Percentage Change of Exchange Rate ((E(St+1) St)/St)	Rate of Return in US\$ Deposit $i^* + ((E(St+1) St)/St)$	Differences of Return between Rupiah and US\$ Bank Deposit $i - i^* - ((E(St+1) St)/St)$
0.06	0.012	14,400	14,190	0.0148		0.0268	0.0332
0.06	0.012	14,400	14,140	0.0184		0.0304	0.0296
0.06	0.012	14,400	14,090	0.0220		0.0340	0.0260
0.06	0.012	14,400	14,040	0.0256		0.0376	0.0224
0.06	0.012	14,400	13,940	0.0330		0.0450	0.0150
0.06	0.012	14,400	13,890	0.0367		0.0487	0.0113
0.06	0.012	14,400	13,840	0.0405		0.0525	0.0075
0.06	0.012	14,400	13,790	0.0442		0.0562	0.0038
0.06	0.012	14,400	13,740	0.0480		0.0600	0.0000
0.06	0.012	14,400	13,690	0.0519		0.0639	-0.0039
0.06	0.012	14,400	13,640	0.0557		0.0677	-0.0077
0.06	0.012	14,400	13,590	0.0596		0.0716	-0.0116
0.06	0.012	14,400	13,540	0.0635		0.0755	-0.0155
0.06	0.012	14,400	13,490	0.0675		0.0795	-0.0195
0.06	0.012	14,400	13,440	0.0714		0.0834	-0.0234

From Table 2, it is seen that the current spot exchange rate is initiated at Rp. 14,190/US\$. This spot rate is surely not an equilibrium rate since the difference between Rupiah and US\$ rate of return is positive at 3.33% which means that Rupiah bank deposits offer the higher rate of return than US\$ bank deposit. This situation will motivate the market actors to buy more Rupiah bank deposit and sell their US\$ bank deposit in the foreign exchange market so that the exchange rate Rupiah against US\$ will fall. By allowing the exchange rate to fall by Rp. 50 and its folds, then the rate of return in US\$ bank deposit will rise and result a smaller differences between Rupiah and US\$ rate of return. When the difference between the rate of return of Rupiah bank deposits and US\$ bank deposits disappear or become zero, then the market actors are no longer willing to buy Rupiah bank deposits and sell US\$ bank deposits. They will have no longer tendency to change their financial position.

When the current spot exchange rate is initiated, for instance, at the level Rp. 13,440/US\$, then there will be negative differences between Rupiah and US\$ rate of return. It means that US\$ bank deposits now offer the higher rate of return than Rupiah bank deposits which cause the foreign exchange market is not in equilibrium. The market actors are being motivated to buy more US\$ bank deposit and sell their Rupiah bank deposit. These actions will increase the demand for US\$ and also the supply of Rupiah that will rise the price of US\$ in term of Rupiah or Rupiah will depreciate against US\$. Since the exchange rate rises by Rp. 50 and its folds, the rate of return in US\$ bank deposits are getting smaller and finally going to zero which mean that both of them have offered the same rate of return. When it happens, there will be no longer tendency for market actors to buy US\$ bank deposits and sell Rupiah bank deposits.

The mechanism in the foreign exchange market leads the market to the equilibrium which the asset of Rupiah bank deposits and US\$ bank deposits offer the same rate of return for the market actors. The equilibrium foreign exchange market results an equilibrium exchange rate at the level Rp. 13,740/US\$ as shown in Table 2.

By comparing the equilibrium exchange rate to the current spot exchange rate, it is found that the equilibrium rate is lower than the current spot rate. This result shows that Rupiah currency is actually undervalued towards US\$ currency in the foreign exchange market. This situation happens because the demand for US\$ bank deposits is greater than its supply. Thus, even though the rate of return in holding Rupiah bank deposits is higher than US\$ bank deposit, however

the demand for US\$ comes not only from buying US\$ bank deposits as an asset but also from import activities to finance the buying of imported goods. These import activities will inevitably create the demand for US\$. The pressure from import activities finally increase the demand for more US\$ so that the exchange rate rises to the level higher than its equilibrium.

Having seen how the equilibrium exchange rate is determined by interest parity, the next part is to explain how the exchange rate is being affected by the changes in Rupiah interest rate, US\$ interest rate and expected exchange rate in the future, respectively. These three factors were assumed constant in the previous discussion. However, the volatility of exchange rate is strongly affected by the changing of these factors.

The Effect of Rupiah Interest Rate Changing

The first factor is the changes of Rupiah interest rate. At the current time, Rupiah interest rate is prevailing at the rate of 6%. Since Bank Indonesia for last few months has shown the efforts to apply an easy monetary policy by decreasing BI 7 day repo rate (BI7DRR). This rate is now known as reference policy rate that determined by Bank Indonesia as a signal to banking and money market in order to determine their deposit and lending rate. Thus, the changing of BI7DRR shows the direction of monetary policy applied by Bank Indonesia. Following the decreasing of this reference policy rate, then it is assumed that Rupiah interest rate is also falling, say to 5%. The decreasing of Rupiah interest rate to 5% affects the foreign exchange market because some market actors are getting less interested to hold Rupiah bank deposit. Thus, they will switch their Rupiah bank deposit to US\$ bank deposit. This action will rise the demand for US\$ so that the price of US\$ in term of Rupiah will also rise or Rupiah is depreciating against US\$. On the contrary, the increasing of Rupiah interest rate will decrease the demand for US\$ so that the price of US\$ in term of Rupiah will fall or Rupiah is appreciating against US\$.

Table 3 shows the calculation of the effect of a fall in Rupiah interest rate on the exchange rate. By recalculating the differences rate of return between Rupiah and US\$ bank deposits, then it can be found that the equilibrium exchange rate is at the level Rp. 13,873/US\$. This new equilibrium rate is at the level where the rate of return in holding Rupiah and US\$ bank deposits are already the same, that is 5% respectively. When all else equal, a decreasing of Rupiah interest rate by 1% on bank deposits will cause the price of US\$ in term of Rupiah rising from Rp. 13,740/US\$ to Rp. 13,873/US\$ or Rupiah is depreciating against US\$ by 0.97%.

Table 3 *THE EFFECT OF A FALL IN THE RUPIAH INTEREST RATE ON THE EXCHANGE RATE*

Expected Exchange Rate($E_{(St+1)}$)	Equilibrium Exchange Rate (St)	Rupiah Interest Rate (i)	US\$ Interest Rate (i^*)	Percentage Change of Exchange Rate ($(E_{(St+1)} - St)/St$)	The Difference of Rate of Return between Rupiah and US\$ ($i - i^* + (E_{(St+1)} - St)/St$)
Rp.14.400/US\$	Rp.13,873/US\$	5%	1,2%	3,80%	0

The Effect of US\$ Interest Rate Changing

The second factor is the changes in US\$ interest rate on bank deposits. At the current time, US\$ interest rate is prevailing at the rate 1.2%. By assuming that this US\$ interest rate rises to 2.2%, then the rate of return in holding US\$ bank deposits ($i^* + (E_{(St+1)} - St)/St$) must be recalculated to find out the new equilibrium exchange rate. Since the US\$ interest rate has increased by 1%, the rate of return in holding US\$ bank deposits will rise. This changing will motivate the market actors to buy more US\$ bank deposits and sell Rupiah bank deposit. These actions will increase the demand for US\$ and supply of Rupiah so that the price of US\$ in term Rupiah will rise or Rupiah depreciates against US\$. On the contrary, the decreasing of US\$ interest rate will decrease the demand for US\$ so that the price of US\$ in term of Rupiah will fall or Rupiah is appreciating against US\$.

Table 4 shows the calculation of the effect of a rise in US\$ interest rate on the exchange rate. By recalculating the rate of return in holding US\$ bank deposits after increasing by 1%, then it can be found that the equilibrium exchange rate is at the level Rp. 13,873/US\$. This new equilibrium rate is at the level where the rate of return in holding US\$ and Rupiah bank deposits are the same, that is 6%. Thus, when all else equal, an increasing of US\$ interest rate by 1% on

bank deposits will cause the price of US\$ in term of Rupiah rising from Rp. 13,740/US\$ to Rp. 13,873/US\$ or Rupiah is depreciating against US\$ by 0.97%.

Table 4 THE EFFECT OF A RISE IN THE US\$ INTEREST RATE ON THE EXCHANGE RATE

Expected change $E(St+1)$	Ex- Rate	Equilibrium change Rate (St)	Ex- Rate (i)	Rupiah Interest Rate (i)	US\$ Interest Rate (i*)	Percentage of Exchange ((E(St+1) St)/St)	Change Rate	The Difference of Rate of Return between Ru- piah and US\$ (i - i* + (E(St+1) St)/St)
Rp.14.400/US\$	Rp.13,873/US\$	6%			2,2%	3,80%		0

The Effect of Expected Exchange Rate Changing

The third factor is the changes of expected exchange rate. The previous analysis used the expected exchange rate according to the macro economy assumption in the design of state budget 2020. The expected rate is set for Rp. 14,400/US\$. When the market actors change their expectation of exchange rate, then it will affect the equilibrium exchange rate. It is assumed that the expected exchange rate changes to Rp. 14,500/US\$ or Rupiah is expected to depreciate against US\$ by Rp. 100. The change will rise the expected rate of return in holding US\$ bank deposits so that the market actors will be motivated to buy more US\$ bank deposit and sell their Rupiah deposits. This action will increase the demand for US\$ and supply of Rupiah in the foreign exchange market. As the consequence, the price of US\$ in term of Rupiah will rise or Rupiah will depreciate against US\$. On the contrary, when Rupiah is expected to appreciate against US\$ then the demand for US\$ will decrease that resulting a falling in the price of US\$ in term of Rupiah or Rupiah is depreciating against US\$.

Table 5 shows the calculation of the effect of a rise in expected exchange rate on the exchange rate. When the rate of return in holding US\$ and Rupiah bank deposits are already the same, then the foreign exchange market will be in equilibrium that resulting an equilibrium exchange rate. The equilibrium exchange rate is reached at the level Rp. 13,836/US\$. When all else equal, a rise in the expected future exchange rate by Rp. 100 will cause the price of US\$ in term Rupiah rising from Rp. 13,740/US\$ to Rp. 13,836/US\$ or Rupiah is depreciating against US\$ by 0.70%. The expectation of market actors is formed and strongly influenced by all information available in the economy.

Table 5 THE EFFECT OF A RISE IN THE EXPECTED EXCHANGE RATE ON THE EXCHANGE RATE

Expected change $E(St+1)$	Ex- Rate	Equilibrium change Rate (St)	Ex- Rate (i)	Rupiah Interest Rate (i)	US\$ Interest Rate (i*)	Percentage of Exchange ((E(St+1) St)/St)	Change Rate	The Difference of Rate of Return between Ru- piah and US\$ (i - i* + (E(St+1) St)/St)
Rp.14.500/US\$	Rp.13,836/US\$	6%			1,2%	4,80%		0

DISCUSSION

The changing of Rupiah interest rate, US\$ interest rate and expected future exchange rate, respectively, have could describe the volatility of exchange rate Rupiah against US\$. By mastering this logic, it will be useful and helpful for the market actors and monetary authority to comprehend the situation of foreign exchange market. The market actors will have a good insight in making a decision that involving foreign exchange for having a good management of their portfolio investment. The monetary authority can intervene properly the foreign exchange market in order to direct the exchange rate to their expected level. From the theoretical perspective, this asset approach by applying UIP condition can be a good benchmarking to other approaches or theories in order to explain the determination of exchange rate.

The result of this paper shows that the foreign exchange market is not in equilibrium position as indicated by the actual exchange rate deviates from its equilibrium. The actual exchange rate is undervalued towards its equilibrium rate. This situation will have an unexpected impact to domestic economy that may trigger a rise of inflation. [Iyke \(2019\)](#) also found that the Indonesian foreign exchange market is inefficient since forex investors or traders can still earn profit

from such exchange rates by exploiting pricing anomalies. Therefore, this would require interventions by the relevant authorities to correct the market mispricing. Deal with this situation, the central bank needs to intervene the foreign exchange market in order to strengthen Rupiah value against US\$. This rational is supported by (Koijen & Yogo, 2020) who state that government policy is important for exchange rate and asset prices where central bank plays an important role in managing exchange rate and the term structure of interest rate globally.

Interest rate plays an important role in applying monetary policy in Indonesia since Bank Indonesia as central bank is nowadays using interest rate as a reference policy rate, called BI 7 day repo rate. This rate is actually as a signal to show the direction of monetary policy. As a signal, this reference policy rate will be followed by banks in determining their deposit and lending rate as well. The result of this research shows that the changing of domestic interest rate have a negative influence to exchange rate Rupiah against US\$. Thus, the setting of reference interest rate by central bank will be an effective policy variable to affect the exchange rate. Khan, Teng, and Khan (2019) have the same result for their research, which shows that the interest rate has a negative effect on the exchange rate. They said that the government should implement a vital monetary policy by influencing the interest rate to reduce the volatility of exchange rate. (Kuncoro, 2020) confirms that interest rate policy has a positive pressure on the bilateral exchange rates volatility in the short run. Therefore, monetary policy should be conducted based on the monetary rule in order to maintain the stability of exchange rate instead of discretionary policy.

CONCLUSION

This paper has shown the application of asset approach to determine the equilibrium exchange rate Rupiah against US\$ and how it could be fluctuating based on the UIP condition. Some interesting things can be concluded from the result and discussion. First, It was found that the actual exchange rate is completely different from the equilibrium exchange rate where Rupiah is undervalued towards US\$. The demand for US\$ was derived not only from buying US\$ bank deposits as asset but also from buying US\$ to finance import needs. The pressure from import activities pushed the actual exchange rate to the higher level than its equilibrium one. Second, when all else equal, a decreasing of Rupiah interest rate on bank deposits will rise the price of US\$ in term of Rupiah or Rupiah is depreciating against US\$, or vice versa. Third, when all else equal, an increasing of US\$ interest rate on bank deposits will rise the price of US\$ in term of Rupiah or Rupiah is depreciating against US\$, or vice versa. Fourth, when all else equal, a rise in the expected future exchange rate will rise the price of US\$ in term Rupiah or Rupiah is depreciating against US\$, or vice versa. The changing of these three factors may show and describe clearly its effect on the volatility of exchange rate.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

Even though the volatility of exchange rate can be described simply and obviously by applying the UIP condition, but there are some limitations that must be noted. First, the exchange rate predicted is only for the short run in order to indicate whether the actual exchange rate deviates from its equilibrium rate or not. Second, it is difficult to determine the expected level of exchange rate since each market actors can have different opinion about this expected rate as consequence of having different level of market knowledge or information. The expected exchange rate that used here is the government assumption rate in which can be different from what market actors expect. In fact, the expected exchange rate is a vital variable in UIP condition to determine the equilibrium exchange rate. Third, the analysis here is applied based on the assumption that risk and liquidity of bank deposits are being constant. Thus, there is no different risk and liquidity from holding Rupiah or US\$ bank deposit. In fact, market actors decision must consider these two factors. These limitations can yield different results of equilibrium exchange rate.

Based on those limitations, it is important in the future to find the more proper model or approach for Indonesia foreign exchange market in order to determine equilibrium exchange rate properly. The proper equilibrium exchange rate will be useful for decision makers such as government, bankers and investor. It will also prevent distortion in foreign exchange market so that the financial resources can be allocated optimally.

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