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The Portofolio Model of Exchange Rate Determination:

The case of Rupiah exchange rate

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***Abstract*—Indonesia economy is prone to the world economy that makes Rupiah sensitive and volatile. Thus, it affects macroeconomic stability. In conclusion, Rupiah exchange rate should be maintained in order to maintain macroeconomic stability. An approach model development of Rupiah exchange rate is needed to explain the behavior of Rupiah exchange rate to US dollar. This research aimed to analyze Rupiah exchange rate behavior based on portfolio model. This research can be used to determine exchange rate management policy to stabilize rupiah. The Portfolio exchange rate model explained that the exchange rate nominal was influenced by cumulative current account change and exchange rate value was determined by stock equilibrium. Analysis method used error correction model (ECM) to test the portfolio model. If in the short term there is an imbalance, the ECM model will correct it in the long run. With this mechanism the problem of smooth regression can be avoided through the use of difference variables that remain in the model without losing long-term information caused by the use of different data only. The research period was 2000.1-2016.4 by using quarterly period. The research result find that variables in portfolio model showed national income, interest rate, and foreign exchange reserves influenced Rupiah exchange rate to US dollar in short run. In the other hand, price variable did not significantly influence Rupiah exchange rate to US dollar. Based on the test of portfolio model, a Rupiah exchange rate stabilization policy could be assigned based on foreign exchange reserves management.**

Keywords—exchange rate; macro economic stabilility; portofolio; error corection model; foreign exchange reserve

I. INTRODUCTION

This research is important as Rupiah exchange rate fluctuation will influence macroeconomic indicators. A good exchange rate management will keep Rupiah exchange rate stabilization. Portfolio balance model sees from other aspects towards exchange rate fluctuation. According to this model, exchange rate is influenced by micro factor such as participants of foreign exchange rate market that reflected on asset management by considering risk factor.

Portfolio balance approach stated that domestic currency is just one kind of financial assets demanded by a country's citizens. In a simple portfolio balance approach, all individual and companies have financial wealth in various assets combinations in form of domestic currency, domestic obligation, foreign exchange reserves etc. [1].

This approach stated that the amount of exchange rate is determined by cumulative change of current account, while foreign currency agents conducted portfolio that agreeing upon exchange rate risk. The foreign currency agents also believe that the risk couldn't be eliminated by conducting diversification. Thus, they perceive that equilibrium at stock market determined exchange rate. The existence of risk implies that interest rate difference is equal to change expectation on exchange rate plus premium risk [2].

Portfolio equilibrium in short term explains some stock allotment of wealth between security fraud alternatives and expected result and exchange rate. The equilibrium portfolio shock is assumed to be eliminated by immediate adjustment of exchange rate and interest rate [3]. Thus, the wealth owner creates demand exactly the same with financial supply and demand in short term. As long as the assumed price was constant, the exchange rate changes will influence payment balance. As a result, flexible exchange rate brings about changes in net foreign claims and wealth.

Current account change is also important in portfolio balance model in arrangement redistribution of international wealth. The digression of portfolio equilibrium is also important to that the capital interaction and other economic variable will be able to explain exchange rate movement.

In portfolio balance model, money demand depends on the domestic interest rate and national income. Foreign variable, such as foreign interest rate, price level, and foreign national income are assumed as exogenous variables. Next, domestic and foreign security frauds were viewed as equal in term of period and risk. There is no capital flow supervision and no transaction fee, but market imperfection exists [4,5].

The changes of exchange rate, interest rate, wealth, and future assets value prediction will change financial markets equilibrium and push every investors to relocate their financial assets in order to meet the new equilibrium or portfolio balance for both long and short terms. The striking difference in size and speed adjustment between financial stock and real factor

gives a very important implication on the formation process of exchange rate and other changes or the dynamic from time to time. In general, on exchange rate changes, financial sector gives more influence compared to the real sector [6,7]. However, there is a possibility that exchange rate experiences rapid change as a result of real sector changes. This phenomena is known as a surge.

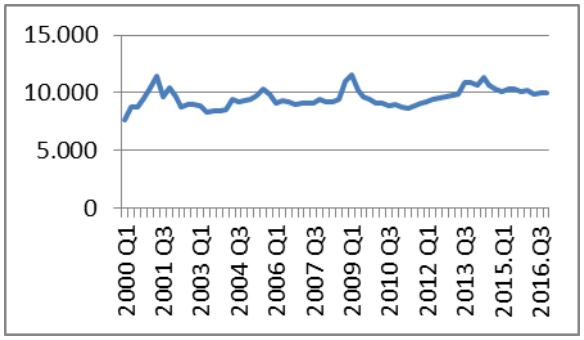

Fig. 1. Rupiah exchange rate to US Dollar in 2000-2016. Source: Bank Indonesia.

This research aimed to test the use of portfolio balance as exchange rate model approach in explaining Rupiah exchange rate. Frankel conducted portfolio balance research by using variable asset based risk. The research concluded that the influence towards exchange rate was consistent to portfolio balance model theory [8]. Kearney and McDonald conducted research focusing on intervention policy conducted by central bank. It was concluded that the influence of sterilized intervention indirectly supporting portfolio balance model [9,10]. The economic variables used in this model to estimate rupiah exchange rate are customer price index, interest rate, and asset value.

II. METHOD

A. Population and Sample

This research population was all macro economy indicators or variables of Indonesia and US. According to Portfolio Balance Model, this research sample was macro variable including exchange rate, customer price index, interest rate, output rate, and asset value. The research period was 2000.1-2016.4 by using quarterly period.

B. Variable Definition

This research used Rupiah exchange rate to US Dollar dependent variable. The independent variable used were: Customer Price Index, Interest Rate, Output Rate, and Asset Value. Those variables were defined as below:

- Exchange rate (S_t) is Rupiah exchange rate to US Dollar. It was measured by how much Rupiah was needed to get one US Dollar.
- Customer Price Index (PRICE) is operationally ratio of Customer Price Index in US and Indonesia.
- Interest Rate (IR) is interest ratio in US and Indonesia. This research used SBI and Federal Reserve.
- Output Rate (GDP) is a ratio between Gross Domestic Product of US and Indonesia based on constant price.
- Asset Value (CDEV) is the ratio of foreign-exchange reserve of US and Indonesia.

C. Type and Data Source

This research used secondary data. It is a data collecting method that obtained from documents arranged by trusted and valid organizations/institutions. The data was obtained from Bank Indonesia reports, Economy statistics and Indonesia Monetary, The Head Office of Statistic Bureau, and International Monetary Fund.

According to Portfolio Balance Model, this research data including exchange rate, customer price index, interest rate, output rate, and asset value. The research period was 2000.1-2016.4 by using quarterly period.

D. Data Analysis Technique

This study uses technical error correction model (ECM) to test the model. Basically, the ECM model is used to see a long-term balance between economic variables in a model. If in the short term there is an imbalance, the ECM model will correct it in the long run. With this mechanism the problem of smooth regression can be avoided through the use of difference variables that remain in the model without losing long-term information caused by the use of different data only. Thus it can be said that the ECM model is consistent with the concept of cointegration or Granger Representation Theorem.

Error correction model is an alternative to test the possibility of cointegration of observed variables. If error correction term (ECT) on the results of significant regression means the error correction model is a valid (valid) model, and the observed variables are cointegrated or the regression result residual is stationary [11].

The basic ECM model is as follows:

$$\Delta Y_t = \alpha_0 + \alpha_1 \Delta X_t + \alpha_2 EC_t + e_t$$

E. Basic Model: Portfolio Model

Exchange rate equation model of exchange rate balance:

$$s_t = c_0 + c_1 (r_t - r^*_t) + c_2 (y_t - y^*_t) + c_3 (p_{t-1} - y^*_{t-1}) + c_4 (w_t - w^*_t)$$

Where :

s_t	: USD to IDR exchange rate
c_0	: intercept
$c_{1,2,3,4}$	: coefficient
p* and p	: ratio of CPI USA and Indonesia
w* and w	: ratio of USA and Indonesia foreign exchange reserves
y* and y	: ratio GDP USA and Indonesia
r* and r	: ratio interest rate USA and Indonesia

III. RESULT AND DISCUSSION

A. Stationary Test

Requirements accomplishment on stationary data gives guarantee that there is relation between dependent and independent variables in long term. Thus, it is useful in theory hypothesis test.

TABLE I. DICKEY FULLER TEST

Variable	ADF Value	MacKinnon Critical Value
IR_INDO	-6.978523	1% level : -3.560019 5% level : -2.917650 10% level : -2.596689
IR_AS	-3.260242	
KSPOT)	-7.191798	
PRICEAS	-3.916543	
PRICEINDO	-8.100638	
GDP_INDO	-5.872468	
GDP_AS	-4.121012	
CDEV_AS	-7.100069	
CDEV_INDO	-5.240687	

All variables in the portfolio balance model are GDP_AS, IR_INDO, IR_AS, KSPOT, PRICE_INDO, PRICE _AS, CDEV_INDO, CDEV_AS, GDP_INDO and GDP_INDO are stationary. Decision making is based on the level of significance by comparing the ADF Statistics Test with MacKinnon Critical Value, if the ADF test value is greater than the Critical Value, the variable is stationary. This result means that variable in the model have relation in the long run.

B. Cointegration Test

The Cointegration test is one of the methods to indicate probability of long term balance relation between economic variables as what required by economic theory.

The test results show the Trace Statistic value of 65.83 is greater than 5 percent critical value so it is concluded that the model has a long-term balance.

C. Autocorrelation Test

This test is aimed to find out whether autocorrelation happened in sequential disturbance variables. The results show a probability value of 0.290551 (not significant) or there is no autocorrelation in the model.

TABLE II. BREUSCH-GODFREY TEST

Breusch – Godfrey Correlation LM Test			
F-statistic	1.269787	Probability	0.290551
Obs*R-square	2.825262	Probability	0.243502

D. Heteroscedasticity Test

This test aimed to see each variable that restricted by particular value from constant free variable or the same for all observation.

The data processing results can be seen that each dependent variable is not significant to the independent variable, where the level of significance D (LGDP): 70.59%, D (IR): 35.61%, D (PRICE): 14, 34% and D (LCDEV): 33.24%, so it can be concluded that heteroscedasticity is ignored in the model.

TABLE III. GLEJSER TEST

Dependent Variable : ARES01		
Variable	t-Statistic	Prob.
D(LGDP)	0.379620	0.7059
D(IR)	0.931628	0.3561
D(PRICE)	1.487000	0.1434
D(LCDEV)	0.979075	0.3324
ECT(-1)	0.197600	0.8442
R-square	0.096819	
DW stat	1.970891	
F stat	1.050536	

E. Multicolinearity Test

Multicolinearity Test can be conducted by Auxiliary Regressions Test (AXR). This test basically compares main model regression and free variable regression alternately.

The test results show that the partial model R Square value LGDP; 0.8240, IR; 0.7920, PRICE: 0.1014 and LCDEV; 0.3218) is smaller than the main model R square value (0.9045), so it is concluded that the model is free from multicolinearity.

TABLE IV. AUXILIARY REGRESSION TEST

Dependent Variable : ARES01		
R^2 Partial Model		R^2 Main Model
Dep. Var D(LGDP)	0.8240	0.9045
Dep Var D(IR)	0.7920	
Dep Var D(PRICE)	0.1014	
Dep Var D(LCDEV)	0.3218	

F. Estimation

ECM is one alternatives to test the integrated probability of observed variables. Error correction model is considered as a valid model if error correction term (ECT) on regression is significant.

TABLE V. ECM ESTIMATION

Variable	Coefficient	t-Statistic	Prob.
C	0.027652	5.917361	0.0000
D(LGDP)	0.497833	8.989154	0.0000
D(IR)	-0.452748	-6.779653	0.0000
D(PRICE)	0.000536	1.191338	0.2394
D(LCDEV)	-0.002411	-1.829073	0.0736
ECT(-1)	0.766436	6.995611	0.0071

The data processing results show that the probability value ECT: 0.0071 indicates that the ECM model is valid and the observed variables are cointegrated. The value of R-square is 0.911401 meaning that 91.14% of the variation of the dependent variable is able to be explained by the variation in

the set of variables of national income, interest rate, price and foreign exchange reserves. While the probability value of F-stat: 0.0000 implies that simultaneously independent variables affect the dependent variable.

IV. DISCUSSION

The interest rate variable that is able to explain the variation of the exchange rate variable with the coefficient value shows a negative sign. This is because the increase in the domestic money supply relative to the foreign money stock will lead to excess supply of domestic money (excess supply). This causes an increase in the demand for foreign currency (US Dollar) to secure its liquidity or to obtain profits. The next impact that occurs is a decrease in foreign currency (depreciation).

National income variables are able to explain the behavior of the Rupiah exchange rate with a positive coefficient. The basis of the theory that explains is the consumption theory (marginal propensity to consume) which explains the addition or increase in income used as an additional consumption. Surveys conducted in developing countries, including Indonesia, find that the MPC value is higher than the MPS, meaning that most of the increase in income is used as additional consumption than for savings. A sign of positive national income coefficient indicates that an increase in national income will increase foreign exchange rates. The explanation is that the increase in Indonesia's national income will cause domestic consumption to increase, a transformation effect that explains the tendency of public consumption patterns in the presence of international trade explains that if people's income increases they tend to consume (import) goods from abroad. This has an impact on increasing foreign exchange, and will increase foreign exchange rates [5].

Foreign exchange reserve variables affect the exchange rate variable and positive coefficient value. The foreign exchange reserve variable is often used by the government to stabilize the exchange rate by intervening in the money market. The economic crisis in 1998 proved that intervention was an important way by the government to stabilize the Rupiah exchange rate. The increase in foreign exchange reserves will cause an increase in the amount / quantity of foreign exchange, so that the value of foreign exchange is appreciated. Kearney and McDonald conducted research focusing on intervention policy conducted by central bank. Central Bank intervention policy will reduce foreign reserve, so it will make foreign exchange tend to appreciation [9,10]. It was concluded that the influence of sterilized intervention indirectly supporting portfolio balance model.

While the price level variable does not affect the exchange rate variable. The relationship can be explained as follows, inflation which is a reflection of the price level is a condition where the overall price of goods increases in general and continues [6]. In quantity theory (Irving Fisher), inflation is caused by an increase in the money supply, an increase in the money supply in the country (relative to the stock of foreign money) will cause excess supply of money (excess supply). In times of economic crisis, this causes an increase in demand for foreign currency (US Dollar) to secure its liquidity or to gain profits. The next impact that occurred was a decrease in the domestic currency (depreciation).

V. CONCLUSION

Testing of the portfolio model shows that the model is able to explain the behavior of the Rupiah exchange rate. In the context of the portfolio model, the foreign exchange reserve variable is very important in managing exchange rates. This is supported by the results of research that shows the variable foreign exchange reserves affect the exchange rate. Therefore, the government needs to carry out a management policy for foreign exchange reserves for policy interventions in the foreign exchange market. The policy is carried out to affect exchange rate stability through the supply side which in turn will affect macroeconomic stability. The test results also show that the variable interest rate in this case the BI Rate can also be used as a monetary policy tool for stabilizing the Rupiah exchange rate.

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