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Analysis of Macroeconomic Variable Shocks and Monetary Policy on Real Effective Exchange Rates in Indonesia

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ABSTRACT
This study examines the effect of monetary policy and macroeconomic variable shocks on the real effective exchange rate in Indonesia. The analysis model used is the cointegration of Johansen-Juselius and error correction models (ECM). Data is used by time series from 2008Q1 to 2018Q4. The findings in this study are in the long term monetary policy through interest rate policy (BIRate), economic growth, and economic openness significantly affect the real effective exchange rate in Indonesia. In the short term, interest rate policy (BIRate) and economic growth significantly affect the real effective exchange rate. Economic openness creates a disruption to the real effective exchange rate equilibrium in the short term but moves back towards its equilibrium in the long run.

Keywords: *cointegration, ECM , exchange rate, monetary policy*

1. INTRODUCTION

The achievement of exchange rate stability is the main objective of monetary policy in every country in the world. A stable exchange rate contributes to strengthening the national economy and the competitiveness of a country (Montes & Ferreira, 2020). In an open economy, the stability of the real exchange rate is a central problem that becomes the reference in shaping policy design. Besides, fundamental macroeconomic factors influence exchange rate fluctuations so that it becomes a major consideration in maintaining exchange rate stability (Bouraoui & Phisuthtiwatcharavong, 2015).

In developing countries like Indonesia, exchange rate stability is a major challenge when implementing monetary policy independence. In addition, policies must be able to preserve the equilibrium and stability of the exchange rate when implementing floating exchange rates and free trade (Elfaki, 2018).

Empirically, monetary expansion affects the weakening of the real exchange rate. Although in the long run it will stimulate output growth and increase productivity in the economy. Thus, a decrease in interest rates has an impact on the depreciation of the exchange rate (Lee & Kim, 2019).

Although monetary policy has a strong influence on the real effective exchange rate, shocks to macroeconomic variables affect the real effective exchange rate. According to Barbosa et al., (2018) economic growth positively influences the real effective exchange rate. A growing economy shows good economic prospects and high productivity (An et al., 2016; Bowman et al., 2015; Montes & Ferreira, 2020)

Meanwhile, according to Ye et al.,(2014) Economic openness affects the real effective exchange rate. The openness of economic affects strengthening the real exchange rate. Economic openness facilitates the entry of capital flows into a country, thereby strengthening the possibility of strengthening the real effective exchange rate. Besides, economic openness provides the possibility to increase exports, so that it will make a positive contribution to strengthening the real effective exchange rate of a country (Boudias, 2015).

However, economic openness also has the possibility to weaken the real effective exchange rate. Free trade that occurs because of an open economy, provides the possibility of increased imports. Increased imports put pressure on the domestic exchange rate so that it will depreciate the real exchange rate (Barbosa et al., 2018; Kataria & Gupta, 2018).

Based on several previous studies, monetary policy related to interest rates, economic growth, and economic openness affects the real effective exchange rate. This study aims to present a dynamic model in examining the effects of shocks in macroeconomic variables on the real effective exchange rate and the article deals with the implications of changing determinants of short-term and long-term effective exchange rate shocks in Indonesia. With the application of the Johansen multivariate cointegration method and the error correction model (ECM).

2. METHODS

This study applies the multivariate Johansen cointegration method and error correction model (ECM). This study fully uses a time series secondary data source covering the years from 2008Q1 to 2018Q4. The model of the long-term relationship between the real effective exchange rates is as follows:

$$REER = f\{BIRate, Growth, OP\} \quad (1)$$

Where the Real Effective Exchange Rate (REER) is the average value of a currency relative to several other countries' currencies that have been adjusted to the price index of a particular country. Weight is determined by comparing the relative trade balance of a country's currency against each country in the index.Indonesian Monetary Policy rate (BIRate) is interest rate policy determined by Bank Indonesia concerned with monetary policy, Economic Growth (IR) is the percentage increase in total output in a country measured by changes in real GDP and economic openness (OP) is the ratio of the number of exports and imports to GDP. The time-series data is sourced from world development indicator, world bank. REER variable data in the form of logarithms while variable data (BIRate, Growth, OP) are in the form of percentages so that they are not logged.

$$\log REER_t = \beta_0 + \beta_1 BIRate_t + \beta_2 Growth_t + \beta_3 OP_t + \varepsilon_t$$

Where ε is a random error. The expected sign of this study is β1> 0, which means the influence of BIRate on the REER has a positive coefficient, β2 >0 which means that the influence of economic growth on the REER is a positive coefficient and β3 <0 means that the influence of economic openess on the REERhas a coefficient negative.

Equation 3 includes ECt-1, to integrate the short-term dynamics in the function of the long-term money supply so that the error correction model (ECM) is used as follows:

$$\Delta \log REER_t = \beta_0 + \beta_1 \Delta BIRate_t + \beta_2 \Delta Growth_t + \beta_3 \Delta OP_t + EC_{t-1} + V_t$$

where EC_{t-1} = error-correction term lagged one period.

Estimating of the study model involves three steps, namely: first, the test unit root avoids false regression results. One of the unit root tests is used ADF (Augmented Dickey fuller) test. Second, the variables are integrated in the same order, then cointegration will be tested by using multivariate Johansen cointegration analysis. Third, co-integrated variables, all model

requirements are fulfilled and error correction model (ECM) estimation can be applied.

3. RESULTS AND DISCUSSION

Unit Root Test

Unit root test is very important to do before conducting a cointegration test on the research variable. This test is intended to analyze the possibility of false regression which will show t-statistics and f-statistics that lead to wrong conclusions. So, time-series data must be stationary or in the case of non-stationarity, the right methodology must be applied to correct. The study uses the augmented Dickey-Fuller (ADF) test for unit root tests.

Table 1. Unit Root Test Augmented Dickey Fuller

Variable	Level	Prob. Values	1st difference	Prob. Values	Order of integration
	Constant		Constant		
REER	-2.275123	0.1845	-5.382110	0.0001	I(1)
BIRate	-2.835200	0.0620	-3.291964	0.0216	I(1)
Growth	-2.008745	0.2821	-3.809531	0.0060	I(1)
OP	-1.188282	0.6710	-6.321275	0.0000	I(1)

Notes: ADF test was performed using Eviews 10.

Cointegration test

The Johansen-Juselius cointegration test is applied to find out the equilibrium in the long run. Arethere similarities in the movement and stability of the relationship between the variables in this study or not

Table 2. Johansen-Juselius Multivariate Cointegration Test

H0	H1	Eigenvalue	Trace Statistic	0.05 Critical Value	Max-Eigen Statistic	0.05 Critical Value
r=0*	r>0	0.570485	66.56334	47.85613	35.49416	27.58434
r≤1	r>1	0.390498	31.06918	29.79707	20.79476	21.13162
r≤2	r>2	0.123419	10.27442	15.49471	5.532522	14.26460
r≤3	r>3	0.106762	4.741901	3.841466	4.741901	3.841466

Notes: * denotes rejection of the hypothesis at the 0.05 level. these nonstandard critical values are taken from MacKinnon-Haug-Michelis (1999)

The Akaike information criterion (AIC) and the Schwarz (SC) information criterion of the VAR estimation, explain that the optimal lag length is used 2. In table 2 inform that the trace statistic value 66.56334is above the critical value 47.85613at r = 0, it indicates that the hypothesis of no cointegration is rejected. The Max-Eigen statistics are higher than the value of the critical value, which means the null hypothesis without cointegration at r = 0 is rejected at a significant level of 0.5 percent, and supports the alternative hypothesis.

Thus, it can be concluded that there is a cointegration relationship on the variable under study. The cointegration relationship states that there is a long-run equilibrium between exogenous and endogenous variables in this study.

Table 3. Estimation of Ordinary Least Square (OLS)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.461328	0.071266	62.60068	0.0000
BIRate	-0.021376	0.004065	-5.258605	0.0000
Growth	0.061850	0.007748	7.982603	0.0000
OP	-0.002533	0.000849	-2.984406	0.0048
R-squared	0.699911	F-statistic	31.09797	
Adjusted R-squared	0.677405	Prob(F-statistic)	0.000000	

Note: *, **, ** represents statistical significance at the level of 1%, 5%, and 10%

The estimation of ordinary least square (OLS) in table 3 shows that BI Rate, Economic growth and economic openness significantly affect the Real effective exchange rate. Increased BI Rate has an impact on depreciate the real effective exchange rate in Indonesia. Every increase in BIRate by 1%, in the long run, has an impact on depreciate the money supply by 0.02%. Meanwhile, economic growth that increases every 1% has an impact on appreciate the real effective exchange rate by 0.06%.

Estimation of the error correction model

The stability of the parameter study model in the long term can be examined with an error correction model (ECM). So, we can identify the variables that affect real effective exchange rate.in the short term and the variables that cause shocks on the real effective exchange rate. The next resut is about the short-term relationship between BI Rate, Economic growth and economic openness with real effective exchange rate in Indonesia.This condition can be seen in the results of the ECM estimation of the money supply in table 4.

Table 4. Estimasi error- correction model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001334	0.003900	0.342115	0.7341
D(BIRate)	-0.021426	0.008922	-2.401461	0.0213
D(Growth)	0.056982	0.013594	4.191823	0.0002
D(OP)	-0.001879	0.001548	-1.213351	0.2325
ECT(-1)	-0.495234	0.126206	-3.924014	0.0004
R-squared	0.474823	F-statistic	8.589143	
Adjusted R-squared	0.419541	Prob(F-statistic)	0.000049	

Note: *, **, *** shows a significant level of 1%, 5%, and 10%

The estimation results presented that the lag term error significantly affected shocksthe real effective exchange rate. This condition shows that there is an imbalance in the short-term relationship between economic openness and the real effective exchange rate. Economic openness in the short term does not significantly influence the real effective exchange rate.

Meanwhile, BIRate and economic growth show a significant influence on the real effective exchange rate. The decrease in interest rates affects the appreciation of the real effective exchange rate and the increase in economic growth affects the appreciation of the real effective exchange rate in the short term.

The coefficient of determination R2 is 47 percent of the total variation in the real effective exchange rate in Indonesia, which can be explained by the macroeconomic economic variables investigated. Meanwhile, the term error correction illustrated the proportion of an imbalance in the real effective exchange rate., in the long run, can be corrected annually at a significant level of 5 percent. About 49 percent of the imbalances in the real effective exchange rate shocks are corrected every year in Indonesia.

Monetary Policy Effect on the Real Effective Exchange Rate in Indonesia

Basically, monetary policy is the main policy instrument in controlling exchange rate stability. The central bank intervenes in exchange rate movements to anticipate the impact on the economy in the event of a shock. Based on the estimation results, the error correction model (ECM), Bank Indonesia through the interest rate policy significantly influences the real effective exchange rate in Indonesia. However, the results of the study indicate that an expansive monetary policy that significantly appreciates the real effective exchange rate. This finding is supported by research conducted by(Lee & Kim, 2019; Montes & Ferreira, 2020; Thompson, 2012)

The results shown different conditions from conventional concepts and theories where strict monetary policy affects the appreciation of the real exchange rate. Monetary expansion allows arousal in the economy to influence expectations of the economy, especially in terms of prices and income. Monetary expansion allows a strengthening in the domestic financial market, so that it will affect capital inflows that will indirectly strengthen the real exchange rate (Bowman et al., 2015; Chortareas et al., 2012)

Meanwhile, in the long-term estimation results, it was found that expansive monetary policy appreciates the real effective exchange rate. This condition shows that the direction of monetary policy in Indonesia must take expansive policies to strengthen financial markets to influence productivity gains. High productivity impacts the appreciation of the real effective exchange rate (Bahmani-Oskooee & Kones, 2014; Bouraoui & Phisuthtiwatcharavong, 2015; Özmen & Erdal, 2017).

The Impact of Macroeconomic Variable Shock on real effective Exchange Rates

The Shocks on macroeconomic variables affect the real effective exchange rate fluctuations. Based on the estimation results of the error correction model (ECM), It was found that the real effective exchange rate in Indonesia was significantly affected by economic growth.. Increased domestic productivity provides a positive sentiment towards the market and thus affects the condition of the real exchange rate.This finding is supported by previous research which explains that an economy that has good prospects will have a positive influence on the real effective exchange rate (Kataria & Gupta, 2018; NETO, 2018; Tunaer Vural, 2019).

Furthermore, the effect of economic openness on the real effective exchange rate shows an insignificant effect in the short term. This condition supports previous research which found that Economic openness does not have a significant effect on the real effective exchange rate in Indonesia (Barbosa et al., 2018; Elfaki, 2018; Kataria & Gupta, 2018; NETO, 2018; Tunaer Vural, 2019). This finding also shows that economic openness is a disruption to the real effective exchange rate equilibrium in the short term. However, in the long run, economic openness will adjust to its equilibrium.

4. CONCLUSION

Exchange rate stability is a major challenge for developing countries when implementing independent monetary policies. Monetary policy interventions affect exchange rate stability, so it is important to use the right policy instruments. In addition, the effect of shocks on macroeconomic variables cannot be separated from the real effective exchange rate. According to the results

of cointegration tests and error correction models, monetary policy through interest rate policy affects the real effective exchange rate in the short and long term. This finding shows that monetary policy effectively influences exchange rate stability.

Economic growth has a positive effect on the real effective exchange rate in the short and long term. An increase in productivity gives a positive sentiment to the market so that it increases the real effective exchange rate. Meanwhile, economic openness becomes a disruption to the real effective exchange rate equilibrium in the short run, but in the long-run economic openness adjusts and returns to its equilibrium.

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