The Intervention of Macroeconomic Variables on Monetary Stability in Indonesia: Error–Correction Model Approach

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Abstract
This study investigates the influence of macroeconomic variable interventions on monetary stability in Indonesia. The analysis model used is cointegration of Johansen-Juselius and error correction model (ECM). Data is used by time series from 1988 to 2018. The findings in the study show that in the long run Gross Domestic Product (GDP), economic openness, and inflation significantly affect the money supply in Indonesia. In the short term, economic openness significantly influences the money supply. Overall, the intervention of the real variable interest rate raises shocks to monetary stability in the long run, although in the short run it is able to maintain its balance. The Monetary Authority in Indonesia needs to make adjustments and integration in establishing policies to realize the sustainability of monetary stability in Indonesia.
Keywords*: ECM, cointegration, monetary stability*

Introduction
The relationship between macroeconomic variables to monetary stability explains that how economic fundamentals influence monetary policy, especially those related to the money supply(Folarin & Asongu, 2019). The stability of money supply occupies a central role in the evaluation and design of monetary policy.

The Indonesian Monetary Authority has established a monetary policy formula in an effort to realize economic stability through a policy of regulating the money supply. The realization of monetary stability by controlling the money supply, the economy will lead to ideal conditions. Although the regulation of the money supply has been carried out through a monetary policy mechanism, the expected monetary stability has not been achieved ideally. This indicates that there is a disruption in the economy that affects the stability of the money supply.

In identifying the effect of macroeconomic variables on the money supply, some empirical research(Buchanan, Le, & Rishi, 2012; Cacciatore, Ghironi, & Lee, 2016) found that the condition of the money supply is influenced by the level of economic openness in a country. Economic openness which facilitates foreign investment will cause an increase in the money supply in the economy. Economic openness also shows that trade liberalization allows an increase in production so that it will trigger growth in the financial sector.

Furthermore, research (S. Asongu, Governance, & Enowbi, 2015; Ndirangu & Nyamongo, 2015)reveals that domestic productivity affects the increase in the money supply. High GDP growth shows a high economic passion so that it will increase investment and consumption. An economy that shows optimistic growth prospects will lead to growth in the real sector which will then increase demand for money (Nchor & Adamec, 2016; Nyumuah, 2017).

The money supply is determined by price stability(Urbanovsky, 2016). The tendency of price changes that indicate a stable level will lead investment in high amounts because they view the economy will continue to move in good condition as seen from high purchasing power. In addition, the ease of investment seen from low-interest rates is the main indicator that increases the money supply (S. Asongu et al., 2015; S. Asongu, Governance, Folarin, & Biekpe, 2019).

Based on some previous studies, economic openness, Gross Domestic Product (GDP), Inflation, and real interest rates affect the stability of the money supply in Indonesia. This study is intended to present a

dynamic model in determining the money supply and empirically examine the implications of changes in the determinants of possible short-term and long-term money supply shocks in Indonesia. With the application of the multivariate Johansen cointegration method and the error correction model (ECM).

Besides the introductory part, then the second part will discuss the methodology, the third part will analyze the results and discussion and the fourth part will conclude the conclusion.

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 1987 to 2018. The model of the long-term relationship between the real effective exchange rates is as follows:

$$Ms = f\{GDP, INF, IR, OP\} \quad (1)$$

Where Ms is the money supply (national Currency) is used as a measure of monetary stability, Gross Domestic Product (GDP) is a measure of national income, Inflation (INF) is an indicator of price change as measured by changes in the consumer price index, interest rate (IR) measured by real interest rates, 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. Ms and GDP variable data in the form of logarithms while variable data (INF, OP, IR) are in the form of percentages so that they are not logged.

$$\log Ms_t = \beta_0 + \beta_1 \log GDP_t + \beta_2 INF_t + \beta_3 IR_t + \beta_4 OP_t + \varepsilon_t \quad (2)$$

Where ε is a random error. The expected sign of this study is $\beta 1 > 0$, which means the influence of GDP on the money supply has a positive coefficient, $\beta 2 < 0$ which means that the influence of inflation on the money supply is a negative coefficient, $\beta 3 < 0$ means that the influence of real interest rates on the money supply has a coefficient negative and $\beta 4 > 0$ which means that the effect of economic openness on the money supply has a positive coefficient.

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:

$$\Delta \log Ms_t = \beta_0 + \beta_1 \Delta \log GDP_t + \beta_2 \Delta INF_t + \beta_3 \Delta IR_t + \beta_4 \Delta OP_t + EC_{t-1} + Vt$$

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 augmented dickey-fuller and Phillips-Perron. Second, the variables are integrated in the same order, then cointegration will be tested by using multivariate Johansen cointegration analysis. Third, the cointegrated variable, then we can determine the error correction model and the estimated standard method.

Results and Discussion

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		
Ms	-4.376163	0.0016	-3.200966	0.0298	I(0)
GDP	-0.394554	0.8982	-3.948207	0.0050	I(1)
INF	-4.743536	0.0006	-9.323979	0.0000	I(0)
IR	-5.390428	0.0001	-10.45104	0.0000	I(0)
OP	-2.919552	0.0545	-8.415430	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	0.843187	104.4422	69.81889	55.58112	33.87687
r<1	r>1	0.548183	48.86103	47.85613	23.83434	27.58434
r<2	r>2	0.390210	25.02670	29.79707	14.83923	21.13162
r<3	r>3	0.256087	10.18747	15.49471	8.874954	14.26460
r<4	r>4	0.042807	1.312515	3.841466	1.312515	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 3 inform that the trace statistic value 104.4422is above the critical value 69.81889at r = 0, it indicates that the hypothesis of no cointegration is rejected, and alternative hypotheses are accepted. The value of max-Eigen statistics is greater 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-term balance between exogenous and endogenous variables in this study.

Table 3. Estimation of Ordinary Least Square (OLS)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-65.06950	4.461622	-14.58427	0.0000
LOGGDP	3.605608	0.156977	22.96901	0.0000
INF	-0.027818	0.011221	-2.479001	0.0197
OP	0.042564	0.007235	5.883044	0.0000
RIR	-0.021847	0.016511	-1.323167	0.1969
R-squared	0.869173	F-statistic	290.1917	
Adjusted R-squared	0.852292	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 GDP and economic openness significantly affect the money supply. Increased GDP has an impact on increasing the money supply in Indonesia. Every increase in GDP by 1%, in the long run, has an impact on increasing the money supply by

3.6%. Meanwhile, economic openness that increases every 1% has an impact on increasing the money supply by 0.04%.

Furthermore, inflation and real interest rates show a non-significant effect on the money supply in Indonesia. This finding confirmed previous research which explains that the money supply is not significantly affected by inflation(Nchor & Adamec, 2016) and real interest rates (Ariff, Chung, & Shamsher, 2012; Urbanovsky, 2016).

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 the money supply in the short term and the variables that cause shocks on the money supply.

The next discussion is about the short-term relationship between Gross Domestic Product (GDP), Inflation, Economic Openness and real interest rates with the money supply in Indonesia. Thus, it can be seen that the money supply equilibrium model is in accordance with the stability of monetary policy and does not interfere with economic stability. 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	0.180862	0.023580	7.670014	0.0000
D(LOGGDP)	-0.290827	0.418586	-0.694784	0.4936
D(INF)	-0.004241	0.004032	-1.051604	0.3030
D(OP)	0.007974	0.002900	2.749135	0.0109
D(RIR)	-0.003115	0.005032	-0.618895	0.5416
RES(-1)	-0.180604	0.068630	-2.631543	0.0144
R-squared	0.528917	F-statistic	5.613846	
Adjusted R-squared	0.434701	Prob(F-statistic)	0.001332	

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

The estimation results presented that the lag term error significantly affected shocks to the money supply. This condition showed that there is a disequilibrium in the short-term relationship between gross domestic product (GDP), inflation and real interest rates and the money supply. This finding is supported by previous findings that economic conditions as indicated by changes in GDP, inflation, and real interest rates do not significantly influence changes in the money supply. Gross Domestic Product, Inflation, and Real Interest Rates led to shocks to the stability of the money supply in Indonesia (El, Bin, & Ainon, 2019; Folarin & Asongu, 2019). This condition meant that the intervention of these variables disturbs monetary stability in Indonesia in the short term. However, GDP has adjusted and returned to its balance in the long run. Thus, it can be observed that the condition of GDP only disrupts the short-term equilibrium.

Nevertheless, economic openness had a significant influence on the money supply in Indonesia. Thus, it is necessary to adjust the policy of the money supply with inflation, GDP and real interest rates in order to achieve monetary stability through the equilibrium of the money supply. This finding is consistent with previous research which shows that economic openness significantly influences the stability of the money supply in the short term (Ariff et al., 2012; S. A. Asongu, Folarin, & Biekpe, 2018).

The coefficient of determination R2 is 52 percent of the total variation in the money supply 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 money supply which, in the long run, can be corrected annually at a significant level of 1 percent. About 18 percent of the imbalances in the money supply shocks are corrected every year in Indonesia.

Conclusion

Monetary stability which is the goal of policy cannot be separated from the influence of intervention in macroeconomic variables in Indonesia. Therefore, adjustments need to be made by integrating monetary policy with other policies that control the conditions of macroeconomic variables. Based on the results of the cointegration test and the ECM test conducted, the economic conditions indicated by changes in GDP, inflation, and real interest rates in the short term caused shocks to monetary stability in Indonesia. Although in the long run, there is an adjustment in the balance between GDP and interest rates on monetary stability in Indonesia. Thus, there needs to be an effective policy in controlling inflation in order to achieve monetary stability in Indonesia.

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