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Abstract

This study investigates the significance of Divisia monetary aggregates in formulating the monetary policy in Indonesia. A money demand function has been constructed to compare the relative performance for Simple-sum M1 and M2 (SSM1 and SSM2) and Divisia M1 and M2 (DM1 and DM2) monetary aggregates. The econometrics testing procedures that have been utilized in the estimation include unit root test, cointegration test, Vector Error Correction Model (VECM), Granger causality test and residual test. Empirical findings indicate that only DM1 model yields credible result amongst all of the money demand models. The obtained coefficients for DM1 model are consistent with a prior theoretical expectation and carry plausible magnitudes. The DM1 model is satisfactory as proven by the diagnostic tests. Divisia monetary aggregates are proven not only theoretical superior but also empirical valid as useful measurement of money for the case of Indonesia. The central bank of Indonesia may consider using Divisia monetary aggregates as the policy variables in formulating monetary policy.

***JEL Classification*: E41, C43, C32**
Keywords: Money Demand, Divisia Money, VECM

1. Introduction

Financial liberalization has been playing an essential role in economic development by allowing financial market determined by market forces. Fry (1995) states that the growth in financial system has positive effect on the volume and/or efficiency of investment and the long-run rate of economic growth. However, instability or poor management in the financial market in the country will create negative impact to the economic growth and development. Financial liberalization helps in promoting financial system efficiency and enhancing the effectiveness as well as flexibility of monetary policies. An open capital market leads to financial market deepening by absorbing more foreign investments and generates higher return projects. Therefore, financial liberalization plays an important role to boost up the economic growth.

Monetary policy is among the most important macroeconomic policies used by a government to affect the money supply and interest rate in the financial market. A central bank is

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nominated by the government to conduct the monetary policy in the country. For example, Bank Indonesia has the role to promote financial market stability by safeguarding the Rupiah value and controlling the money supply to influence the liquidity condition, consequently, affect the real economy activities. The central bank can monitor the market liquidity through its monetary policies like open market operation, discount loan and required reserve ratio. Yet, before any decision is made on how much of the money supply it shall channel into the market, the central bank needs to know about the amount of money demanded by the economy.

By estimating the money demand equation, the monetary authority can obtain useful information on which monetary aggregate is better to be used as the monetary policy tool under the current economic condition. Money plays an essential role in the transmission and formation of monetary policy, while financial liberalization plays a key role in determining money demand and its fluctuations. However, does the rapid financial development in Indonesia bring any significant impact on the use of monetary aggregate as the monetary policy tool? Belongia (1996) contends that the incompetence of the conventional monetary aggregates to internalize the pure substitution effects leads to the instability of money demand function. Therefore, it is crucial for policymakers in Indonesia to know which monetary aggregate is the most suitable policy variable in formulating its monetary policy.

1.1 Significance of Divisia Monetary Aggregates

The idea of Divisia monetary aggregate was contributed by Barnett (1980). According to Barnett (1980), there is a weakness of Simple-sum money in which all monetary components are assigned with an unitary weight. Barnett (1980) argues that different components of asset in a non-linear aggregation should be attached with different weights corresponding to their "moneyness" when the asset components are not perfect substitute. Consequently, the weights should given according to the liquidly of each components. For instance, the financial assets that are often used for transaction should be given a higher weight due to the higher opportunity cost. Meanwhile, lower opportunity cost financial assets that are mostly used for saving purposes and involve less transaction should be given a lower weight.

In this regard, Divisia money is able to capture the demand shifts among various types of monetary assets (Cysne, 2000). This is because Divisia money is constructed by aggregating the expenditure share for the monetary assets and the share can be used as the index weight. Different monetary assets will be assigned with different weights according to their "moneyness". Therefore, Divisia money is able to represent a valid structural economic variable for the services of the quantity of money. As a result, the significance of weighted monetary aggregation has motivated Bank of England and Federal Reserve Bank of St. Louis to construct and publish their Divisia measure of money in addition to the conventional measure of money.

Schunk (2000) argues that a theoretically valid measure of monetary services can be purveyed by Divisia monetary aggregate. Divisia aggregation is depending on both consumer demand and economic aggregation theories (Thornton and Yue, 1992). In order to maximize the consumers' utility, consumers will allocate their incomes over a single aggregate measure of monetary services and all other commodities. Drake and Fleissig (2006) state that only the monetary aggregates which assume the financial assets as less than perfect substitution and have the capability to measure the assets with varying weight according to the economic conditions from time to time can predict the economy activity accurately. Hence, there is no doubt to say that Divisia monetary aggregate can perform as a better measurement for money.

Financial reforms had caused money demand to become unstable. In Indonesia, monetary policy has been utilized as an aim to boost up the economy, reduce the inflation rate, and improve the value of currency. Due to the Asian Financial Crisis, Rupiah is floating and the interest rate is increasing. To fight with this crisis, Central Bank Act 1999 and Central Bank Act 2004 have been amended. Bank Indonesia was free to make monetary policies in compliance to the inflation targeting in line with its independence at 1999.

Nevertheless, Masson *et al*. (1998) argue that in some middle-to-high income countries, the inflation targeting does not function well as a good monetary policy. Indonesia that currently adopts inflation targeting policy is also facing the same problem due to frequent changes of inflation rate as a result of fluctuations in the international crude oil price. Hence, Bank Indonesia may consider utilizing Divisia monetary aggregates in formulating its monetary policy if a stable money demand function could be identified using Divisia money as Divisia money has the ability to affect real economic activity.

The rest of this paper is organized as follows. Section 2 provides a brief literature review and section 3 discusses the data and methodology used in the study. The empirical findings will be presented in section 4 and section 5 concludes.

2. Previous Study

Financial liberalization has led to the instability of money demand (Ireland, 1995; Belongia, 1996; Odularu and Okunrinboye, 2009). Many studies have been carried out to examine the appropriate money demand function which has the capability to cope with the financial liberalization. In the earlier study, Habibullah (1998) conclude that there is a long-run relationship between income and all the monetary aggregates (both Simple-sum and Divisia M1 and M2). James (2005) evaluates the impact of financial liberalization towards the money demand in Indonesia. He finds that a long-run stable money demand function could be identified by taken into account the financial liberalization effect, suggesting that financial liberalization plays an essential role in affecting the demand for money and its fluctuations. Nevertheless, Narayan (2007) discovers that money demand function in Indonesia is unstable. Consequences, he claims that money targeting is not an option for Bank Indonesia. In contrast, in order to ensure macroeconomic sustainability, currency substitution should be restraint.

In the earlier study in comparing the relative performance of Simple-sum and Divisia monetary aggregates, Yue and Fluri (1991) assert that narrow monetary aggregates (Simple-sum M1 or Divisia M1) have less explanatory power on the inflation than the broader monetary aggregates (Simple-sum M2 or Divisia M2) in Switzerland. In examining the long-run relationship between inflation and monetary aggregates, they notice that except for Simple-sum M2, all the monetary aggregates can influence the rate of inflation over the period up to four or more years. On the other hand, Eberl (1998) reports that Divisia monetary aggregate M3 shows a faster speed of adjustment towards equilibrium as compared to Simple-sum M3, indicating Divisia type of money is more responsive to market disturbances in German.

For the case of US, Darrat *et al*. (2005) conclude that Divisia monetary aggregates are significantly cointegrated with real GDP and interest rate, but not for the case of Simple-sum monetary aggregates. Moreover, only Divisia monetary aggregates have a stable long-run

relationship with macroeconomic variables in both full and post-1980 sample period. Thus, the results indicate that Divisia money can better cope with changes in financial innovation and deregulation. In the study by Elger *et al*. (2006), Divisia monetary aggregates are found to be able to provide more information about the velocity shocks. Meanwhile, Divisia monetary growth exhibits more consistent pattern with the business cycle across both high and low inflation and interest rate periods as compared to the Simple-sum counterparts (Barnett *et al*., 2009).

Meanwhile, using quarterly data, Habibullah *et al*. (2002) claim that both the narrow and broad money supply are capable to affect the long-run movement of real output in Malaysia. On the other hand, Dahalan *et al*. (2005) propose that Divisia M2 should be used when conducting monetary policy in Malaysia since it performs the best in the money demand function with inflation, domestic and foreign interest rates, financial wealth, and income. In line with this, Puah *et al*. (2006) reveal that the expansion of Divisia monetary aggregates has long-run positive impact on the real output. Along with Dahalan *et al*. (2005), Puah *et al*. (2008) also conducted a study in Malaysia to compare the relative performance of the Simple-sum and Divisia monetary aggregates using money demand function. The results reveal that only Divisia M2 is able to bring the money demand towards long-run equilibrium. Moreover, Leong *et al*. (2010) conclude that the Divisia M2 money demand is more stable over time and has the capability to produce more credible money demand function. Hence, Divisia monetary aggregate can be considered as a usefulness monetary policy tool.

3. Data and Methodology

In the empirical estimation, this study employs a series of econometrics testing procedures which consist of unit root test, cointegration test, Vector Error Correction Model (VECM), Granger causality test and residual test to estimate the money demand functions.

3.1 Data Description

The period for the study covers 1981Q1-2005Q4. In formulating the money demand function, this study follows Hueng (1998) and Narayan (2007) by assuming that the demand for money depends on a measure of income, both domestic and foreign interest rates and exchange rate. The Simple-sum monetary aggregates M1 and M2 (SSM1 and SSM2) and Divisia monetary aggregates M1 and M2 (DM1 and DM2) are constructed by the authors following the approaches suggested by Barnett (1980) and further extended by Anderson *et al*. (1997). Other data are compiled from various issues of *International Financial Statistics (IFS)* which published by the International Monetary Fund (IMF). All variables are transformed into natural logarithm form before any estimation is being conducted.

3.2 Money Demand Specification

Dickey *et al*. (1991) state that general specification of the long-run money demand can be defined as:

$$M = f(Y, P, Z) \quad (1)$$

where M = nominal money;
Y = nominal income level, proxy by Gross Domestic Product (GDP);
P = price level, proxy by CPI; and
Z = all other economic variables which influence the money demand.

According to Johansen (1992), in order to reduce econometric problems, the nominal terms in money balance should be in lieu of real terms. Consequently, the money demand specification can be expressed by Equation (2) with the assumption that the economic agents do not face the money illusion problem (Dickey *et al*., 1991):

$$RM = f(RY, Z) \quad (2)$$

where RM represents real money demand while RY represents real income level (real GDP).

In this study, the variables which comprise in Z are both domestic and foreign interest rates as well as exchange rate. The functional relationship of demand for money with the variables in log linear form is as follows:

$$RM = f(RY, R_1, R_2, NEX) \quad (3)$$

where RM = real monetary aggregate (RSSM1, RSSM2, RDM1 or RDM2);
RY = real income, proxy by real GDP (RGDP);
R_1 = opportunity cost of holding money, proxy by domestic interest rate (Saving Deposit Rate, SDR);
R_2 = opportunity cost of holding money, proxy by foreign interest rate (US Treasury Bill Rate, USTBR); and
NEX = nominal exchange rate.

Since real GDP is adjusted for changes in the prices throughout the year, it can be considered as real purchasing power which will influence the real demand for money over the time. The real demand for money is positively influenced by the growth in real output. In nutshell, economic growth is directly related to the purchasing power which is represented by the real income.

A change in domestic interest rate is expected to move the demand for money in the opposite direction. Since interest rate represents the rate of return for holding alternative financial assets, when domestic interest rate rises, the demand for money will fall whilst the demand for financial assets will increase because it can yield higher return. In contrast, a change in foreign interest rate is expected to move the demand for money in the same direction. Over the time, the domestic and foreign moneys are imperfect substitutes (Hueng, 1998). Consequences, the opportunity cost of holding money will reduce when the foreign interest rate increases.

Bahmani-Oskooee and Shin (2002) argue that an increase in domestic currency value of foreign financial assets held by the domestic residents will induce a depreciation of domestic currency. Currency substitution effect exists to cut down the demand for money during a depreciation of currency while wealth effect exists to reduce the demand for money during an appreciation of exchange rate. Wealth effect implies that when the Rupiah depreciates, the demand for Indonesian goods and services from foreigner will increase. There is a positive relationship between wealth effect and money demand. Thus, the demand for domestic currency will increase. In contrast, the currency substitution effect reveals that when currency depreciation reflects on expectation of further depreciation, investors may switch from holding Rupiah into holding more of foreign currency as well as foreign financial assets. Simultaneously, demand for Rupiah will reduce.

4. Finding and Discussion

4.1 Unit Root Test Results

Augmented Dickey-Fuller (ADF) unit root test has been employed to examine the existence of unit root in the data series. The optimal lag lengths for ADF unit root test are selected based on Schwarz Information Criterion (SIC). To conserve space, the ADF unit root test results are not presented here[1]. Empirical results show that all of the series is non-stationary at level, but do not contain unit root after first differencing. These results are in line with the argument by Nelson and Plosser (1982), in which they state that most of the macroeconomic variables are non-stationary.

4.2 Multivariate Cointegration Tests Results

Table 1 reports the Johansen-Juselius multivariate cointegration test results. Only the results of maximum eigenvalue test are reported since Johansen and Juselius (1990) claim that this test is more powerful than the trace test where it provides more definite results as cross terms have been compounded in the test. There is an opportunity for a meaningful money demand function to exist if the cointegration is found. Empirical results show that the null hypothesis of zero cointegration ($r = 0$) can be rejected at 5 percent significance level for all of the models, implying that a single cointegrating vector exists in all of the money demand models under study. Therefore, a long-run stable linear equilibrium relationship is said to be existed among the variables in the models. In other words, the variables are intimately bound in the long-run.

Table 1
Johansen and Juselius Cointegration Tests Results

H_o	H_1	λ_{max} (k=4, r=1)				CV (max, 5%)
		RSSM1	RSSM2	RDM1	RDM2	
r = 0	r = 1	44.883**	40.687**	46.673**	41.902**	33.640
r ≤ 1	r = 2	19.154	19.113	19.310	17.928	27.420
r ≤ 2	r = 3	10.307	12.227	10.865	16.088	21.120
r ≤ 3	r = 4	4.620	11.081	5.617	3.565	14.880
r ≤ 4	r = 5	0.922	2.340	1.107	1.329	8.070

Notes: r is the number of cointegration vectors and k represent the lag length. Lag selection is based on Schwert's (1987) formula, l_4= int{4(T/100)$^{1/4}$}. Asterisk (**) indicate significant at the 5% level.

4.3 Normalized Cointegrating Vector

Only the model that can generate credible coefficients with the sign of the coefficients that are consistent with a prior hypothesis of money demand theory is considered as a well-defined money demand model. Moreover, the elasticity of the variables can be represented by the coefficients of the variables. In order to identify a well-defined long-run money demand function, normalizing the coefficients of real money demand for all the models was conducted. The normalized cointegrating vectors for real SSM1, real SSM2, real DM1 and real DM2 models are tabulated in Table 2.

[1] The ADF unit root test results are available upon request from the authors.

Table 2
Vector Error Correction Estimates

Test for Exclusion		**b_1**	**b_2**	**b_3**	**b_4**	**b_5**
Parameter Estimated	**Constant**	**LRSSM1**	**LRGDP**	**LSDR**	**LUSTBR**	**LNEX**
Elasticities	3.492	-1.000	1.528	-0.422	0.347	-0.111
[*t*-statistics]			[17.591]***	[-5.697]***	[6.917]***	[-2.591]***
Parameter Estimated	**Constant**	**LRSSM2**	**LRGDP**	**LSDR**	**LUSTBR**	**LNEX**
Elasticities	7.586	-1.000	2.110	1.168	-0.655	-0.518
[*t*-statistics]			[7.344]***	[7.744]***	[-4.142]***	[-3.416]***
Parameter Estimated	**Constant**	**LRDM1**	**LRGDP**	**LSDR**	**LUSTBR**	**LNEX**
Elasticities	2.347	-1.000	1.357	-0.392	0.302	-0.103
[*t*-statistics]			[15.747]***	[-5.362]***	[6.292]***	[-2.336]***
Parameter Estimated	**Constant**	**LRDM2**	**LRGDP**	**LSDR**	**LUSTBR**	**LNEX**
Elasticities	5.962	-1.000	2.017	-0.447	0.378	-0.188
[*t*-statistics]			[17.285]***	[-4.795]***	[5.919]***	[-3.132]***

Note: Asterisk (***) indicate significant at 1% level.

When normalizing the cointegrated vector for SSM1, the coefficients for all of the variables in the money demand function indicate correct signs. In addition, all of the variables also demonstrate the results that are statistically significant at 1 percent level. The results in SSM1 model are consistent with the prior hypothesis of money demand model. Hence, the money demand function that is derived from the SSM1 model is deemed appropriate.

For SSM2 model, the coefficients signs for both LSDR and LUSTBR are inconsistent with the money demand theory. Positive sign in the coefficient of SDR means that positive relationship exists, indicating when SDR increases, the demand for money will increase too. In fact, SDR and money demand should be in opposite direction since the opportunity cost of holding money increases when SDR rises. In contrary, in SSM2 model, there is negative relationship among USTBR and money demand. USTBR and money demand should move in the same direction where the opportunity cost of holding money declines when USTBR rises. James (2005) also reveals that the domestic interest rate and money demand are moving in the opposite direction while foreign interest rate and money demand should react in the same direction.

Along with SSM1 model, the coefficients for all of the variables in the money demand functions derived for DM1 and DM2 models demonstrate correct signs and statistically significant at 1 percent level. Nevertheless, when normalizing the cointegrated vector for all of the models, although SSM1, DM1 and DM2 models carry correct signs, SSM1 and DM1 perform better results by comparing the coefficient of RGDP. According to quantity theory of money, the coefficient for RGDP should be around one. Therefore, a meaningful money demand function can be derived from both SSM1 and DM1 models[2]. In other words, instead of using SSM1, DM1 also can be employed as an alternative of monetary aggregate to estimate the money demand function. The real DM1 money demand function is shown as Equation (4).

$$LRDM1 = 2.347 + 1.357LRGDP - 0.392LSDR + 0.302LUSTBR - 0.103LNEX \quad (4)$$

[2] In addition, narrow money in Indonesia is more stable than broad money (see for example, Anglingkusumo, 2005; Bahmani-Oskooee and Rehman, 2005).

These values were normalized with respect to the demand for real DM1 and it reflects the long-run elasticity measures of the variables. β' = (-1.00, 1.357, -0.392, 0.302, -0.103) represents the coefficient estimates of the cointegrating vector. The results imply that Indonesia's demand for money is elastic with respect to real GDP, but is inelastic with respect to both domestic and foreign interest rates as well as nominal exchange rate.

When RGDP increases by one percent, real DM1 money demand will increase by 1.357 percent. In general, for a lower income country, an increase of income will induce greater demand for money. In other words, increase in income will create higher purchasing power. The residents are capable to spend more money on both goods and services in order to maximize their desires (Heung, 1998; Narayan, 2007). Results revealed that domestic interest rate demonstrates negative relationship with real DM1. Domestic interest rate and demand for money are negatively related. One percent increase in domestic interest rate will lead to 0.392 percent decrease in demand for real DM1 money. Thus, this indicates that an increase in the domestic interest rate lowers the holding of money.

In the contrast, foreign interest rate and money demand exhibit positive relationship. Real DM1 money demand will increase by 0.302 when foreign interest rate increases by one percent. Hence, this indicates that domestic and foreign moneys are imperfect substitutes. The holding for domestic money as well as withdraws of foreign currency move in the same direction or raises together when the opportunity cost of holding foreign currency increases (Heung, 1998). Based on the results for both domestic and foreign interest rates in Table 2, the coefficient of the domestic interest rate is slightly more elasticity than the foreign interest rate. This reveals that the long-run money demand for Indonesia (DM1) responds more to the domestic interest rate.

Last but not least, the nominal exchange rate has negative effect on the domestic money demand. When Rupiah depreciates by one percent, the demand for real DM1 money reduces by 0.103 percent. Hence, currency substitution effect exists in Indonesia since depreciation in currency will lead to the decline in money demand where the holding of Rupiah by foreigners and Indonesian will be decreased. In contrast, Indonesian will increase the holding of foreign money.

In short, the demand for money is positively related to the real GDP and foreign interest rate but negatively related to the domestic interest rate. Results also confirm that the depreciation of the currency could weaken the demand for money. Furthermore, DM1 can be used as an alternative monetary policy variable in capturing the impact of financial liberalization in Indonesia.

4.4 Temporal Causality Test Results Based on VECM

The existence of cointegration vector in the money demand model demonstrates that the variables in the model under this study are cointegrated and possess long-run relationship. According to Masih *et al*. (2009), vector error correction model (VECM) plays an important role in detecting the endogeneity or exogenity of the variables in the model. Thus, VECM is utilized to obtain the direction and intensively of causal effects in the system since the direction of Granger causality is not implied by the cointegration test. Table 3 shows the summary of the Granger causality test results based on VECM for Indonesia's demand for money.

Table 3
Granger Causality Test Results

Dependent Variables	χ^2-statistic (*p*-value)					ECT	
	A. SSM1						
	ΔRSSM1	ΔRGDP	ΔSDR	ΔUSTBR	ΔNEX	Coefficients	*t*-statistics
ΔRSSM1	-	9.002 (0.029)**	7.270 (0..064)*	4.713 (0.194)	1.315 (0.726)	-0.188	-3.154***
ΔRGDP	11.666 (0.009)***	-	1.312 (0.726)	2.304 (0.512)	10.884 (0.012)**	-0.083	-2.383***
ΔSDR	11.545 (0.009)***	2.838 (0.417)	-	2.574 (0.462)	20.772 (0.000)***	-0.227	-1.415
ΔUSTBR	1.131 (0.770)	0.887 (0.829)	4.237 (0.237)	-	3.678 (0.237)	-0.612	-3.589***
ΔNEX	7.490 (0.058)*	9.085 (0.028)**	6.016 (0.111)	1.802 (0.615)	-	0.239	-1.976***
	B. SSM2						
	ΔRSSM2	ΔRGDP	ΔSDR	ΔUSTBR	ΔNEX	Coefficients	*t*-statistics
ΔRSSM2	-	32.265 (0.000)***	11.104 (0.011)***	4.295 (0.231)	18.096 (0.000)***	-0.021	-1.380
ΔRGDP	18.272 (0.000)***	-	0.845 (0.827)	0.553 (0.907)	21.122 (0.000)***	0.031	2.884***
ΔSDR	7.490 (0.058)*	9.085 (0.028)**	-	6.016 (0.111)	1.802 (0.615)	0.005	-0.090
ΔUSTBR	11.465 (0.010)***	0.715 (0.870)	2.820 (0.420)	-	14.831 (0.002)***	0.255	4.983***
ΔNEX	1.131 (0.770)	0.887 (0.829)	4.237 (0.237)	3.678 (0.298)	-	-0.017	-0.041
	C. DM1						
	ΔRDM1	ΔRGDP	ΔSDR	ΔUSTBR	ΔNEX	Coefficients	*t*-statistics
ΔRDM1	-	12.674 (0.005)***	4.581 (0.205)	8.479 (0.037)**	4.219 (0.239)	-0.236	-3.945***
ΔRGDP	14.624 (0.002)***	-	0.774 (0.856)	2.937 (0.401)	11.039 (0.012)**	-0.043	-1.274
ΔSDR	7.398 (0.060)*	5.409 (0.144)	-	10.650 (0.014)**	3.877 (0.275)	-0.153	-1.006
ΔUSTBR	12.028 (0.007)***	4.872 (0.181)	1.301 (0.729)	-	14.010 (0.003)***	-0.659	-4.085***
ΔNEX	7.866 (0.049)**	1.574 (0.665)	4.568 (0.206)	1.142 (0.767)	-	0.236	2.006***
	D. DM2						
	ΔRDM2	ΔRGDP	ΔSDR	ΔUSTBR	ΔNEX	Coefficients	*t*-statistics
ΔRDM2	-	12.852 (0.005)***	13.807 (0.003)***	5.885 (0.117)	1.102 (0.777)	-0.123	-3.011***
ΔRGDP	23.967 (0.000)***	-	0.572 (0.903)	3.929 (0.269)	13.134 (0.004)	-0.032	-1.256
ΔSDR	3.347 (0.341)	3.654 (0.301)	-	7.659 (0.054)*	5.638 (0.131)	-0.231	-1.911***
ΔUSTBR	7.701 (0.053)*	1.275 (0.735)	2.554 (0.466)	-	1.473 (0.688)	0.195	2.105***
ΔNEX	5.739 (0.125)	6.771 (0.080)*	1.974 (0.578)	22.638 (0.000)***	-	-0.616	-4.809***

Notes: Δ is the first different operator. Figures in parentheses are the *p*-values. Asterisks (*), (**) and (***) indicate significant at 10%, 5% and 1% levels, respectively.

The error-correction term (ECT) is incorporated in the estimation of VECM approach. In order to evaluate the significance of lagged ECT, *t*-statistics were employed whereas the joint-significance of the lagged differenced variables was evaluated by employing the *F*-statistics. Moreover, the significant and correct sign of ECT reveal that the long-run causal relationship exists between the specified variables in four of the models.

The estimated coefficient of the ECT for SSM1 model has correct negative sign and significant at the 1 percent level. Hence, the ECT confirms that the variables in the system are cointegrated. The estimated coefficient of ECT is -0.188, implying 18.8 percent of the short-run deviations of the demand for money would be adjusted each quarter towards the long-run equilibrium level of money demand. This verifies that the demand for SSM1 has fast adjustment to correct disequilibrium among all the variables in the system. The period to meet the equilibrium level of demand for SSM1 is less than one and the half year.

For SSM2 model, the estimated coefficient of the ECT carries a negative sign and it is smaller than one but insignificant at the 5 percent level, indicating that the variables in the system are not cointegrated. The short-run deviations of the demand for money are unable to adjust towards the long-run equilibrium level of money demand in this model.

Table 3 also shows that the ECT for DM1 model displays a significant and correct negative sign, which reinforced that the variables in the system are cointegrated. The estimated coefficient of ECT is -0.236. In other words, the coefficient of ECT in DM1 model indicates that 23.6 percent of adjustment occurs in one quarter, suggesting that the system takes around one year to adjust to the long-run equilibrium. Hence, the DM1 money demand in Indonesia has relatively fast adjustment to correct disequilibrium among all the variables in the system.

The estimated coefficient of the ECT for DM2 model also has a correct significant negative sign and smaller than -1 which is -0.123. The ECT in DM2 model indicates that the adjustment is about 12.3 percent in a quarter towards the long run equilibrium level of money demand. This means that two years are needed to bring back disequilibrium to the long-run stable condition.

By comparing the ECT for SSM1, SSM2, DM1 and DM2 models, DM1 model was proved to be having the fastest adjustment towards the long-run equilibrium in the money demand function. Therefore, this result implies that DM1 has the potential to be used as the alternative monetary aggregates policy variable for the case of Indonesia. Referring to Table 3(C), the causality directions between money demand and its variables for DM1 model are being presented. Money demand and financial determinants tend to Granger cause one another for DM1 in the short-run. The results reveal that DM1 can Granger cause all the determinants in the equation. In addition, bidirectional causality occurs between DM1 and RGDP as well as between DM1 and USTBR. On the other hand, there is a short-run relationship running from NEX toward RGDP and USTBR. Meanwhile, USTBR affects SDR.

4.5 Residual Tests Results

The residual tests were employed to investigate the appropriateness of the results derived from the VECM framework. The residual tests utilized in this study included VEC Residual Serial Correction Lagrange Multiplier (LM) tests and Jarque-Bera (JB) normality test. The results for residual tests for SSM1, SSM2, DM1 and DM2 models are reported in Table 4. The findings indicate that only DM1 model is free from normality as well as serial correlation problems. As such, these results again testify that DM1 seems to be the most appropriate monetary variable as manifested by the residual tests.

Table 4
Residual Tests Results

Model	LM(2) [*p*-value]	LM(4) [*p*-value]	JB
SSM1	36.379 [0.003]***	41.261 [0.022]**	26.990***
SSM2	48.152 [0.004]***	23.621 [0.541]	40.383***
DM1	17.056 [0.880]	31.602 [0.179]	18.070
DM2	24.483 [0.492]	35.675 [0.077]	27.312***

Notes: LM(2) and LM(4) refer to Langrange Multiplier tests of 2nd and 4th order serial correlation, respectively. JB is the Jarque-Bera statistic for testing normality.

5. Conclusion

In this study, the relative performance of Simple-sum and Divisia monetary aggregates in Indonesia using the money demand function has been compared. In formulating money demand specification, the features of financial innovation and liberalization were taken into account. This study follows Heung (1998) and Narayan (2007) which assume that the demand for money depends on a measure of real income, both domestic and foreign interest rates and exchange rate.

The ADF unit root test results show that all the variables are integrated with order one, *I*(1). Next, a single cointegrating vector was found in each of the models (SSM1, SSM2, DM1 and DM2), indicating all the alternative monetary aggregates exhibit a stable long-run equilibrium nexus with the specified explanatory variables. In order to obtain the long-run money demand parameters, the cointegration vectors are being normalized. Empirical findings imply that both narrow money (SSM1 and DM1) demand models can yield credible results. The obtained coefficients for SSM1 and DM1 models are statistically significant and consistent with a prior theoretical expectation. Results reveal that positive relationship exists between real GDP and money demand[3]. Meanwhile, domestic interest rate and exchange rate exhibit negative impact while foreign interest rate shows positive effect towards the demand for money. These results are consistent with the findings by Chaisrisawatsuk *et al*. (2004), James (2005), and Dahalan *et al*. (2005). Hence, besides SSM1, DM1 can be also employed as an alternative money aggregate in formulating monetary policy in Indonesia.

Nevertheless, Granger causality test results based on VECM framework show that SSM1 is unable to capture the financial liberalization impact where there is no linkage among foreign interest rate with other money demand determinants. Moreover, DM1 performs the fastest adjustment towards the long-run equilibrium level of money demand. In addition, the robustness of the results is cross-checked via the residual tests. The residual tests results reveal that only DM1 model is free from normality as well as serial correlation problems. As such, the findings from this study prove that DM1 is more appropriate to be utilized as the monetary aggregate in the conduct of monetary policy in Indonesia.

To summarize, Divisia monetary aggregate, particularly DM1 is proven not only theoretical superior but also empirical valid as a useful measurement of money compared to their Simple-sum counterpart for the case of Indonesia. Not only that, the development of Divisia measures of money allows more accurate and relevant information to be obtained by the policymakers viewing that these weighted monetary aggregates can better cope with the fast

[3] This finding is in line with Puah *et al*. (2008a) and Puah *et al*. (2008b) which they found that the narrow monetary aggregate can influence the real output in Indonesia.

changing financial liberalization and innovation environment. Hence, Bank Indonesia may consider employ monetary aggregate targeting by using Divisia money as the policy variable alongside with the traditional Simple-sum monetary aggregates.

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