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Abstract

This study re-examines the long-run neutrality (LRN) of money on real output in Malaysia using quarterly Divisia money data from 1981:1 to 2004:4 based on Fisher and Seater's (1993) nonstructural reduced form bivariate ARIMA model. Special attention has been given in identifying the number of unit root and cointegrating vector, as a meaningful LRN test is critically depends on such properties. Empirical results indicate that LRN is deviated from Malaysian economy when Divisia money is used. In particular, Divisia monetary expansion seems to have long-run positive effect on real output in Malaysia.

***JEL Classification*: C12, C43, E50**

Keywords: ARIMA Model, Divisia Money, Long-run Neutrality of Money

1. Introduction

There are voluminous studies in finding out the influence of money on real economy activity. Different methodologies and models have been applied to test the empirical validity of money in order to give the answer whether money is a viable monetary policy variable. Literature shows that most of the earlier studies on money use different level of monetary aggregates such as M1, M2 and M3 to evaluate the performance of money. Until 26 years ago, the traditional or simple sum monetary aggregates are the most commonly used measure of money in the empirical literature. However, the use of simple sum monetary aggregates has received much criticism because it is inconsistent with the microeconomics and statistical index number theory.

In the simple sum aggregation method, different monetary component assets are given the same weight. In other words, the component assets are regarded perfect substitutes. This implies that coins and notes are assumed to provide the same transactions or liquidity services as interest-bearing deposits such as savings deposits or time deposits within the broad monetary aggregate. Clearly, this assumption is not valid in the context of optimizing agent. In reality, nevertheless, it is obviously that the different monetary components included in the broad monetary aggregates are actually imperfect substitutes. Generally, the role of coins and notes are limited to the function of media of exchange to facilitate market transactions. They do not serve as a

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store of value function because they are non interest-bearing. On the other hand, savings deposits and time deposits as well as other newly emerging financial assets are interest-bearing components, which have a mixture of transactions and store of value characteristics varying from asset to asset and over time. Due to these differences, it is inappropriate to assume all the components in the simple sum aggregate are perfectly substitutable and given them equal weight in the construction of the aggregate.

In the last three decades, this deficiency becomes more apparent as financial innovation and deregulation introduce many newly issue financial instruments in the market, in which provide both transaction and liquidity services. As a result, simple sum aggregation of financial assets is suboptimal with respect to transactions services of money. The more heterogeneous of the monetary components, the less valid the simple sum aggregate as a measure of money.

During the 1980s, almost all Asian countries, including Malaysia in this study, have liberalized their domestic financial systems. The key reforms were aimed at liberalizing interest rates, reducing controls on credit, enhancing competition and efficiency in financial system, strengthening supervisory framework and promoting the growth and deepening of financial markets. The liberalization of the financial system was accompanied by the relaxation of restrictions on international capital flows and a shift toward more flexible exchange rate arrangements (Tseng and Corker 1993, pp. 9).

Financial liberalization that brings to a more efficient and sophisticated financial system, however, may lead to a breakdown of the stable and predictable relationship between monetary aggregates and economic activity. In line with the increase in the sophistication of the financial system, financial innovation and deregulation have pervaded in Malaysian financial markets. The emerging of newly issued financial assets has blurred the definition of money because most of these financial assets are immediate or easy access, and given the market-related interest rates. The traditional simple sum aggregate cannot distinguish between the transaction service and store of value function provided by them. Thus, there is a need for reassessment of the appropriate instruments of monetary policy in the context of Malaysian economy.

Although the use of weighted monetary aggregates has gained much attention, the exploration in this area is relatively limited in the context of Malaysian economy. Therefore, it motivates us to address this issue by constructing the weighted monetary aggregates for Malaysia, and then use them to conduct a study to examine their long-run impact on real economic activity. Specifically, we intend to re-examine the LRN of money study in Malaysia by Habibullah, *et al*. (2003) using Divisia monetary aggregates proposed by Barnett (1980).

2. Divisia Index

Hulten (1973) points out that in continuous time, the Divisia quantity index (see Divisia, 1925) is exact for the unknown monetary services (quantity) aggregate. In particular, the continuous time Divisia index, M_t^D, is given by the differential equation:

$$\frac{d\log(M_t^D)}{dt} = \sum_{i=1}^{n} s_{it} \frac{d\log(m_{it}^*)}{dt} \quad (1)$$

where m_{it}^* is the optimum monetary asset and the expenditure share for the i^{th} monetary asset is defined as:

$$s_{it} = \frac{m_{it}^* \pi_{it}}{\sum_{i=1}^{n} m_{it}^* \pi_{it}} \quad (2)$$

It is clearly shown in the continuous time Divisia quantity index, the growth rate of M_t^D is equal to the share-weighted average of the growth rates of the monetary component quantities. Unlike the simple sum index, which simply assumes that all component monetary assets are perfect substitutes, the Divisia quantity index assigns weight to each of its components according to the degree that they provide monetary services.

Diewert (1976) demonstrates that there exists a class of superlative statistical index numbers, which are exact for second-order approximations to unknown economic aggregator in the linearly homogeneous function in discrete time. One of the most important superlative index numbers is the Tornqvist-Theil discrete time approximation to Divisia continuous time quantity index. For monetary aggregation, the Tornqvist-Theil monetary quantity index (or more commonly known as Divisia index) is defined as follows:

$$M_t^{TT} = M_{t-1}^{TT} \prod_{i=1}^{n} \left(\frac{m_{it}^*}{m_{i,t-1}^*} \right)^{\frac{1}{2}(s_{it}+s_{i,t-1})} \quad (3)$$

Diewert (1976) shows that Divisia index is exact for the translog flexible functional form, and it provides a second-order approximation to the unknown subutility function obtained from the microeconomic optimization. Barnett (1980) advocates the use of Divisia index due to its straightforward interpretation, which can be seen by taking the logarithms of Equation (3):

$$\log M_t^{TT} - \log M_{t-1}^{TT} = \sum_{i=1}^{n} \bar{s}_{it} (\log m_{it}^* - \log m_{i,t-1}^*) \quad (4)$$

where $\bar{s}_{it} = \frac{1}{2}(s_{it} + s_{i,t-1})$ is the average expenditure share for all i. Equation (4) clearly indicates that the growth rate of the Divisia index is simply a weighted average of the growth rates of component monetary assets. The Divisia index is in line of microeconomic theory. They are regarded high quality statistical approximations of the true, but unknown aggregates in the utility function. Therefore, it is clear that the Divisia index is, at least theoretically, superior to the simple sum index. The relative performance of these two indexes in empirical applications, however, is actually an empirical issue.

3. The Fisher and Seater Methodology and Data

The classical theory of macroeconomics asserts that there exists a 'classical dichotomy' in which nominal variables has no effect on real economic activity in the long run. This line of research has attracted great academic interest for a long period. There are various econometric procedures in testing this classical quantity theoretic proposition. One of the leading approaches in testing the LRN of money is the use of a nonstructural reduced form bivariate ARIMA model developed by Fisher and Seater (1993, hereafter FS). FS propose the use of a simple and relatively structural free model because structural details are not relevant to LRN as it does not depends on the short-run dynamics of the economy. Their test is critically depending on the order of integration of money and real series. In particular, a context of valid LRN test exists only when the order of integration of the money and real series is at least equal to one, and equal for both series. Furthermore, there should be no common trend exists within the two-variable set data.

Let m be the log of nominal Divisia money and y is the log of real output:

$$a(L)\Delta^{\langle m\rangle}m_t = b(L)\Delta^{\langle y\rangle}y_t + u_t$$
$$d(L)\Delta^{\langle y\rangle}y_t = c(L)\Delta^{\langle m\rangle}m_t + w_t \qquad (5)$$

where Δ represent the first difference operator, $a(L)$, $b(L)$, $c(L)$ and $d(L)$ are distributed lag polynomials in the lag operator L, with $a_0 = d_0 = 1$, and b_0 and c_0 are not restricted. $\langle m\rangle$ and $\langle y\rangle$ are the orders of integration of the money and real output. The LRN can be defined in terms of the long-run derivative (LRD) of y with respect to a permanent change in m as follows:

$$LRD_{y,m} \equiv \lim_{k\to\infty} \frac{\partial y_{t+k} / \partial u_t}{\partial m_{t+k} / \partial u_t} \qquad (6)$$

where $\lim_{k\to\infty} \partial m_{t+k} / \partial u_t \neq 0$. If $\lim_{k\to\infty} \partial m_{t+k} / \partial u_t = 0$, there will be no permanent innovations in the level of money and thus the neutrality propositions cannot be tested. $LRD_{y,m}$ expresses the ultimate impact of an exogenous money disturbance on y relative to that disturbance's ultimate impact on m.

There are permanent changes in both m_t and y_t when $\langle m\rangle \geq 1$ and $\langle y\rangle \geq 1$. If the variables have the same order of integration, $\langle m\rangle = \langle y\rangle$, $LRD_{y,m}$ can be treated as the long-run elasticity of y with respect to m and it can be evaluated using the impulse response representation of Equation (5). The special case occur when $\langle m\rangle = \langle y\rangle = 1$, then the $LRD_{y,m} = c(1)/d(1)$. LRN requires that $LRD_{y,m} = 0$ if y is a real variable.

When the error vector $(u_t\ w_t)'$ is iid $(0,\sigma^2)$, and the money supply is exogenous, the term $c(1)/d(1)$ is the Bartlett estimator of frequency-zero coefficient in a regression of $\Delta^{\langle y\rangle}y_t$ on $\Delta^{\langle m\rangle}m_t$, and it can be estimated by $\lim_{k\to\infty}\beta_k$, where β_k is the slope coefficient from the following regression:

$$\left[\sum_{j=0}^{k} \Delta^{\langle y \rangle} y_{t-j}\right] = \alpha_k + \beta_k \left[\sum_{j=0}^{k} \Delta^{\langle m \rangle} m_{t-j}\right] + \varepsilon_{kt} \tag{7}$$

LRN is testable when $\langle m \rangle = \langle y \rangle = 1$, and Equation (7) becomes:

$$(y_t - y_{t-k-1}) = \alpha_k + \beta_k (m_t - m_{t-k-1}) + \varepsilon_{kt} \tag{8}$$

The null hypothesis of LRN is $\beta_k = 0$. The rejection of the null hypothesis implies the deviation of LRN.

Quarterly time series of real GDP and Divisia money at two levels of aggregation (M1 and M2) from 1981Q1 to 2004Q4 were used in this study. Since the Divisia money data are not available, we need to construct them using the asset components and rates of return for each component asset. For real output, we use GDP deflated by CPI at a base year of 2000. All the data can be obtained from the Quarterly Statistical Bulletin of Malaysia published by Bank Negara Malaysia – the centre bank of Malaysia. All variables were in the natural logarithm form.

4. The Empirical Results

Since FS's test critically depends on the order of integration of the variables, the nonstationarity property of the data needs to be examined properly. In doing so, we utilize the augmented Dickey-Fuller (ADF) (Said and Dickey, 1984), PP (Phillips and Perron, 1988), and the stationarity KPSS (Kwiatkowski *et al*., 1992) tests to check for the presence of a unit root in the data. Results of the unit root tests are reported in Table 1. For the ADF and PP tests, it is clearly shown that the data are nonstationary in levels but contain a unit root in their first differences. Meanwhile, in the KPSS test, the null hypothesis of trend stationarity is rejected for all data in levels form. However, we cannot reject the null of level stationarity in the first differences of the data in KPSS test. As such, we conclude that the order of integration of the data is one, and therefore, the LRN restriction $c(1)/d(1)$ is thereby testable.

Table 1: Results of Unit Root Tests

Series	ADF	PP	KPSS
		Level	
Divisia M1	-1.816(0)	-1.662(3)	0.265(4)***
Divisia M2	-1.621(0)	-1.882(4)	0.189(4)**
Real GDP	-2.005(5)	-3.052(4)	0.187(4)**
		First Difference	
Divisia M1	-3.447(3)**	-10.655(4)***	0.095(4)
Divisia M2	-8.875(0)***	-8.913(3)***	0.100(4)
Real GDP	-4.752(4)***	-9.980(4)***	0.054(4)

Notes: Asterisks (**) and (***) denote significant at the 5% and 1% levels respectively. The optimal lag lengths for ADF, PP and KPSS tests were chosen based on Schwarz Information Criterion (SIC), Newey-West using Bartlett kernel and Schwert (1987) formula, where $k = [4(T/100)^{1/4}]$ respectively.

As stated by FS, a meaningful LRN is testable in the absence of cointegration between money and real output. The reason behind is that in order for money to be LRN with respect to real variable, it must exhibit instances of permanent change and that the respective stochastic trends driving monetary and real variables are uncorrelated in the long run. As reported in Table 2, the Johansen and Juselius (1990) cointegration test shows that we cannot reject the null hypothesis of no cointegration between real output and both Divisia M1 and M2. This further indicates that the conditions necessary for meaningful LRN test hold for our data.

Table 2: Results of Johansen and Juselius Cointegration Test

Series	k	λ-max		λ-trace	
		H_0: r=0	H_0: r≤1	H_0: r=0	H_0: r≤1
Divisia M1	5	2.652	0.235	2.887	0.235
Divisia M2	6	12.172	0.042	12.214	0.042

Notes: Asterisks (**) indicate significant at the 5% level. Lag selection is based on Schwarz Bayesian Criterion (SBC).

For the next step, we proceed to apply Equation (8) to test for LRN. The estimated results are then presented in graphical form in Figures 1 and 2. We found that the point estimates of β_k in Figures 1 and 2 tend to move away from the zero line as the lag length (k) increases. The 95 percent confidence bands do not include zero except for k < 2 for Divisia M1 and k < 5 for Divisia M2. This result implies that LRN does not hold in the economy of Malaysia when Divisia money is used. In particular, we notice that the Divisia monetary stimulus do have long-run positive impact on real output in Malaysia.

FIGURE 1: REAL GDP on DIVISIA M1: 1981:1-2004:4

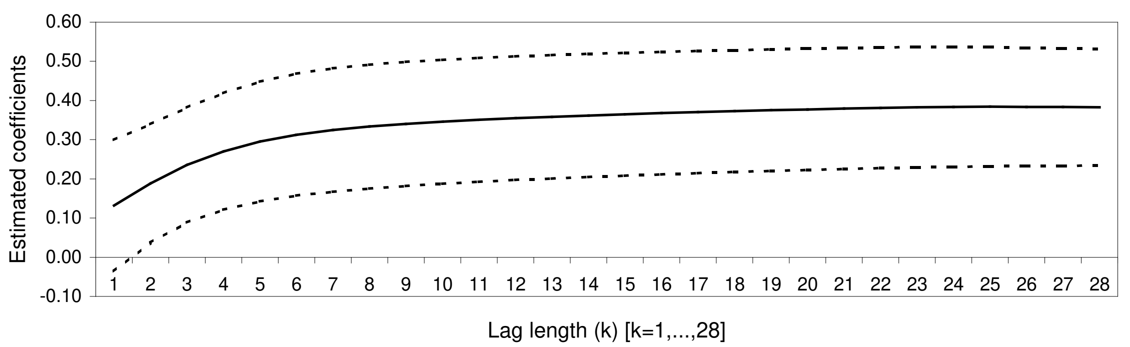
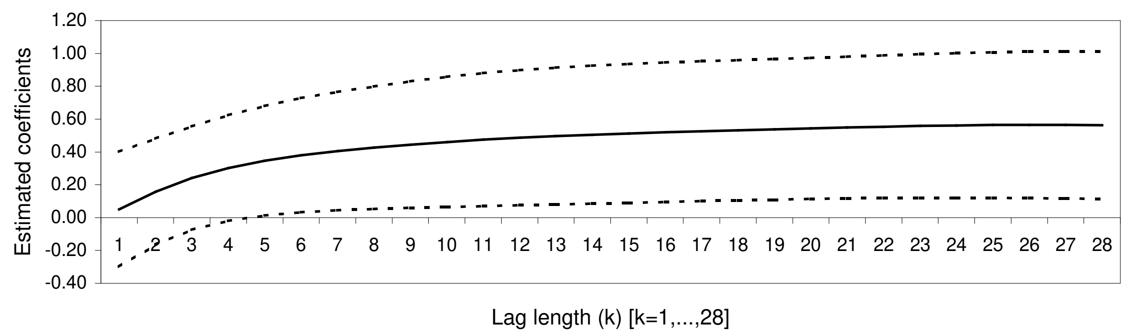


FIGURE 2: REAL GDP on DIVISIA M2: 1981:1-2004:4



5. Conclusion

In this paper, we re-examine the LRN of money study in Malaysia by Habibullah, *et al*. (2003) using Divisia monetary aggregates proposed by Barnett (1980). The purpose of our study is to provide alternatives to the monetary aggregates currently used by the Bank Negara Malaysia. Special attention has been given to the nonstationarity and cointegration properties of the data, since meaningful FS tests critically depend on such properties. We discover that all of the series are $I(1)$ and the Divisia money series do not cointegrated with real output. We found evidence against LRN, indicating the permanent shocks to the level of Divisia money do have important effect on real economic performance. Our finding is in line with Habibullah, *et al*. (2003) in which they found that the LRN hypothesis is not supported when quarterly official monetary aggregates are used. To conclude, this study provides empirical evidence that support the usefulness of the Divisia monetary aggregates as alternative intermediate variable for the case of Malaysia.

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References:

Bank Negara Malaysia. *Monthly Statistical Bulletin*, various issues. Kuala Lumpur: Bank Negara Malaysia.

Barnett, W.A. (1980). Economic monetary aggregates: An application of index number and aggregation theory. *Journal of Econometrics*, *14*(1), 11-48.

Diewert, W.E. (1976). Exact and superlative index numbers. *Journal of Econometrics*, *4*(2), 115-145.

Divisia, F. (1925). L'Indice Monétaire et la Théorie de Ia Monnaie. *Revue d'Economie Politique*, *39*, 980-1008.

Fisher, M.E., & Seater, J.J. (1993). Long-run neutrality and superneutrality in an ARIMA framework. *American Economic Review*, *83*, 402-415.

Habibullah, M.S., Mohamed, A., Puah, C.H., & Baharumshah, A.Z. (2002). The relevance of monetary aggregates for monetary policy purposes in Malaysia. *Borneo Review*, *13*(1), 1-12.

Hulten, C.R. (1973). Divisia index numbers. *Economnetrica*, *63*, 1017-1025.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimated and inference on cointegration with application to the demand for money. *Oxford Bulletin of Economics and Statistics*, *52*, 169-210.

Kwiatkowski, D., Phillips, P.C.B., Schmidt, P., & Shin, Y. (1992). Testing the null hypothesis stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root? *Journal of Econometrics*, *54*, 59-78.

Phillips, P.C.B., & Perron, P. (1988). Testing for a unit root in time series regression, *Biometrika*, *75*(2), 335-346.

Said, S.E., & Dickey, D.A. (1984). Testing for unit root in autoregressive-moving average of unknown order. *Biometrika*, *71*, 599-607.

Schwert, G.W. (1987). Effects of model specification tests for unit root in macroeconomic data. *Journal of Monetary Economics*, *20*, 73-103.

Tseng, W., & Corker, R. (1933). SEACEN study on monetary policy and financial reform. In A. Talid (Ed.). *Monetary policy in the SEACEN countries: An update*. Kuala Lumpur: The South East Asian Central Banks (SEACEN) Research and Training Centre.