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Money Supply, Stock Prices and the Efficient Market Hypothesis: The Case of Malaysia

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ABSTRACT

The purpose of the present study is to investigate the empirical relationships between money supply and stock prices in the Kuala Lumpur Stock Exchange (KLSE) using monthly data that span from January 1978 to September 1992. More specifically, we tested market informational efficiency in the KLSE by testing the causal relationships between money supply and stock prices using the cointegration technique. In the analysis, we used alternative monetary aggregates namely, the Simple-Sum and Divisia monies. Results from our error-correction model suggest that market informational efficiency hypothesis can be rejected for KLSE with respect to the growth of money supply (for both Simple-sum and Divisia monetary aggregates).

ABSTRAK

Tujuan kajian ini adalah untuk menentukan hubungan empirikal antara penawaran wang dengan harga-harga stok di Bursa Saham Kuala Lumpur (KLSE) menggunakan data bulanan daripada Januari 1978 hingga September 1992. Kajian ini lebih khusus menguji hipotesis kecekapan maklumat pasaran KLSE dengan menentukan hubungan penyebab antara penawaran wang dan harga-harga stok menggunakan teknik kointegrasi. Dalam analisa tersebut, agregat kewangan alternatif iaitu wang Campuran-mudah dan Divisia digunakan. Juga, indeks-indeks harga stok seperti indeks Komposit, Perusahaan, Kewangan, Perumahan, Perladangan dan Bijih Timah digunakan dalam kajian ini. Keputusan-keputusan daripada model-model pembetulan ralat yang dianggarkan mencadangkan bahawa hipotesis kecekapan maklumat pasaran terhadap pertumbuhan-pertumbuhan penawaran wang boleh ditolak untuk KLSE.

INTRODUCTION

Following the work of Sprinkel (1964), several studies have attempted to test statistically the reaction of the stock market to changes in money supply. The money supply-stock market nexus has been widely tested because of the belief that money supply changes have important direct effects through portfolio changes, and indirect effects through their effect on real activity variables, which in turn have been postulated to be fundamental determinants of stock prices.[1] Nevertheless, given the importance of money in the determination of stock prices, an important question to ask is: How efficient do stock market participants incorporate the information contained in money supply changes into stock prices? The answer is important because if the market is inefficient with respect to relevant dissemination of information, then investors can earn consistently higher than normal rates of return and furthermore, it raises serious doubts about the ability of the stock market to perform its fundamental role of directing funds to the most productive sectors of the economy.

More importantly is the question: Do different measures of money supply give different effects on stock prices? A summary of the impact of alternative definitions of money supply used in the recent money supply-stock market nexus are presented in Table 1. As shown in Table 1, the presence or the absence of lead-lag relationships between money supply and stock prices are sensitive to the choice of the definition of money supply used. Take the case of Mookerjee (1987), where for Canada, the stock market is efficient with respect to narrow money supply M1, but with broad money supply M2, the results suggest that money supply is the leading indicator for the stock price. Furthermore, results from Thornton (1993), Ho (1983) and Jones and Uri (1987) point to the same conclusion that stock market is sensitive to the different measures of money supply. This has led us to infer that a different choice of definition of money supply can give a different impact on the stock prices.

In Malaysia, the choice of definition of money supply is important because more recently, the Central Bank of Malaysia has noted that broad money supply, M2 and M3 have been given greater emphasis as the intermediate target for monetary management (Bank Negara Malaysia, 1985).[2] Although the Central Bank of Malaysia has given greater emphasis to the use of broad money M2 and M3 as guides for monetary policy purposes, the effectiveness of M2 and M3 as monetary instruments is still subject to empirical investigation. For example, in a recent study, Ghosh and Gan (1994) have questioned the role of broad money M3 as a monetary instrument, and they conclude that, 'the broad concept (M3) does not slot well with the Malaysian economy where the more relevant stock of money seems to be the conventional and narrow one (M1).'

The conclusion arrived at by Ghosh and Gan (1994) is not without support. Habibullah (1992) investigates the effectiveness of money M1, M2 and M3 as a result of financial sophistication and financial innovations in Malaysia by testing the Gurley-Shaw hypothesis. Gurley and Shaw (1960) have hypothesised that the presence of interest-bearing financial assets offered by non-bank financial intermediaries would increase the interest rate elasticity of money demand and as a result will hinder the effectiveness of M1, M2 and M3 for monetary policy purposes. Habibullah (1992) concludes that the Malaysian monetary data do not support the Gurley-Shaw contention that changes in the financial markets and the growth of money substitutes will increase the interest elasticity of money demand for M1, M2 and M3. This results imply that money supply M1, M2 and M3 have been stable for the period under study and the Central Bank of Malaysia may used all three definitions of money supply for monetary policy purposes. Therefore, excluding M1 for monetary management is uncalled for.[3] In other words, Habibullah's (1992) study indicate that money supply M1, M2 and M3 are equally good monetary instruments affecting economic conditions in Malaysia.

Therefore, the present study is important at least for two reasons. First, it is interesting to know whether money supply, M2 and M3 are important macroeconomic variables from the viewpoint of the market participants. If broad money supply is an important source of information in their decision making process, then stock prices should have incorporated this information. Secondly, it is important for the monetary authority to know whether money supply, M2 and M3 have an impact on the stock market. If M2 and M3 are not leading indicators for the stock market, then other measures of money supply should be preferred. In other words, M2 and M3 will not have a systematic lagged effect or any economic importance to an efficient market.

METHODOLOGY

The Traditional Granger Causality Tests

Traditionally, to test the informational efficiency of the stock market, the causality test developed by Granger (1969) was used. A direct test of Granger causality between stock price (S) and money supply (M) amounts to estimating the following equations:

$$\Delta S_t = \alpha_0 + \Sigma_{i=1}^{k} \alpha_i \Delta S_{t-i} + \Sigma_{j=1}^{N} \beta_j \Delta M_{t-j} + \mu_{1t} \quad (1)$$

$$\Delta M_t = \gamma_0 + \Sigma_{i=1}^{k} \gamma_i \Delta S_{t-i} + \Sigma_{j=1}^{N} \delta_j \Delta M_{t-j} + \mu_{2t} \quad (2)$$

Table 1
Summary of Previous Studies on Money Supply and Stock Market Relationship

Authors	Periods	Money	Countries	Conclusions
Mookerjee (1987)	Monthly (1975:1-1985:3)	M1	France, USA, Germany, Netherlands.	Independent
			Japan, Italy, Switzerland.	Unidirectional $(M \rightarrow S)$
			Canada.	Unidirectional $(M \leftarrow S)$
			UK.	Bidirectional $(M \Leftrightarrow S)$
		M2	France, USA, Germany, Switzerland.	Independent
			Japan, Italy, Canada.	Unidirectional $(M \rightarrow S)$
			UK, Netherlands.	Unidirectional $(M \leftarrow S)$
	Quarterly (1975:1-1985:1)	M1	France, USA, Japan, Switzerland, Netherlands, UK, Germany, Belgium.	Independent
			Italy.	Unidirectional $(M \rightarrow S)$
			Canada.	Unidirectional $(M \leftarrow S)$
		M2	France, USA, Japan, Switzerland, Netherlands, Germany, Belgium.	Independent
			Italy, Canada.	Unidirectional $(M \rightarrow S)$
			UK.	Unidirectional $(M \leftarrow S)$
Thornton (1993)	Quarterly (1963:1-1990:4)	M0	UK.	Independent
		M5	UK.	Unidirectional $(M \leftarrow S)$
Ho (1983)	Monthly (1975:1-1980:12)	M1	Hong Kong.	Independent
			Australia, Singapore, Thailand.	Bidirectional $(M \Leftrightarrow S)$
			Japan, Philippines.	Unidirectional $(M \rightarrow S)$
		M2	Singapore.	Bidirectional $(M \Leftrightarrow S)$
			Australia, Hong Kong, Japan, Philippines, Thailand.	Unidirectional $(M \rightarrow S)$
Jones and Uri (1987)	Monthly (1974:5-1983:10)	MB	USA.	Unidirectional $(M \rightarrow S)$
		M1	USA.	Unidirectional $(M \rightarrow S)$
		M2	USA.	Independent

where μ_{1t} and μ_{2t} are independent, and $E[\mu_{1t},\mu_{1s}]=0, E[\mu_{2t},\mu_{2s}]=0$, and $E[\mu_{1t},\mu_{2s}]=0$, for all $t\neq s$.

From equations (1) and (2), unidirectional causality from stock price to money supply can be established if the estimated coefficients on the lagged stock price variables are significantly different from zero in equation (2), and the estimated coefficients on the lagged money supply variables as a group are not significantly different from zero in equation (1). This finding would imply informational efficiency. Causality from money to stock prices would be implied if the estimated coefficients on the lagged money supply variables as a group are significantly different from zero in equation (1), and the coefficients of the lagged stock price variables as a group in equation (2) are not significantly different from zero. This finding would suggest informational inefficiency.

If, however, the estimated coefficients of the lagged variables of both stock price and money supply as a group in equations (1) and (2) are significantly different from zero, then bi-directional causality is implied between stock prices and the money supply. This finding would also imply stock market inefficiency. Finally, if the estimated coefficients on the lagged variables of both stock price and money supply as a group in equations (1) and (2) are not significantly different from zero, then no causality is implied between stock price and money and the two series are not temporally related to each other and are independent. This finding would imply market efficiency.

The Error Correction Model Approach

When estimating equations (1) and (2), the series are required to be in their stationary form. Conventionally, the variables are transformed in their first-difference form in order to induce stationarity or using some filter rule due to Box and Jenkins' (1970) approach. However, Granger and Newbold (1977) have pointed out that the danger in differencing the data is that there is loss of potential valuable long-run information contained in the variable expressed in levels. More recently, Engle and Granger (1987) have demonstrated that if two non-stationary variables are cointegrated, a vector autoregression in the first-difference is mis-specified. [4] It was shown in ranger (1988) that, if S_t, M_t are both I(1), but are cointegrated, then they will be generated by an error-correction model of the following form:

$$\Delta S_t = -\theta_1 z_{1,t-1} + \text{lagged}[\Delta S_t, \Delta M_t] + \varepsilon_{1t} \quad (3)$$

$$\Delta M_t = -\theta_2 z_{2,t-1} + \text{lagged}[\Delta S_t, \Delta M_t] + \varepsilon_{2t} \quad (4)$$

where one of θ_1, $\theta_2 \neq 0$ and ε_{1t}, ε_{2t} are finite-order moving averages. Thus, in the error-correction model, there are two possible sources of causation of S_t by M_{t-1} either through the z_{t-1} term, if $\theta_1 \neq 0$, and through ΔM_t term if they are present in the equation. Without z_{t-1} being explicitly used, the model will be mis-specified and the possible values of lagged M_t in forecasting S_t will be missed. Rewriting equations (1) and (2) in order to take into account the error-correction term, we have the following error-correction model (Granger 1988),

$$\Delta S_t = \alpha_0 + \sum_{i=1}^{k} \alpha_i \Delta S_{t-i} + \sum_{j=1}^{N} \beta_j \Delta M_{t-j} - \theta_1 z_{1,t-1} + \mu_{1t} \quad (5)$$

$$\Delta M_t = \gamma_0 + \sum_{i=1}^{k} \gamma_i \Delta S_{t-i} + \sum_{j=1}^{N} \delta_j \Delta M_{t-j} - \theta_2 z_{2,t-1} + \mu_{2t} \quad (6)$$

where z_{t-1} is the lagged residual from the cointegration regression between stock price and money supply in level. Granger (1988) points out that, based on equation (5), the null hypothesis that M does not *Granger cause* S is rejected not only if the coefficients on the lagged money supply variables are jointly significantly different from zero, but also if the coefficient on z_{t-1} is significant. The error-correction model also provides for the finding that M *Granger cause* S, if z_{t-1} is significant even though the coefficients on lagged money supply variables are not jointly significantly different from zero. Furthermore, the importance of α's and β's represent the short-run causal impact, while θ gives the long-run impact. In determining whether S *Granger cause* M, the same principle applies with respect to equation (6).

The Test for the Order of Integration

Before we estimate equations (1) and (2), however, we have to determine whether the z_{t-1} terms in equations (5) and (6) are valid. To ascertain the validity of the z_{t-1} term, we estimate that the cointegrating regressions comprise the two variables, that is, S_t and M_t. If the residual z_t of the linear combination of S_t and M_t is I(0), then z_{t-1} should be included in equations (1) and (2) and therefore equations (5) and (6) are appropriate for the Granger causality testing. If on the other hand, z_t is not I(0), then equations (1) and (2) are appropriate in the Granger causality testing approach.

However, before the cointegrating regressions can be estimated, we have to determine the order of integration of the series of interest. An integrated series needs to be differenced in order to achieve stationarity. A time series Y_t, that requires no such differencing to obtain stationarity is denoted as $Y_t \sim I(0)$. Therefore, an integrated series such as $Y_t \sim I(2)$ is said to be growing at an increasing rate, $Y_t \sim I(1)$ series appear to grow at a constant rate while $Y_t \sim I(0)$ series appear to be trendless. Thus, if two time series Y_t and X_t are integrated in a different order, say $Y_t \sim I(2)$ and $X_t \sim I(1)$ respectively, then they must be drifting apart over time. Therefore, a regression of Y_t on X_t would encounter a spurious regression problem, as the residual would also be I(2); this will violate the underlying assumptions of ordinary least squares (OLS). Thus, it is important to determine that the time series of interest have the same order of integration before we proceed into further estimation.

If on the other hand, the two time series Y_t and X_t are both I(1) then it is normally the case that a linear combination between the two will also be I(1) so that a regression of Y_t on X_t would produced spurious results. This is because the residual is also I(1), and it violates the assumptions of OLS. In a special case, however, a linear combination of two I(1) variables will result in a variable (residual) which is I(0) and in this special case, the two series are said to be cointegrated. This regression is permissible since the residual is I(0) or stationary, as it satisfies the underlying assumption of OLS.

In this study we employed unit root tests to determine the order of integration of the individual series. This is because only variables that are of the same order of integration may constitute a potential cointegrating relationship. We employed the Augmented Dickey and Fuller (1981) unit root test. The test is the *t*-statistic on parameter α of the following equation:

$$\Delta S_t = \delta_0 + \alpha S_{t-1} + \Sigma_{i=1}^{L} \delta_i \Delta S_{t-i} + \nu_t \qquad (7)$$

where ν_t is the disturbance term. The role of the lagged dependent variables in the Augmented Dickey-Fuller (ADF) regression equation (7) is to ensure that ν_t is white noise. Thus, we have to choose the appropriate lag length, L. In this study we used Schwert's (1987, 1989) criteria which is given by the following formulation:

$$L_4 = \text{int}\{4(T/100)^{1/4}\} \qquad (8)$$

where T is the total number of observations.

The null hypothesis, H_0: S_t is I(1), is rejected (in favour of I(0)) if α is found to be negative and statistically significantly different from zero. The computed *t*-statistic on parameter α, is compared to the critical value tabulated in MacKinnon (1991). If a time trend is also included in equation (7), we have the following equation (9), which is used to determine whether the series is trend-stationary (TS),:

$$\Delta S_t = \delta_0 + \theta t + \beta S_{t-1} + \Sigma_{i=1}^{L} \delta_i \Delta S_{t-i} + \tau_t \qquad (9)$$

where t is a time trend. If parameter β is negative and significantly different from zero then S_t is said to be trend-stationary. The difference between a difference-stationary process (DSP) and a trend-stationary process (TSP) is that, the former requires differencing to achieve stationarity (Dickey and Fuller, 1979). For TSP, however, stationarity is achieved by inclusion of a time trend variable. It is important to check for the correct form of non-stationary behaviour of the time series because a difference-stationary process which is stochastic cannot be cointegrated with a trend-stationary process which, on the other hand, is deterministic. Nelson and Plosser (1982) have demonstrated that many economic time series appear to be difference-stationary processes.

However, a formal test to check whether S_t has a stochastic trend but not a deterministic trend is to use the standard likelihood ratio test, Φ_3 (see Dickey-Fuller, 1981). The estimated value of Φ_3 is then compared with the critical value of Φ_3 tabulated in Dickey and Fuller (1981). If the calculated Φ_3 is less than the critical value of Φ_3, we cannot reject the null hypothesis that, H_0: $\beta=0$ and $\theta=0$. On the other hand, to test that S_t has a stochastic trend, not a deterministic trend and no drift is to test the null hypothesis that, H_0: $\beta=0$, $\theta=0$ and $\delta=0$, and calculate Φ_2. If the estimated value of Φ_2 is less than the critical value of Φ_2 in Dickey and Fuller (1981), we may conclude that S_t is a random walk with no drift.

The unit root tests were also carried out for first-difference of the variables, that is, we estimate the following regression equation:

$$\Delta^2 S_t = \delta_0 + \alpha S_{t-1} + \sum_{i=1}^{L} \delta_i \Delta^2 S_{t-i} + \omega_t \qquad (10)$$

where the null hypothesis is H_0: S_t is I(2), which is rejected (in favour of I(1)) if α is found to be negative and statistically significantly different from zero.

The Cointegration Test

After determining that the series are of the same order of integration, we test whether the linear combination of the series that are non-stationary in levels are cointegrated. To conduct the cointegration test, we follow Engle and Granger's (1987) two-step procedure for testing the null of no cointegration. In the first step, we run the following cointegrating regression:

$$S_t = \gamma_0 + \gamma_1 M_t + \eta_t \qquad (11)$$

and in the second step, the ADF unit root test is conducted on the residual η_t as follows,

$$\Delta\eta_t = \alpha\eta_{t-1} + \varepsilon_t \qquad (12)$$

The null hypothesis is H_0: $\alpha=0$, that is S_t and M_t are not cointegrated by means of t-statistic of parameter α. The critical value is tabulated in MacKinnon (1991). If t_α is smaller than the critical value, then S_t and M_t is said to be cointegrated. In this study, we also follow Engle and Granger (1987) in reporting the following cointegrating regression which the Durbin-Watson (CRDW) statistic computed as follows:

$$CRDW = [\Sigma_{t=2}^{N}] (\eta_t - \eta_{t-1})^2] / [\Sigma_{t=1}^{N} \eta_t^2] \qquad (13)$$

The null hypothesis of no cointegration is rejected for values of CRDW which are significantly different from zero. The critical values for CRDW are tabulated in Engle and Yoo (1987).

Data Used in the Study

In this study we used monthly time series data for the Kuala Lumpur Stock Exchange (KLSE) stock price indices, namely; the Composite, Industrial, Finance, Property, Plantation and Tin stock indexes. The KLSE stock indices were collected from various issues of the Investors Digest published monthly by KLSE. On the other hand, money supply M1 comprises currency in circulation and demand deposits held by non-bank private sector; M2 comprises of M1 plus saving deposits, fixed deposits, and negotiable certificate of deposits at commercial banks; and M3 comprises of M2 plus saving deposits, fixed deposits, and negotiable certificate of deposits at finance companies, Bank Islam, merchant banks and discount houses. Data on monetary aggregates were taken from various issues of the Quarterly Bulletin published by Bank Negara Malaysia. In this study the data used spans from January 1978 to September 1992. All data used in the analysis are transformed into natural logarithm.

DISCUSSION OF EMPIRICAL RESULTS

Results of the Integration Tests

Table 2 presents the results of the unit root tests on the levels and first-differenced of the series. Following Schwert (1987, 1989), the truncation lag length chosen was based on the integer portion of the value of L, that is, $L_4=\text{int}\{4(T/100)^{1/4}\}$ and T is the number of observations. With T=105, we have $L_4=4$. The results for estimating equation (9) shows that none of the series are able to reject the null hypothesis of unit root. In all cases the test statistic t_β is larger than the critical value of -3.45 tabulated in MacKinnon (1991) at five percent level of significance. These results imply that the view that the series are a trend-stationary process can be rejected. The results are also supported by Φ_3, where in all cases the estimated Φ_3 is smaller than the critical value tabulated in Dickey and Fuller (1981). On the other hand, the significance of Φ_2 in most cases indicate the presence of drift term. This implies that estimating equation (7) is more appropriate in this case. The test statistic t_α derived from estimating equation (7) shows that the null hypothesis of unit root cannot be rejected for all series. These results clearly indicate that all series are non-stationary in their level form.[5] Furthermore, the significance of Φ_2 strongly suggest the series have unit root with drift.

On the other hand, the lower-half of Table 2 shows the results of unit root tests for first-differenced of the series. MacDonald (1990) and Perron (1988) have noted that since it was expected *a priori* that differencing would have removed the trend, the appropriate estimating equation is then equation (7). As shown in Table 2, none of the series are able to reject a unit root in first-differenced. The t_α test statistics for all series are significantly different from zero at five percent level. We thus conclude that all series are of the same order of integration, that is, they are all I(1) processes.

Results of Cointegration Tests

The bivariate cointegration tests are presented in Table 3. For CRDW, in all cases, the null hypothesis of no cointegration cannot be rejected. The calculated CRDW values are smaller than that of the critical value tabulated in Engle and Yoo (1987) at five percent level of significance. Similar results can also be concluded from t_α test statistics. In all cases, the calculated t_α test statistics are larger than the critical value tabulated in MacKinnon (1991). The above results obviously suggest that money supply, M1, M2 and M3 and stock prices in the Kuala Lumpur Stock Exchange are not cointegrated. This implies that in the long-run the efficient markets hypothesis cannot be rejected for the Kuala Lumpur Stock Exchange.

The non-cointegration results imply that the traditional granger causality test using equations (1) and (2) are in order. The results of the Granger causality analysis using K and N equal 3 are presented in Table 4. The *F*-statistics are calculated as follows:

$$F^*_{(N,T\text{-}K\text{-}N\text{-}1)} = [(SEE_1 - SEE_2)/N] \;/\; [SEE_2/(T\text{-}K\text{-}N\text{-}1)] \qquad (14)$$

where SEE_1 is the sum of squared errors from the restricted equation (1) with the restriction that all β's equal zero. SEE_2 is the sum of squared errors of the unrestricted equation (1). T is the number of observations and K and N are the truncation lag length chosen. Under the null hypothesis, the calculated F^* is distributed as F with (N, T-K-N-1) degrees of freedom. For a suitably large F^*, we can reject the null hypothesis that Y does not *Granger cause* X. As indicated by the results in Table 4, in all cases there is no evidence to show in the short-run that money *Granger cause* stock prices and *vice versa*. Interestingly, these results are consistent with most countries like France, USA, Germany, Netherlands and Switzerland in Mookerjee (1987).

Further Analysis with the Error Correction Model (ECM)

More recently, it has been recognised that the univariate analysis presented above has low power (for example, ADF and CRDW) and has led Jenkinson (1986) and Banerjee et al. (1986)

Table 2
Results of Integration Tests

Series	Based on equation (2)			Based on equation (1)	
	t_β	Φ_2	Φ_3	t_α	Φ_2
A. Series in Level Form					
Composite	-2.69	2.68	3.34	-2.03	2.74
Industrial	-2.93	3.52	4.50	-1.75	2.26
Finance	-2.68	3.92	4.47	-2.40	4.19
Property	-2.20	2.66	3.45	-2.34	3.06
Plantation	-3.30	4.87	6.73	-3.08	5.12
Tin	-2.97	2.97	4.44	-2.72	3.73
M1	-1.73	8.74	1.60	-0.81	11.73
M2	-1.81	8.84	1.95	-1.22	11.95
M3	-0.73	5.40	1.94	1.60	7.43
B. Series in First-Differenced					
Composite	-	-	-	-5.48	15.05
Industrial	-	-	-	-6.22	19.40
Finance	-	-	-	-5.48	15.05
Property	-	-	-	-5.13	13.17
Plantation	-	-	-	-5.93	17.65
Tin	-	-	-	-5.24	13.74
M1	-	-	-	-7.08	25.07
M2	-	-	-	-5.44	14.80
M3	-	-	-	-3.53	6.23

Note: Monetary data for M3 starts from January 1984 to September 1992. Critical values are from MacKinnon (1991). t_α and t_β at 5 percent level are -2.86 and -3.41 respectively.

Table 3
Results of Cointegration Tests

Cointegrating Regressions	CRDW	t_a
A. Money Supply, M1		
Composite=f(Money)	0.13	-2.91
Money=f(Composite)	0.09	-2.10
Industrial=f(Money)	0.20	-3.21
Money=f(Industrial)	0.17	-2.64
Finance=f(Money)	0.13	-2.47
Money=f(Finance)	0.10	-1.58
Property=f(Money)	0.06	-1.99
Money=f(Property)	0.03	-0.62
Plantation=f(Money)	0.14	-2.82
Money=f(Plantation)	0.08	-1.01
Tin=f(Money)	0.09	-2.85
Money=f(Tin)	0.01	-1.07
B. Money Supply, M2		
Composite=f(Money)	0.10	-2.72
Money=f(Composite)	0.06	-1.96
Industrial=f(Money)	0.13	-2.64
Money=f(Industrial)	0.09	-2.10
Finance=f(Money)	0.14	-2.62
Money=f(Finance)	0.12	-1.87
Property=f(Money)	0.06	-1.97
Money=f(Property)	0.03	-0.73
Plantation=f(Money)	0.15	-2.90
Money=f(Plantation)	0.09	-1.29
Tin=f(Money)	0.10	-2.96
Money=f(Tin)	0.01	-1.33
C. Money Supply, M3		
Composite=f(Money)	0.14	-3.05
Money=f(Composite)	0.09	-2.60
Industrial=f(Money)	0.13	-2.44
Money=f(Industrial)	0.09	-1.93
Finance=f(Money)	0.21	-2.94
Money=f(Finance)	0.10	-2.16
Property=f(Money)	0.09	-2.23
Money=f(Property)	0.02	-0.67
Plantation=f(Money)	0.21	-2.69
Money=f(Plantation)	0.01	-0.16
Tin=f(Money)	0.13	-2.97
Money=f(Tin)	0.01	-0.02

Note: Critical value for t_a at 5 percent level is -3.45 (MacKinnon, 1991). Critical value for CRDW at 5 percent level is 0.39 (Engle and Yoo, 1987).

Table 4
Results from the Traditional Granger Causality Tests

Stock Indices	Money	Money does not *Granger cause* stock price	Stock price does not *Granger cause* money	Conclusions
Composite	M1	*F* = 0.91	*F* = 0.88	Independent
	M2	*F* = 0.81	*F* = 0.18	Independent
	M3	*F* = 1.23	*F* = 0.88	Independent
Industrial	M1	*F* = 0.62	*F* = 0.48	Independent
	M2	*F* = 1.01	*F* = 0.19	Independent
	M3	*F* = 0.84	*F* = 0.95	Independent
Finance	M1	*F* = 0.43	*F* = 0.76	Independent
	M2	*F* = 0.96	*F* = 0.44	Independent
	M3	*F* = 0.89	*F* = 1.55	Independent
Property	M1	*F* = 0.60	*F* = 0.93	Independent
	M2	*F* = 0.99	*F* = 0.34	Independent
	M3	*F* = 0.73	*F* = 1.28	Independent
Plantation	M1	*F* = 1.03	*F* = 1.48	Independent
	M2	*F* = 0.29	*F* = 0.95	Independent
	M3	*F* = 1.24	*F* = 1.12	Independent
Tin	M1	*F* = 0.88	*F* = 2.06	Independent
	M2	*F* = 0.80	*F* = 0.29	Independent
	M3	*F* = 0.60	*F* = 1.23	Independent

Note: Critical value for *F*-statistic at 5 percent level is 2.60 for $F(3, \infty)$.

to recommend estimation of an error-correction model as a direct test for cointegration, and also as the starting point for modelling and testing. Jenkinson (1986) points out that the Engle-Granger two-step estimation procedure is a form of static cointegrating regression in which the residual exhibits an autoregressive pattern. Furthermore, Sargan and Bhargava (1983) have showed that the power of the CRDW test becomes very low as r approaches unity.[6]

As an alternative test for testing cointegration, therefore, the error-correction model is the appropriate approach. The ECM approach is derived from an important theorem presented by Engle and Granger (1987) that if a set of variables is cointegrated, then there always exists an error-correcting formulation of the dynamic model and *vice versa*. Using this approach, the residual from the cointegrating regression equation (11) is substituted into equation (5) and allowing for a simple reparameterised equation, the following regression is then re-estimated using OLS.

$$\Delta S_t = \phi_0 + \phi_1 \Delta M_t - \lambda ECM_{t-1} + \varepsilon_t \qquad (15)$$

Parameter λ is then evaluated to see whether it is significantly different from zero. The significance of the error-correction term (ECM_{t-1}) is sufficient enough to infer cointegration among the variables in question. Banerjee et al. (1986) have pointed out that the *t*-statistic of the error-correction term is a more powerful statistic for testing the null of unit root. Furthermore, they also showed that under the alternative of cointegration this *t*-statistic is more powerful than those of the Dickey-Fuller type tests.

The results of the error-correction model estimated for each of the stock price indices and money supply M1, M2 and M3 are presented in Table 5 respectively for Composite, Industrial, Finance, Property, Plantation and Tin. From Table 5, we observe that the ECM_{t-1} terms are significantly different from zero in all regressions estimated, and also in all equations, the coefficient of the error-correction term, ECM_{t-1}, has the correct negative sign and is significant, lending support to the finding that stock price and money supply M1, M2 and M3 are cointegrated, and in this case, money supply *Granger cause* stock price. These results imply that the KLSE market is inefficient with respect to money supply growth.

Is There a Role for Divisia Money in Malaysia?

It has been the general practice by central bankers worldwide to formulate monetary aggregates by adding various components of financial assets together. These aggregates are called "simple-sum" monetary aggregates. Barnett and his associates (Barnett, 1980; Barnett et al., 1984, 1992; Barnett and Chalfant, 1989, 1990; Hancock, 1987; Rotemberg, 1993) have showed that the traditional simple-sum approach is incorrect, as such, not suitable to measure the flow of monetary services. The simple-sum monetary aggregates implies that each component received equal weights and therefore is implicitly considered to be perfect a substitute. This is, however, not true in the real world. Furthermore, the existing literature on money substitutes have proven otherwise (Chetty, 1969; Boughton, 1984; Husted and Rush, 1984; Habibullah, 1991, 1988). Some financial assets have more 'moneyness' than others, and should be given more weights. The Divisia aggregates proposed by Barnett (1980) which was derived theoretically from the economic aggregation theory and first-order conditions for utility optimization has been found to be more appropriate to measure the flow of monetary services of a nation.

The recent studies by Barnett (1984), Serletis (1987), Hancock (1987), Barnett et al. (1984), Serletis and Atkins (1988), and Belongia and Chalfant (1989, 1990) on United States monetary data found that Divisia monetary aggregates are superior to the simple-sum in terms of stable velocity and its tractability to nominal income and price level. Similar conclusions were also found in other studies for other countries. Examples of these studies includes Ford et al. (1992) and Drake (1992) on the United Kingdom, Ishida (1984) and Suzuki (1987) on Japan, Fase (1988) on the Netherlands, Horne and Martin (1989) on Australia,

Table 5
OLS Estimates for the Error-Correction Representation, equation (15)

Stock Indices	Money	ϕ_0	ϕ_1	λ	R^2	S.E.	D.W.
Composite	M1	0.0057 (0.9038)	0.4411 (2.1046)**	0.0739 (-2.7346)**	0.06	0.080	1.74
	M2	0.0004 (-0.0679)	0.9175 (2.9165)**	0.0654 (-2.5772)**	0.07	0.080	1.75
	M3	0.0077 (-0.7383)	1.0484 (1.6032)	0.1028 (-2.7720)**	0.08	0.079	1.71
Industrial	M1	0.0043 (0.6858)	0.5155 (2.4403)**	0.1010 (-3.0213)**	0.07	0.080	1.81
	M2	0.0011 (-0.1642)	0.9112 (2.8414)**	0.0739 (-2.5962)**	0.06	0.081	1.84
	M3	0.0048 (-0.4863)	0.8444 (1.3413)	0.0792 (-2.2206)**	0.05	0.076	1.55
Finance	M1	0.0070 (1.0950)	0.4611 (2.1700)**	0.0770 (-2.9042)**	0.07	0.081	1.98
	M2	0.0020 (0.2872)	0.8262 (2.6464)**	0.0781 (-2.6849)**	0.07	0.081	1.97
	M3	0.0101 (-0.9852)	1.1443 (1.7724)*	0.1269 (-2.9048)**	0.10	0.078	1.89
Property	M1	0.0047 (0.6082)	0.5446 (2.1257)**	0.03612 (-1.8981)*	0.04	0.098	1.75
	M2	0.0036 (-0.4305)	1.1948 (3.1968)**	0.03441 (-1.8151)*	0.07	0.097	1.75
	M3	0.0180 (-1.4432)	1.4288 (1.8294)*	0.0622 (-2.0248)**	0.06	0.094	1.63
Plantation	M1	0.0015 (0.2707)	0.5562 (3.0318)**	0.0888 (-3.1324)**	0.10	0.070	1.87
	M2	0.0034 (-0.5703)	0.8948 (3.3166)**	0.0924 (-3.1462)**	0.10	0.070	1.86
	M3	0.0067 (-0.7368)	0.3999 (0.6958)	0.1252 (-2.7650)**	0.07	0.069	1.76
Tin	M1	0.0033 (-0.4793)	0.3099 (1.3658)	0.0520 (-2.2058)**	0.04	0.087	1.86
	M2	0.0053 (-0.7027)	0.4264 (1.2553)	0.0625 (-2.5485)**	0.04	0.087	1.87
	M3	0.0123 (-0.9913)	0.8125 (1.0441)	0.0737 (-2.0148)**	0.04	0.094	1.80

Note: **Statistically significant at 5 percent level (*t*-statistic = 1.960). *Statistically significant at 10 percent level (*t*-statistic = 1.645).

Yue and Fluri (1991) on Switzerland, Driscoll et al. (1985) on Austria, and McCann and Giles (1989) on New Zealand.

An early attempt to investigate the relationship between Divisia money and stock prices was conducted by Habibullah and Baharumshah (1993) for Malaysia,[7] and Serletis (1993) for the United States. These results are summarised in Table 6. Both studies conclude that Divisia money and stock market are independent. In other words, the efficient market hypothesis cannot be rejected. In this study we provide new evidence on the relationship between Divisia money and stock prices in Malaysia. Apart from using the Composite stock price index as in Habibullah and Baharumshah (1993), we tested the Divisia money M1 and M2 with other sectoral stock prices, namely Industrial, Finance, Property, Plantation and Tin.[8]

Divisia Money and Stock Prices: Some New Evidence

The Divisia monetary series were subjected to the test of integration followed by the test for cointegration. These results are presented in Table 7 for the unit root testing and Table 8 for the cointegration test. Unit root test for the order for integration suggests that all Divisia money series are I(1). In other words, the Divisia monetary series are non-stationary in their level form; and the results of cointegration presented in Table 8 indicate that the linear combination between the Divisia money and stock prices are non-stationary. This imply that the two series, that is Divisia M1 and M2 and the stock prices in the KLSE are not cointegrated. These results are similar to our earlier analysis between stock prices and simple-sum monetary aggregates.[9]

The non-cointegration between Divisia money and stock prices lead us to estimate the traditional Granger causality test. The results are reported in Table 9. We observe that in all cases, the null hypothesis that money does not *Granger cause* stock prices and *vice versa* cannot be rejected. The results are again consistent with the simple-sum monetary aggregates.

We next test the relationship between Divisia money and stock prices with the error-correction model discussed earlier. The results are presented in Table 10. It was shown that in all cases the ECM_{t-1} terms are significantly different from zero. Furthermore, the coefficient of the error-correction term show the correct negative sign and this will suggest cointegration between the two series and that Divisia money does affect stock prices at the KLSE. These results are consistent with the simple-sum M1 and M2 which imply that Malaysian stock market are informationally inefficient with respect to money supply. In this case, simple-sum M1, M2 and M3, and Divisia M1 and M2 can be used to predict the growth of the stock prices in the Kuala Lumpur Stock Exchange.

CONCLUSION

This paper has applied recent developments in the theory of non-stationary regressors to analyse the empirical relationships between money supply M1, M2 and M3, measured in both simple-sum and Divisia monetary aggregates (except for Divisia M3), and the stock prices in the Kuala Lumpur Stock Exchange. The results suggest that (i) except for the Plantation index, all other stock price indices and monetary aggregates are non-stationary in their level form, (ii) using the approach suggested by Jenkinson (1986) and Banerjee et al. (1986), our results indicate that there exists an error-correction representation between the money supply (both simple-sum and Divisia) and stock prices, relating the changes in the variables to lagged changes and a lagged combination of levels, and (iii) the error-correction model suggest that money supply *Granger cause* stock prices, and (iv) comparing the performance of the two simple-sum and Divisia monetary aggregates and stock prices, we cannot distinguish between the two, whether one is superior to the other. These results suggest that the efficient market hypothesis can be rejected for the Kuala Lumpur Stock Exchange with respect to the growth of money supply.

The above results have important implications to both the market participants as well as the monetary authority. To the market participants, an inefficient market with respect to

Table 6
Summary of Previous Studies on Divisia Monetary Aggregates and Stock Prices

Authors	Periods	Money	Countries	Conclusions
Serletis (1993)	Monthly			
	(1970:1-1988:5)	*Sum* M1	USA.	Independent
		Sum M2	USA.	Independent
		Sum M3	USA.	Independent
		Sum L	USA.	Independent
		Div M1	USA.	Independent
		Div M2	USA.	Independent
		Div M3	USA.	Independent
		Div L	USA.	Independent
Habibullah and	Monthly	*Sum* M1	Malaysia.	Independent
Baharumshah (1993)	(1978:1-1992:7)	*Sum* M2	Malaysia.	Independent
		Div M1	Malaysia.	Independent
		Div M2	Malaysia.	Independent

Note: *Sum* denotes 'simple-sum' monetary aggregate, and *Div* denotes Divisia monetary aggregate.

Table 7
Unit Root Tests for Divisia Monetary (DM) Series

Series	Based on equation (2)			Based on equation (1)	
	t_β	Φ_2	Φ_3	t_α	Φ_2
A. Series in Level Form					
DM1	-1.73	9.35	1.60	-0.79	12.61
DM2	-2.31	15.04	4.24	-2.17	20.38
B. Series in First-Differenced					
DM1	-	-	-	-7.12	25.90
DM2	-	-	-	-6.43	20.69

Note: Critical values are from MacKinnon (1991). t_α and t_β at 5 percent level are -2.86 and -3.41 respectively.

Table 8
Results of Cointegration Tests for Divisia Money and Stock Prices

Cointegrating Regressions	CRDW	t_α
A. Money Supply, DM1		
Composite=f(Money)	0.13	-2.87
Money=f(Composite)	0.09	-2.03
Industrial=f(Money)	0.20	-3.15
Money=f(Industrial)	0.16	-2.57
Finance=f(Money)	0.13	-2.44
Money=f(Finance)	0.11	-1.53
Property=f(Money)	0.06	-1.97
Money=f(Property)	0.03	-0.57
Plantation=f(Money)	0.14	-2.81
Money=f(Plantation)	0.08	-0.99
Tin=f(Money)	0.09	-2.86
Money=f(Tin)	0.01	-1.07
B. Money Supply, DM2		
Composite=f(Money)	0.11	-2.73
Money=f(Composite)	0.07	-2.02
Industrial=f(Money)	0.15	-2.83
Money=f(Industrial)	0.12	-2.35
Finance=f(Money)	0.14	-2.66
Money=f(Finance)	0.12	-1.94
Property=f(Money)	0.06	-2.00
Money=f(Property)	0.03	-0.81
Plantation=f(Money)	0.15	-2.97
Money=f(Plantation)	0.09	-1.42
Tin=f(Money)	0.10	-2.91
Money=f(Tin)	0.01	-1.47

Note: Critical value for t_α at 5 percent level is -3.45 (MacKinnon, 1991). Critical value for CRDW at 5 percent level is 0.39 (Engle and Yoo, 1987).

Table 9
Results from the Traditional Granger Causality Test for Divisia Money and Stock Prices

Stock Indexes	Money	Money does not *Granger cause* stock price	Stock price does not *Granger cause* money	Conclusions
Composite	DM1	$F = 0.82$	$F = 0.49$	Independent
	DM2	$F = 0.92$	$F = 0.23$	Independent
Industrial	DM1	$F = 0.60$	$F = 0.29$	Independent
	DM2	$F = 0.87$	$F = 0.10$	Independent
Finance	DM1	$F = 0.46$	$F = 0.38$	Independent
	DM2	$F = 0.48$	$F = 0.11$	Independent
Property	DM1	$F = 0.71$	$F = 0.65$	Independent
	DM2	$F = 0.75$	$F = 0.48$	Independent
Plantation	DM1	$F = 0.47$	$F = 1.16$	Independent
	DM2	$F = 0.43$	$F = 0.74$	Independent
Tin	DM1	$F = 0.77$	$F = 1.17$	Independent
	DM2	$F = 0.57$	$F = 0.29$	Independent

Note: Critical value for F-statistic at 5 percent level is 2.60 for $F(3, \infty)$.

Table 10
OLS Estimates for the Error-Correction Representation for Stock Prices and Divisia Money (DM)

Stock Indices	Money	ϕ_0	ϕ_1	λ	R^2	S.E.	D.W.
Composite	DM1	0.0060 (0.9429)	0.4043 (1.9585)*	0.0730 (-2.7177)**	0.05	0.080	1.74
	DM2	0.0017 (0.2597)	0.7283 (2.7017)**	0.0647 (-2.5338)**	0.06	0.080	1.75
Industrial	DM1	0.0045 (0.7161)	0.4843 (2.3282)**	0.0996 (-2.9976)**	0.07	0.081	1.82
	DM2	0.0004 (0.0647)	0.7804 (2.8569)**	0.0830 (-2.7588)**	0.07	0.080	1.84
Finance	DM1	0.0075 (1.1623)	0.4017 (1.9180)*	0.0777 (-2.9211)**	0.06	0.081	1.99
	DM2	0.0033 (0.4966)	0.7153 (2.6333)**	0.0820 (-2.8442)**	0.08	0.081	1.98
Property	DM1	0.0053 (0.6831)	0.4671 (1.8491)*	0.0363 (-1.9091)*	0.04	0.090	1.75
	DM2	0.0012 (-0.1526)	0.9983 (3.0682)**	0.0350 (-1.8505)*	0.06	0.097	1.77
Plantation	DM1	0.0023 (0.4231)	0.4473 (2.4600)**	0.0903 (-3.1626)**	0.08	0.071	1.87
	DM2	0.0034 (-0.5945)	0.9132 (3.9355)**	0.0945 (-3.2488)**	0.12	0.069	1.88
Tin	DM1	0.0024 (-0.3526)	0.2045 (0.9143)	0.0519 (-2.1925)**	0.03	0.087	1.87
	DM2	0.0054 (-0.7512)	0.4525 (1.5508)	0.0572 (-2.3924)**	0.04	0.086	1.87

Note: **Statistically significant at 5 percent level (*t*-statistic = 1.960). *Statistically significant at 10 percent level (*t*-statistic = 1.645).

the growth of money supply will indicate that in the long-run investors will be able to predict stock prices in the Kuala Lumpur Stock Exchange using information on the growth of money supply as the trading rule and can consistently earn excess returns. As to the monetary authority, in the long-run, money supply M1, M2 and M3 (both simple-sum and Divisia) can be useful monetary instruments in affecting the stock market when the need arises. These results suggest that there is a role for the Divisia monetary aggregates as additional monetary policy instruments in Malaysia.

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ENDNOTES

1. It is beyond the scope of the present paper to analyse the precise ways in which money supply can affect stock prices. However, an excellent discussion on how money growth can affect stock prices are provided by Homa and Jaffee (1971), Hamburger and Kochin (1972), Cooper (1974) and Rozeff (1974).

2. As a result of financial liberalisation and sophistication in the Malaysian financial system, the shift from narrow money to broad money was significant in 1985. The Governor of the Central Bank of Malaysia states that, "Of late, the task of monetary policy has been complicated by structural changes in the demand for money. Traditionally, monetary management by the Central Bank was centered on narrow money or M1, that is, currency holdings and demand deposits of the non-bank private sector. However, the behaviour of M1 in 1984 and 1985 was affected significantly by growing sophistication in the financial system and increasing sensitivity to interest rates, which caused large shifts out of currency holdings and demand deposits into interest-bearing deposits not only with the commercial banks, but also the finance companies, merchant banks, and other financial institutions. As a result, the broader definitions of money, M2 and M3, have become increasingly important in terms of a more stable and predictable relationship with underlying economic activity. Reflecting these developments, Bank Negara has now placed greater emphasis on the behaviour of M2 and M3 in monetary management (Bank Negara Malaysia, 1985)."

3. The Gurley-Shaw hypothesis was also rejected for other countries. These include the study by Cagan and Schwatz (1975) and Hafer and Hein (1984) for United States, Chowdhury (1989) for Canada, and Darrat and Webb (1986) for India.

4. The concept of cointegration was first introduced by Granger (1981). The cointegration methodology provides a way in which the long run information of the integrated series in level is conserved into equations that comprise stationary components called the error correction model that gives valid statistical inferences. For any I(*1*) series, it is always true that the linear combination of the two series will also result in an I(*1*). However, if there exists a constant A, such that $z_t = S_t - AM_t$ is stationary or I(*0*), then S_t and M_t will be said to be cointegrated, with A as the cointegrating parameter. If this were not the case, then the variables assumed to be generating the equilibrium could drift apart, which is contrary to the equilibrium concept. If S_t and M_t are I(*1*) but cointegrated, then the relationship $S_t = AM_t$ is considered a long run or 'equilibrium' relationship, and z_t given above measure the extent to which the system S_t, M_t are out of equilibrium

(Granger, 1986). Hence, the existence of a linear combination of two I(*1*) series that is I(*0*) suggests that the series generally move together over time, such that the relationship holds in the long run.

5. The test statistics t_α and t_β are *t*-statistics of parameter α and β in equations (7) and (9) respectively.

6. From Table 3, we can compute ρ using the expression *CRDW=2(1-ρ)*, and the first-order autoregressive coefficient is very close but not equal to one in each of the cointegrating regression. These values ranges from 0.89 for Finance=f(M3) and Plantation=f(M3), to 0.99 for M1=f(Tin), M2=f(Tin), and M3=f(Tin).

7. The first attempt to investigate Divisia monetary aggregates in Malaysia is found in Habibullah (1992). See Appendix A for further discussions on the long-run relationships between Divisia money and income in Malaysia.

8. In this study we do not compute Divisia M3 because data on interest rates and quantity deposits of merchant banks, Bank Islam and discount houses are not available. In Habibullah (1992), the Divisia M3 were calculated based on definition of M3 which comprised of M2 plus saving and fixed deposits at Employee Provident Fund and National Saving Bank. Rate of returns for these deposits are also available.

9. The construction of the Divisia monetary aggregates are presented in Appendix A.

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APPENDIX A
DIVISIA MONEY AND INCOME AND ITS CONSTRUCTION

Divisia Money and Income in Malaysia: Is There a Long-Run Relationship?

Despite the voluminous research on Divisia money available in the literature, research in the theory and practice of Divisia monetary aggregates in the developing countries is rather lacking. An attempt for Malaysia was conducted by Habibullah (1992). Using annual data for the period 1960 to 1990, the Divisia monetary aggregates for M1, M2 and M3 were constructed and used in the analysis. Its performance was compared to the traditional simple-sum monetary aggregates. In his study, Habibullah (1992) tests the stability of the monetary velocities for both simple-sum and Divisia M1, M2 and M3, using the unit root test approach. For stable monetary velocities, the series must possess a single unit root.

The results of the unit root test using the augmented Dickey-Fuller tests for series in levels, first-differenced and second-differenced are presented in Table A1. Results for series in levels and first-differenced clearly indicate that, except for simple-sum M3, monetary velocities which include simple-sum M1 and M2 and Divisia M1, M2 and M3 are I(1) difference-stationary process. As for simple-sum M3, the results indicate that the series contain two unit roots. These results imply that the Malaysian monetary velocities for both simple-sum M1 and M2 and Divisia M1, M2 and M3 are stable for the period 1960 to 1990, and furthermore these results find nothing to distinguish any of the monetary aggregates as indicators of long-run trends in inflation, as each measure apparently exhibits a stable growth rate of velocity for the period under study. On the other hand, for M3, the result suggest that Divisia M3 are to be preferred compared to simple-sum M3 for monetary policy purposes.

The performance of the monetary aggregates are further tested by checking how close the relationships are between the alternatives monetary aggregates with income (measured by gross national product, GNP). A good monetary indicator is one that can predict the growth in national income. Habibullah (1992) tests this relationship using the Granger causality approach. The Granger causality test results are reported in Table A2. The results are rather interesting as they indicate that there is a role for Divisia money in Malaysia. The results clearly show that there is a unidirectional relationship between money and income as both simple-sum and Divisia M1 *Granger cause* GNP. As for M2 and M3, only in the case of Divisia monetary aggregates that show money supply *Granger cause* national income, implying a unidirectional causality between money and GNP. On the other hand, a bidirectional causality is detected between simple-sum M2 and M3, and GNP. For monetary policy purposes then, simple-sum M1 and Divisia M1, M2 and M3 should be preferred to the simple-sum monetary aggregates of M2 and M3.

Construction of Divisia Monetary Aggregates

According to Barnett (1980), a Divisia monetary aggregate can be computed from the Divisia index as follows:

$$\log[DM_t/DM_{t-1}] = \Sigma_{i=1}^{N} w_{it}\{\log[M_{it}/M_{it-1}]\} \quad (A1)$$

where the weight, $w_{it} = 0.5(s_{it}+s_{it-1})$, and s_{it} is the expenditure share on component i, during period t. In order to derive the weight, w_{it}, we are required to compute the expenditure share, s_{it} as $s_{it} = (p_{it}M_{it})/(S_j p_{jt} M_{jt})$. Following Barnett (1978), the user cost, p_{it} is calculated from $p_{it} = (R_t - r_{i,j})/(1+R_t)$, and R_t is the maximum $[r_j, r_i, i=1,2...N. j=1,2...K. i \neq j]$. Table A3 shows the information used in calculating the rate of return on i-th monetary components and the user cost in order to compute the Divisia money M1 (DM1) and M2 (DM2). The monetary data on rate of returns are compiled from various issues of the Quarterly Bulletin published by Bank Negara Malaysia.

Table A1
Augmented Dickey-Fuller Tests on Monetary Velocities

Monetary velocities with alternative money measures	Levels t_α	Levels t_β	First-Differenced t_α	Second-Differenced t_α
Simple-Sum M1	-0.68	-2.34	-3.88	-
Divisia M1	-0.81	-2.34	-3.65	-
Simple-Sum M2	-1.38	-0.76	-3.67	-
Divisia M2	-0.42	-2.67	-3.81	-
Simple-Sum M3	-1.59	-0.61	-2.43	-5.10
Divisia M3	0.18	-2.61	-3.43	-

Note: Critical values for t_α and t_β at 5 percent level are -2.97 and -3.57 respectively (MacKinnon, 1991).

Table A2
Causality Results Between Money and Income

Alternative Monetary Aggregates	Money does not *Granger cause* GNP	GNP does not *Granger cause* money	Conclusions
Simple-Sum M1	$F = 39.08^*$	$F = 0.44$	$M \rightarrow Y$
Divisia M1	$F = 41.49^*$	$F = 0.49$	$M \rightarrow Y$
Simple-Sum M2	$F = 5.90^*$	$F = 3.43^*$	$M \Leftrightarrow Y$
Divisia M2	$F = 10.26^*$	$F = 0.46$	$M \rightarrow Y$
Simple-Sum M3	$F = 4.63^*$	$F = 4.43^*$	$M \Leftrightarrow Y$
Divisia M3	$F = 13.56^*$	$F = 0.50$	$M \rightarrow Y$

Note: Critical value for F-statistic at 5 percent level is 3.42 for $F(2, 23)$.

Table A3
Information Use in the Calculation of User Costs

Component Assets	r_{it} (Rates of Return)	
1 Divisia M1:		
Currency	zero	
Demand Deposits	$\{[r_L - (r_L/(r_{brsd} + r_{brfd12}))].(DD/BA)\}$ where r_L, DD and BA are average lending rate, demand deposits and total assets of the commercial banks respectively (see Habibullah, 1989).	
2. Divisia M2:		
Saving Deposits	r_{brsd}	(saving deposit rate at commercial bank)
One Month Fixed Deposits	r_{brfd1}	(one-month FD rate at commercial bank)
3 - Month Fixed Deposits	r_{brfd3}	(3-month FD rate at commercial bank)
6 - Month Fixed Deposits	r_{brfd6}	(6-month FD rate at commercial bank)
9 - Month Fixed Deposits	r_{brfd9}	(9-month FD rate at commercial bank)
12 - Month Fixed Deposits	r_{brfd12}	(12-month FD rate at commercial bank)
Negotiable Certificate of Deposits	r_{dr}	(discount rate)

3. User Cost, p_{it}

$p_{it} = [R_t - r_{it,jt}] / [1 + R_t]$

and $R_t = \max [r_{jt}, r_{it}; i \neq j; i=1,2...N; j=1,2...K]$

where r_{jt} = 5-year and 20-year government security rates; r_{it} = saving deposit rate and fixed deposit rates (3, 6, 9, and 12-month) at Finance Companies, interbank rate and 7-days Call Money rate.

Note: Authors' calculation.