Reassessing The Stability of Broad Money Demand in Malaysia

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Abstract

This paper re-examines the money demand in Malaysia covering the period from 1974 to 2001, a period characterised by various events particularly the financial sector liberalisation, changes in monetary framework and currency crises. Our results support the existence of fairly stable long-run money demand function despite the various changes and developments in the economy. However, there is an evidence of instability in short-run money demand. On this ground, the monetary targeting framework in Malaysia seems to be appropriate at least in the 1990s and monetary aggregate continue to be a useful longer-term indicator in the formulation of monetary policy.

Keywoods: cointegration; error-correction model; money demand; Malaysia.

1. Introduction

Although long-run stability of money demand is traditionally found in the empirical literature, short-run instability might appear because of portfolio adjustment in response to financial innovations and market deregulations. Many countries, developed and developing, therefore, have de-emphasized the importance of monetary aggregates in conducting monetary policy and base their monetary policy on a combination of indicators such as the exchange rate, nominal GDP or the inflation rate.

Malaysia has gone through similar experience, which includes liberalisation of interest rates, rapid financial innovations and various monetary policy frameworks. The financial liberalization begins with the deregulation of deposit and lending rates in 1978. The process, however, is not uninterrupted. In 1983, the authority introduced the base-lending rate (BLR), to which the banks were required to peg their lending rates. The Central Bank then, requires pegging interest rates for deposit of up to 12-month maturity to that of two leading domestic banks was issued in 1985. This requirement was then abandoned in 1987. In 1991, the BLR was then liberalised in that each bank can determined its own BLR and finally was replaced by intervention rate in 1998. In addition, prior to 1980s, the conduct of monetary policy initially focused on the movement of narrow money (M1). Then, shifted to broader monetary aggregates, initially to M2 in early 1980s, and subsequently to M3 in late 1980s. With further financial liberalisation and innovation, Bank Negara Malaysia (BNM) has shifted away from money supply targeting to a new monetary framework, which now targets interest rates.

Beside the numerous changes in the conduct of monetary policy and development of financial liberalisation, a second interesting feature is that Malaysia has recently been an open economy which exposes the demand for money to external shocks. Certainly, events like financial deregulations and currency crises in Malaysia and elsewhere in the world in the 1990s could have caused large capital inflows and outflows. One obvious question thus is what impact these events had on the stability of Malaysian money demand. In particular, what is the role of exchange rate in determining demand for money and what is the impact of the shift in exchange rate regime. The other question that interesting to investigate is the impact of financial sector changes following rapid financial deregulation and liberalisation on the dynamic behaviour of money demand, particularly, the impact on financial sector deepening and increase financial innovation on the estimated long-run income elasticity and interest rate sensitivity and the role of inflation on influencing the money demand function in Malaysia.

Surprisingly, these questions have not been addressed in great detail in previous literature except for few studies that have been conducted to evaluate the stability of money demand but covered a shorter period of data, did not explicitly address the role of exchange rate and the impact of recent event of currency crisis on the stability of money demand. Among recent studies on Malaysian money demand include Sriram (1999), Ibrahim (1998 and 2001), Tan (1997) and Marashdeh (1997).

This paper is organised as follows: Section 2 and 3 give a selective review of theoretical approaches to examination of money demand and the empirical literature on money demand for Malaysia economy. This section describes the main themes in the literature and summarises the parameter estimates. Section 4, describes the data sets and choice of variables. Section 5 performs the unit root tests for stationarity and Johansen test for cointegration and develops an error-correction model of money demand. In Section 6 and 7, offer some policy implications and concluding remarks.

2. Theoretical Framework of The Demand for Money

2.1. Quantity theory

According to classical economics, all markets are in equilibrium and is always a full employment. The role of money is simple: it serves as the numeraire, that is, a commodity whose unit is used in order to express prices and values, but whose own value remains unaffected by this role (Sriram, 1999). It also facilitates the exchange of goods. Money is "neutral" with no consequences for real economic activity.

The quantity theory emphasized a direct and proportional relationship between money and price level. This relationship was developed in classical equilibrium framework by two alternative but equivalent expressions:

1. *"Equation of exchange " - associated with Irving Fischer's equation:*

$$MV = PT \qquad (1)$$

   where M is the quantity of money in circulation, V is "transactions velocity of circulation of money", T is the volume of transactions and P is the price level. Money is held only to facilitate transactions and has no intrinsic utility.

2. *"Cambridge approach or cash balance approach" - associated* with the Cambridge University economists, especially A.C. Pigou. This alternative paradigm relates the quantity of money to nominal income and stresses the role and importance of money demand in determining the effect of money supply on the price level. Money is held not only as a medium of exchange as in Fischer's case, but also as a store of value that provides satisfaction to its holder by adding convenience and security. Cambridge economists pointed out the role of wealth and the interest rate in determining the demand for money.

2.2 Keynesian Theory

In a Keynesian economy, the most important relationship is the relationship between economic growth and the level of investments. This relationship is related to demand for money, where demand for money induces the money supply. In the long run, money demand and money supply are balanced. In comparison with monetary approach, Keynesian theory assigns to the monetary policy a lower efficiency in the effects on economic development.

Keynes postulated that the individuals hold money with three motives: The *transactions-motive,* i.e. the need of cash for the current transaction of personal and business exchanges. The transactions demand for money arises because of the no synchronization of payments and receipts. Secondly, the *precautionary-motive* provides a contingency plan for unscheduled expenditures during unforeseen circumstances. Finally, the *speculative-motive* - *i*.e. "the object of securing profit from knowing better than the market what the future will bring forth. The speculative demand for money is what Keynes called as "liquidity preference." The theory of "liquidity preference" provides an answer to why economic entities demand and hold money that does not yield any interest, instead of securities or similar assets.

Keynes adopted the *transactional motive* from the monetarist approach of the Cambridge school and considered the fact that a part of the demand for money is associated with transactions related to income developments.

The *speculative motive* of money possession is introduced by Keynes. Formal, Keynes's approach can be written as follows:

$$M = L_1(Y) + L_2(i) \qquad (2)$$

where L_1, expresses the transactional and precautionary motive, L_2 expresses the speculative motive of liquidity preference, Y is nominal GDP and i is the interest rate (Keynes, 1936). These motives exert influence simultaneously and are mutually independent and consequently M is a total money demand.

Keynes considered only nominal level of money demand. After Keynes, according to Dornbusch and Fischer (1994) "people possess money because of its purchasing power, i.e. the quantity of goods and services that they can purchase with money", what means that we must consider the real level of money demand.

2.3 Neo-Keynesian theory of money demand

The neo-Keynesian interpretation of the money demand is based on Keynes's principles. The transactional motive and precautionary motive are expressed as directly proportional to income. The demand for money for the speculative motive is dependent to interest rates. Formally, such dependence can be formulated as:

$$M_{da} = kY \text{ and } M_{ds} = \alpha - \beta i \qquad (3)$$

where M_{da} is demand for active balances, k is the share of active balances in GDP, Y is nominal GDP, M_{ds}, is speculative demand for money, α and β are parameters and i is the interest rate.

The relationship between GDP and precautionary demand for money should be formulated as anti-cyclical instead of pro-cyclical, similar to the transactional motive. Thus, the demand for money can be expressed as follows:

$$M_d = L(Y, i) \qquad (4)$$

where M_d is demand for money, L is the "liquidity preference function", Y is nominal GDP, and i is an interest rate. This approach was developed by Baumol (1952) and Tobin (1956) to an approach based on the possession of money as inventory, where the transactional motive of liquidity preference is particularly emphasized. Results of such considerations lead to the well-known formula:

$$M_d / P = \sqrt{cY / 2i} \qquad (5)$$

where M_d is demand for real balances, c is transactional costs, Y is real GDP *and i* is the interest rate. The Baumol-Tobin model assumption of cost stability in a transaction (c -parameter) is not realistic in the long run.

2.4 Post-Keynesian theories of money demand

Two characteristics of money demand provide the starting point for many of these theories. In transactions models inventory models assume the level of transactions to be known and certain and in the precautionary demand models net inflows are certain. The special characteristics of money lead to formulation of theories that are based on explicit motives to holding it. Post-Keynesian economics emphasizes the role of uncertainty associated with the historical developments of the economy and puts the demand-for-money concept into a broader context.

The volume of money in the economy is the result of a demand and supply process interaction. Through its instruments, the central bank is able to influence the conditions for issuing loans due to the impact of such instruments on interest rate developments. Additionally, the behaviour of the banking sector towards economic entities applying for loans is significantly influenced by institutional characteristics of the banking sector. In this context, an important role is maintained by banking regulation and banking supervision.

Post-Keynesian economics differs from neo-Keynesian especially in the inclusion of the financial motive in the demand for money. The financial motive reflects the fact that entrepreneurs must maintain certain money balances in the course of time, so that they are able to meet their liabilities when entering future contracts associated with the purchase of inputs necessary for the production. If the planned investments do not change, the money balances will remain permanent; if they increase additional financial demand for money is created. In this approach, the demand for money is usually expressed in nominal terms. For transformation to the real demand for money form, it is necessary to consider inflation.

Most economists, however, ignore the fourth motive of holding money balances (i.e. financial motive). Philip Arestis is one important post-Keynesian scholars working on the demand for money theory. In his article discusses the demand for money in a small, open economy. His approach to the demand for money can be expressed using the following equation:

$$M_d = K(Y_r)^a (P^e)^{-b} (CR)^{-c} (ER^e)^{-d} \mu \qquad (6)$$

r where M_d are real money balances, K is the Cambridge coefficient, which is a function of GDP growth, prices and the volume of money in circulation and is expressed by reversed value of money velocity, Y_r is real GDP, P^e is the expected rate of inflation, CR is an estimated variable for credit limitations, ER^e is the expected appreciation or depreciation rate of the currency, u is a non-systematic component and a, b, c, and d are elasticity values.

2.5 Modern monetarist approach

The monetarist approach analysis is based on the assumed direct influence of the volume of money in the economy and nominal income, usually expressed by nominal GDP. In monetary approach of the economy, money plays a primary role with the money supply being a decisive factor. Modem monetarists withdrew from the notion of an exclusive tie between the demand for money and nominal income. They emphasize the influence of both interest rates and yields of other tangible and financial assets.

Among of modem monetarists, Milton Friedman refreshed the traditional quantitative money theory in the Cambridge version. According to Friedman, development of the demand for money depends on the overall wealth of society in various forms (money, bonds, securities, material and human resources) as well as on the taste and preferences of holders of the wealth.

Stability of demand-for-money development is an important assumption on which Friedman and other monetarists base their expansions of the theory. Formally, the demand for money in Friedman's concept may be expressed as follows:

$$M_d = F(Y, W, r_m, r_e - r_m, r_b - r_m, \frac{1}{P}\frac{dp}{dt}, \mu) \qquad (7)$$

where M_d is demand for real money balances, Y is the overall wealth, W is a share of accumulated human resources in the overall wealth, r_m is the expected money yield, r_b is the expected yield of bonds, r_e is the expected yield of securities, $\frac{1dp}{Pdt}$ is the expected change in commodity prices and u is the influence of other factors. The equation (7) indicates the wide range of Friedman's view of demand-for-money issues.

3. Empirical Study on Money Demand for Malaysia Economy

The demand for money in Malaysia has been studied by a number of authors for the past two decade. Earlier papers mostly attempted the partial adjustment framework (PAM) in a closed-and open-economy context.[2] However, the discussion in our study does include these types of literature in comparing the magnitude and signs of various coefficients of the arguments of the money demand function because the PAM as the estimation tool of demand for money has been subject to severe criticism. It is more appropriate to compare the results obtained in this study, which applied the error-correction model (ECM) framework to analyse the demand for money in Malaysia. In that regard, our study discusses the salients features of and results from Sriram (1999), Ibrahim (1998 and 2001), Tan (1997) and Marashdeh (1997). Table 1 summarises the contents of these papers and a few other relevant studies on money demand in Malaysia using the ECM framework.

[Table 1]

These studies have contributed to the understanding of money demand behaviour in Malaysia. However, while they generally indicate structural instability in money demand function, no attempt has been made to include the broadest measure of money, M3 within a longer time period. Furthermore, most of the studies do not address the important of opportunity costs variables such as expected inflation and exchange depreciation to be included in the estimation.

4. The Data and Choice of Variables

All series are quarterly observations expressed in natural logarithms except the interest rates which are expressed in percent per annum. The sample period runs from 1974 to 2001, coincide with the shift in the exchange rate regime and initiation of liberalisation of economic and financial policies. The data source is from the Bank Negara Monthly Statistical Bulletin. The data used in this work include M3

[2] For example, Semudram (1981), Fischer (1983), Yahya (1984a and 1984b), Anuar (1986a and 1986b), Habibullah (1987, 1988 and 1990), Jusoh (1987), Gupta and Moazzami (1990).

measure of broad money (m_t), the real GDP (y_t), the own-rate of money measured by 3-month fixed deposit rate (sr_t), the 3-month Treasury Bill rate (tb_t), real effective exchange rate index (rer_t) and consumer price index (p_t). All series are not seasonally adjusted because such pre-filtering may affect short-term dynamics and exert adverse effects on the power of the unit root and cointegration tests[3]. To correct for seasonality, a set of dummies variables is included.

The present analysis is based on an open-economy money demand function augmented to include real exchange rate and expected inflation as an argument. To begin, the function is represented as:

$$rm_t = \alpha_0 + \beta_1 y_t + \beta_2 sr_t + \beta_3 tb_t + \beta_4 rer_t + \beta_5 \pi_t^e \qquad (8)$$

where rm_t is real money balances demanded; y_t is measured real income; sr_t is own rate of money; tb_t is opportunity cost of holding money with respect to other financial assets; rer_t is real exchange rate and π_t^e is expected inflation rate.
The M3 measure of broad money is chosen because it includes the private sector savings and fixed deposits placed with commercial banks (including Bank Islam Malaysia Bhd), finance company, merchant banks and discount houses, and private holdings of NCD and Central Bank Certificates but excludes placements among these institutions) and it is the broadest measure of private sector liquidity. The choice of real GDP and the CPI deflator as the scale variable and price variables respectively, is standard in existing empirical work on money demand, though alternative measures such as consumption and wealth are also frequently found.

The selection of opportunity cost variables is the most important aspect of modelling the demand for money. The vector of rates of return includes a set of interest rates on assets of the same maturity. Since we use broad money aggregate, it is unreliable to assume that money is not interest bearing. The chosen own rate of return on money is the 3-month fixed deposit rate while the 3-month Treasury Bills rate is chosen as the return on alternative assets. Most of the studies of money demand in

[3] See Ghysels (1990), Davidson and MacKinnon (1993) and Ericsson *et al.* (1994).

Malaysia (Sriram, 1999, Dekle and Pradhan, 1999 and Tan, 1997) utilised Treasury Bills as alternative domestic financial assets for two reasons; first, the market for it is sufficiently liquid in Malaysia and data are available for longer time period.

Instead of using the interest rate as the only opportunity cost of holding money, many researchers have also proxies it with the inflation or expected inflation rate. The expected inflation is proxied by actual inflation (Honohan, 1994). These are supported by diverse factors among others are, poorly developed financial markets, interest rate has a ceiling imposed by central bank and real assets are likely to play a significant role in individual's portfolio choice especially in many developing economies.

There are also wide ranging discussions in the literature regarding the inclusion of both real and financial assets inn argument of money demand function. Since recent studies show that moderate inflation level can exert significant influence on money demand (Baba *et al.*, 1988) and the level of nominal interest rate may not fully incorporated expected inflation rate (Laidler and Parkin, 1975), thus both variables are included in the model.

The exchange rate is normally included as an open-economy to capture the effect for currency substitution in the economy[4]. Its impacts on the domestic demand for money, however, can either be negative or positive. In particular, if the currency depreciation leads public to anticipate further depreciation, than it exerts a negative influence on money demand. By contrast, if depreciation is anticipated, then the exchange rate has positive influence on the money demand (Bahmani-Oskoee and Pourheydarian, 1990). Moreover, if the currency depreciation increases the value of foreign assets held by domestic residents and accordingly, wealth, the money demand could has increased (Arize *et al.*, 1999)[5].

[4] In the money demand literature, various measures of exchange rates have been used. These include nominal effective exchange rate (Bahmani-Oskoee *et al.*, 1998), real effective exchange rate (Chowdhury, 1997), bilateral vis-à-vis the US dollar (Arize *et al.*, 1999) and expected exchange rate (Khalid, 1999).

[5] Given that the exchange rate is found to have a unit root, thus the exchange rate expectations are formed irrationally.

The dummy variable is needed to represent the status of interest rate regime in the economy. Since Malaysia introduced certain discrete policy changes in addition to carrying out a steady pace of reform over decades, a dummy variable DumInt will be introduced to take account the status of the interest rate regime in the country. An impulse dummy, Dum94 is additionally added because government introduced temporary control measures to mop-up excess liquidity from the banking system caused by heavy capital flows in 1994. In addition, additional impulse dummy, Dum98 is also added to represent temporary imposition of capital control and change in exchange rate regime from managed-float to fixed exchange rate regime in 1998.

5. Estimating Money Demand

5.1 Testing for Unit Roots

We begin our empirical analysis by analysing the order of integration of the variables. Inspection of the data suggests that the different time series might have a unit root. The Augmented Dickey-Fuller (1981) test is performed to test for unit roots (including a constant and a time trend) for the sample period 1974 to 2001. The lag length is chosen based on sequential approach (Banerjee *et al.,* 1993) whereby the significance of a constant and a trend is chosen by the conventional t-distribution. If the trend is significant, then retain these variables and checked the significance of lagged terms by t-distribution, where the lag length is originally set at five. Then determine the lag length as the highest lag that is significant within five lags.

[Insert Table 2]

Table 2 shows that the hypothesis of a unit root at level for all variables cannot be rejected at 5 percent level of significant. The tests reject the null hypothesis of a unit root when the variables are measured in first differences.

In order to confirm the results of the traditional unit root test, the variables are also subjected to further examination by means of the stationary test suggested by Kwiatkowski *et al.* (1992)[6]. As shown in columns 4 and 5 of Table 2, the null hypothesis can be rejected for both level stationarity (with constant and no trend in the auxiliary test regression) and trend stationarity (with both constant and a trend) but not for their first differences except for inflation rate, which confirms that these variables can be modelled as integrated of order (1).

5.2 Cointegration Tests

In order to determine the number of cointegrating vectors, representing the long-run relations between the level of the series by means of the Johansen (1988) and Johansen and Juselius (1990) procedures. Accordingly, we estimate a VAR model for real money holdings of M3, real GDP, short-term interest rate, real exchange rate and the inflation rate. The criterion for selecting the optimal lag length consists of choosing the number of lags that are needed to eliminate the vector autocorrelation in the residuals. F-tests of sequential elimination of lags established that the inclusion of three lags for each variable is appropriate. The model includes an unrestricted constant, seasonal dummy and allows for linear trend in the variables but not in the cointegration relationship. The test results in Table 3 reveal that at least one cointegrating vector is present in the data and all diagnostic tests are satisfactory.

The relationship implies that in the long-run real money demand are positively related to income and own rate of return and negatively related to short-term interest rate, exchange rate and inflation. On the basis of the sign of coefficients, we interpret the cointegrating relation as describing the long-run demand for real money and can be written as follows:

$$rm_t = 1.09\,y_t + 0.14\,sr_t - 0.10\,tb_t - 1.79\,rer_t - 4.21\,\pi_t^e \qquad (9)$$

[6] Stationarity tests are useful in that they allow to explicitly test the null hypothesis of stationarity and also access to what extent the non-rejection of non-stationarity in unit root tests may be related to the lack of power of these tests (De Jong *et al.*, 1992).

The signs and magnitudes of the long-run estimated coefficients also appear quite plausible on theoretical grounds. The long-run income elasticity is estimated to be close to unity at 1.09. The estimated long-run income elasticity reflects the growing degree of monetization of the Malaysia economy over time, the continuous improvement made to banking infrastructure over the year and the relatively small number of alternative assets, notably the shallowness of financial assets. Equation (9) also provides an explanation for downward trending behaviour of income velocity of M3 in term of two main factors, firstly, the income elasticity of money demand higher than one and secondly, the significant fall in the inflation rate in the 1990s. Moreover, finding of a larger than unity income elasticity in developing economy is not uncommon (Blejer *et al.*,1991).

Meanwhile, the coefficient on the domestic interest rate is positive as parts of M3 are remunerated. The rate of return of other financial instrument and inflation depress money demand as suggested by theory. Specifically, the semi-elasticity of the own rate of return and return on other financial assets is almost similar in magnitude at 0.14 and –0.10 respectively, while the elasticity of inflation is higher at –4.21. These indicate that agent has more incentive to shift away from money holdings to real assets than other financial instruments when inflation is expected to rise.

[Insert Table 3]

The elasticity of exchange rate is –1.79 and higher than the elasticity of interest rate. The sign shows that the depreciation of Malaysia ringgit would lead to currency substitution as expected for small open economy. This also suggests that depreciation in domestic currency leads to wealth gain from holding assets in foreign denomination in anticipation of further depreciation. Hence, a lower demand for domestic money balances. However, it might also reflect the impact of movement of capital flows on exchange rate. That is, further depreciation could result an outflow of capital and at the same time, might also result in a decline in holding of domestic money balances, either through a decline in net external liabilities of the banking system or holdings of deposits by foreign residents.

5.3 Test of Weak Exogeneity

The test of weak exogeneity permits one to draw inferences from the cointegration relationship that is obtained earlier to examine whether the short-run demand for money could be modelled in a reduced-form. Since one cointegrating relationship has been identified, the weak exogeneity tests are evaluated under the assumption of rank (r) = 1. It is usually examined by restricting the ECM 'loading' coefficients in the system equal to zero (Johansen, 1992). The exogeneity test, as reported in Table 3 suggests that all variables except real money balances (rm_t), are weakly exogenous. Hence, a single equation of short-run demand can be estimated with a single error-correction term entering the equation[7].

5.4 Single-Equation Estimates

Based on the weak exogeneity tests, a single equation unrestricted reduced form model is formulated to analyse the dynamics for money demand function. Since all variables are I(0), the above model can be estimated by the OLS. The results of unrestricted money demand equation are shown in Table 4.

[Insert Table 4]

The short-run model provides information concerning how the dependent variables, that is real money demand, adjusts to restore long-run equilibrium in response to disturbances in demand for money through error-correction term. The error-correction term is calculated from the cointegrating vector representing in the short-run dynamic. The significant EC term carrying a negative sign conveys two pieces

[7] It is also interesting to find that only real money *(rm)* is an endogenous variable. This suggests that only *rm* will adjust towards monetary disequilibria.

of information; agents would correct in the current period a proportion of previous disequilibrium money balances and it assures that the cointegration relationship established previously is valid. In economic term, it represents excess money in the previous period.

The unrestricted model is then reduced into a parsimonious model by following the general-to-specific principles and by applying full-information maximum likelihood (FIML) techniques. The parsimonious model (parentheses indicate t-statistic) can be written as follows:

$$\begin{aligned} \Delta rm_t = \; & \underset{(5.61)}{0.02} + \underset{(2.71)}{0.26}\Delta rm_{t-1} + \underset{(2.03)}{0.19}\Delta rm_{t-2} + \underset{(1.75)}{0.13}\Delta y_t - \underset{(-2.15)}{0.05}\Delta tb_t - \underset{(-3.81)}{0.24}\Delta \pi_t^e \\ & - \underset{(-1.83)}{0.11}\Delta \pi_{t-1}^e - \underset{(-1.98)}{0.05}ECM_{t-1} + \underset{(1.77)}{0.01}Dum94 - \underset{(-1.89)}{0.01}Dum98 \\ & - \underset{(-5.27)}{0.03}seasonal(1) - \underset{(-3.62)}{0.02}seasonal(2) \end{aligned} \qquad (10)$$

$R^2 = 0.41$
S.E. $= 0.02$

The error-correction term incorporating the long-run equilibrium is significant, but the adjustment parameter is very small. According to this estimate the adjustment after a shock to the long-run relationship takes place very slow and it influences the actual money growth rate only slightly. The coefficient of equilibrium correction term indicates that about 5% of the equilibrium is eliminated each the quarters. Hence, the tendency to return to equilibrium after shock is very weak. The adjustment in case of Malaysia seems to be rather slow in comparison with other estimates probably because relatively there are fewer alternatives for money although more financial instruments have been introduced in late 1980s and in early 1990s.

On the other hand, surprisingly, the exchange rate variable and own rate of return do not enter as short-run determinants of the M3 money demand function. This may reflect that the exchange rate movement may only shift the demand for domestic currency to foreign currency when the instability in the exchange rate is perceived as fundamental and long-term phenomenon. In the case of Malaysia, the own rate of return is not an important consideration in portfolio decision to invest in financial and real assets due to rigidity in banking system for example, the degree of competition and the imposition various regulation in the deposit-taking institution. In addition, the changed of the interest rate regime did not influence the demand for money in Malaysia instead the events of capital flows that took place in 1994 and 1998 exhibit significance influence on the dynamic behaviour of money demand.

5.5 Stability Tests

In order to ensure the robustness of the test results, parameters have been evaluated for their stability throughout the study period. The cointegration and error-correction analysis is redone using the recursive estimation method. The following parameter constancy tests are carried out: residual sum of squares, log-likelihood test, one-step residuals and Chow tests. The Chow tests further include one-step Chow test, break-point Chow test, and forecast Chow tests (Res1Step, N-down and N-up Chow tests respectively)[8]. The first type of the test is mainly an indicator of the existence of outliers. The other two types of tests are sequences of 1-step Chow tests and are more appropriate to test for the existence of structural breaks as they provide formal statistical criteria to distinguish outliers from more fundamental structural changes. The break-point Chow test is done by first estimating the model over the whole sample and then testing whether the is evidence of a structural change in the parameters when the sample period is progressively reduced. The predictive failure Chow test is performed by first estimating the model using only the initial observations and then testing whether the parameters change as the sample period is progressively increased. As can be seen from Figure 1, the system of cointegration relationship seems broadly stable over the sample period. However, a significant

[8] The break-point test entails estimating the model using observations 1 to t-1, re-estimating the model using observations t to T and comparing the residual sums of squares. The forecast test entails estimating the model using the observations 1 to M, re-estimating the model using observations 1 to t ($t > M$) and comparing the residual sums of squares.

outlier and instability can be detected in the short-run dynamic money demand equation.

[Insert Figure 1]

The instability of the model is further confirmed by the one-step ahead recursive residuals and forecast Chow test (N-down and N-up Chow tests) shown in Figure 2. One-step residuals test of money demand also shows a violation of 99% confidence interval in 1992, 1994 and 1998, which underlines the finding reported above using the recursive Chow-test. The results indicate the presence of instability in 1992, 1994 and 1998. This period is actually associated with large capital flows, the policy response taken to influence the financial system and the currency crisis. This suggests that the increasing openness of Malaysian financial system to international market and changes in the conduct of monetary policy disturb the stability of short-run money demand. In other words, although the long-run demand for money is stable, the short-run of money demand is subject to disturbance of internal and external shocks.

[Insert Figure 2]

7. Concluding Remarks

In this paper we have re-examined the money demand relationship in Malaysia covering the period 1974 to 2001 by employing cointegration technique and error-correction model. This period coincides with the shift in the exchange rate regime, the initiation of liberalisation of financial sector, and various episodes of economic crises. Theoretically, these changes are usually expected to have a profound effect on the stability of the money demand function. Our results support the existence of stable long-run money demand function despite the various changes and developments, but find some evidence of instability in the short-run. Hence, this suggests that the monetary targeting framework seems to be inappropriate for monetary policy but the broad monetary aggregate could continue to be a useful longer-term indicator in the formulation of monetary policy.

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Table 1: Selected Studies on Malaysian Money Demand based on Cointegration and Error-correction Modelling

Authors	Period/Frequency	Type of Model [1/]	Estimation Procedure [2/]	Variables: Monetary Aggregate	Variables: Scale Variables[4/]	Variables: Interest Rate[5/]s	Variables: Other Variables[6/]	Conclusion
Tseng and Corker (1991)	1970:3-1989:4, Quarterly	Cointegration ECM	EG (1997) with the cointegration test by CRDW, EG and AEG procedure Chow (1960)	ln(real NM) ln(real BM)	ln(real GDP)	ORM: RM2(M2), ARM: DR(M1) RAM2(M2)	expected inflation (GDP deflator based)	Stable cointegration relationship between ln(real NM) and ln(real GDP); and possible stable relationship between ln(real BM) with RAM2 and ln(real GDP); stable ECM for both NM and BM.
Teng (1993)	1973:1-1989:4, Quarterly	Cointegration ECM	EG (1997) with the cointegration test by CRDW, EG and AEG procedure	ln(real MB) ln(real M1) ln(real M2) ln(real M3)	ln(real GNP)	IB3, TB3, TB6, TB12, CBTD3, CBTD6, CBTD9, CBTD12, CBSR		Mixed results depending on the cointegration tests. However, stable long-term relationship is found only for ln(real M1) and ln(real MB) with ln(real GNP) and IB3
Dekle and Pradhan (1997)	1976-1995, Annual	Cointegration	J (1988) JJ (1990)	log(NM/CPI) log(BM/CPI) log(NM) log(BM)	log(real GDP)	CBTD(M1) RAM2(M2) FORR for log(BM/CPI)	log(CPI)	Except for ln(NM), stable cointegration relationships are obtain for all other monetary aggregates. ln(real GDP) and interest rates are not weakly exogenous
Tan (1997)	1973:1-1991:4, Quarterly	Cointegration ECM	J (1988) JJ (1990) Chow (1960)	ln(CC/CPI) ln(M1/CPI) ln(M2/CPI)	ln(real GDP)	CBTD3 (CC, M1 and M2) TB3 (M2)	ln(XRI) (CC and M1)	Stable cointegration relationships exist for all monetary aggregates. However, short-run money demand functions are unstable for the entire period of estimation. Estimation based on subset of samples provides stable results.

Marashdeh (1997)	1980:1-1994:10, Monthly	Cointegration ECM	J (1988) JJ (1990) ECM Chow (1960)	ln(M1)	ln(IPI)	CBTD6	ln(CPI), Trade-weighted exchange rate	Long run money demand for ln(M1) is presence and structural stability tests indicate a stable M1 demand function.
Sriram (1999)	1973:1-1995:12, Monthly	Cointegration ECM	J (1988) JJ (1990) ECM Chow (1960)	ln(M2A/CPI)	ln(IPI)	CBTD3, TB3	Annualised inflation, Annualised nominal average exchange rate RM/US	Fairly stable cointegration long-run and short-run relationships for ln(M2A) exist. However, external events have some influence on the stability.
Ibrahim (2001)	1977:1-1998:8, Monthly	Cointegration ECM	J (1988) JJ (1990) ECM Chow (1960)	ln(M1) ln(M2)	ln(IPI)	TB3	ln(KLCI/CPI) nominal exchange rate RM/US	Stable cointegration relationships exist for ln(M1) and ln(M2). The short-run money demand for ln(M1) shows some evidence of instability for entire period. However, there exist a stable short-run money demand for the post-1986 period.

Note:

1/ ECM = error-correction model;

2/ J (1988) = Johansen; JJ (1990) = Johansen and Juselius; AEG = augmented Engle-Granger cointegration test; CRDW = cointegration regression Durbin-Watson test; EG = Engle-Granger cointegration test; EG (1987) = Engle-Granger (1987) two-step procedure.

3/ BM = broad money; CC = currency in circulation; DD = demand deposit; MB = monetary base; NM = narrow money.

4/ GDP = gross domestic product; GNP = gross national product

5/ ORM = own-rate of money; ARM = returns on alternative assets for money; RAM = money market rate minus time deposit rate weighted by the share of quasi-money in broad money;CBTD3, CBTD6, CBTD9, CBTD12 = interest rate on 3-, 6-, 9-,and 12-month time deposit at commercial banks respectively; CBSR = interest rate on saving deposits with commercial bank; CBTD = commercial bank time deposit rates (maturity not explicitly mentioned); DR = deposit rate (maturity and institution not explicitly mentioned); FORR = foreign interest rates represented by LIBOR plus expected currency appreciation; IB3 = 3-month interbank interest rate; TB3, TB6 and TB12 = yields on 3-, 6- and 12-month treasury bills respectively.

6/ CPI = consumer price index; KLCI = Kuala Lumpur Composite Index; XRI = exchange rate index calculated by assigning equal weights for bilateral exchange rates between ringgit and pound sterling, Singapore dollar, and U.

7/ Chow (1960) = Chow test for stability and structural break tests.

Table 2. Testing for Unit Root

Variable	Augmented Dickey-Fuller		KPSS Test $H_0 = I(0)$	
	t_μ	t_τ	η_μ	η_τ
rm_t	-2.25 [1]	-0.82 [1]	1.22	0.15
y_t	-1.52 [1]	-1.19 [1]	1.19	0.16
sr_t	-2.80 [1]	-2.87 [1]	1.12	1.09
tb_t	-2.69 [0]	-2.59 [0]	1.22	1.09
rer_t	-1.19 [1]	-2.61 [1]	1.15	1.08
π_t^e	-2.88 [5]	-3.28 [5]	0.44	0.12
Δrm_t	-7.56 [0]	-8.01 [0]	0.27	0.09
Δy_t	-6.86 [0]	- 7.23 [0]	0.07	0.06
Δsr_t	-6.24 [0]	-6.23 [0]	0.09	0.04
Δtb_t	-12.37[0]	-12.38 [0]	0.09	0.04
Δrer_t	-8.37 [0]	-8.34 [0]	0.08	0.05
$\Delta\pi_t^e$	-7.33 [3]	-7.27 [3]	0.24	0.10

Note: 5% critical values for t_μ (constant without trend) and t_τ (constant with trend) are –2.89 and –3.45 respectively; 5% critical values for η_μ (constant without trend) and η_τ (constant with trend) are 0.463 and 0.146. Number in [ ] indicates the lag lengths and Δ denotes the change operator that is, $\Delta = (1 - L)$.

Table 3. Cointegration and Weak ExogeneityTests

a) Estimation period 1975.1 – 2001.4

	λ_{max} Eigenvalue	95% C.V	λ_{trace} Eigenvalue	95% C.V
Hypothesis:				
$r = 0$	42.86**	39.4	130.70**	94.2
$r \leq 1$	32.16	33.5	65.41	68.5
$r \leq 2$	15.29	27.1	40.88	47.2
$r \leq 3$	10.96	21.0	22.57	29.7
$r \leq 4$	4.71	14.1	9.44	15.4
$r \leq 5$	3.17	3.8	3.17	3.8

Note: ** denotes the existence of cointegration at 5% significance levels

b) Standardised Eigenvector β'

Variable	rm_t	y_t	sr_t	tb_t	rer_t	π_t^e
	1.00	-1.09	-0.14	0.10	1.79	4.21
		(0.12)	(0.02)	(0.02)	(0.30)	(1.22)

c) Weak Exogeneity Test

	Δrm_t	Δy_t	Δsr_t	Δtb_t	Δrer_t	$\Delta\pi_t^e$
Test statistic[a]	4.38**	2.64	2.71	2.70	0.52	2.46

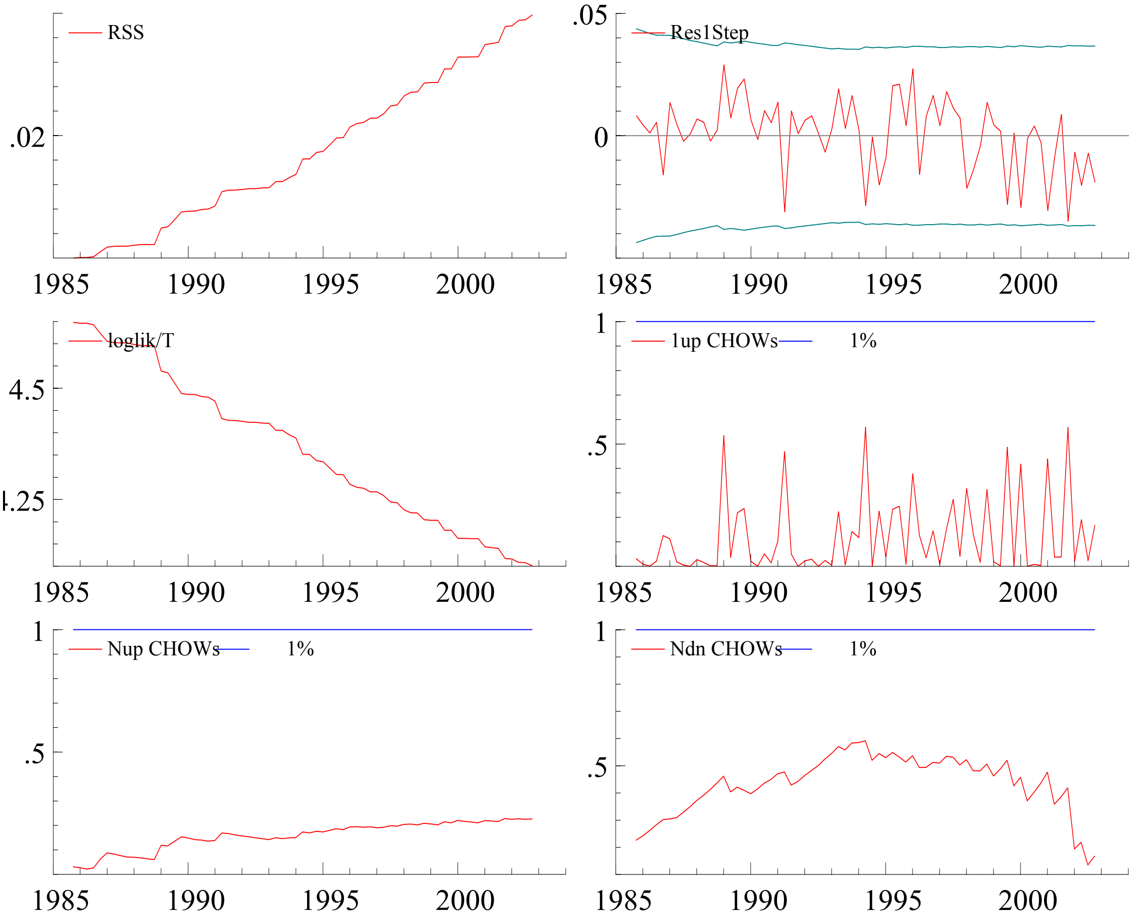
Note: A Wald test for coefficient restriction.
** Rejection of null hypothesis of weak exogeneity at 1% significance level.

Table 4. Unrestricted Short-run Money Demand Equation

Variable	Coefficient	t-value
Δrm_{t-1}	0.32*	3.04
Δrm_{t-2}	0.25*	2.35
Δy_t	0.11*	1.69
Δy_{t-1}	-0.12	-1.51
Δy_{t-2}	-0.04	-0.62
Δsr_t	0.05*	2.08
Δsr_{t-1}	0.01	0.28
Δsr_{t-2}	-0.02	-0.73
Δtb_t	-0.04*	-1.73
Δtb_{t-1}	-0.03	-0.91
Δtb_{t-2}	-0.01	-0.43
Δrer_t	-0.14	-1.36
Δrer_{t-1}	0.06	1.06
Δrer_{t-2}	0.05	0.98
$\Delta \pi_t^e$	-0.23*	-3.48
$\Delta \pi_{t-1}^e$	-0.15*	-1.89
$\Delta \pi_{t-2}^e$	-0.07	-1.07
ECM_{t-1}	-0.07*	-2.64
Dum94	0.01*	1.68
Dum98	-0.02*	-1.86
DumInt	0.01*	1.72
seasonal	-0.01	-0.95
seasonal (1)	-0.04*	-3.71
seasonal (2)	-0.03*	-2.77
Constant	0.02*	4.15
$R^2 = 0.48$	$S.E. = 0.01$	$RSS = 0.02$

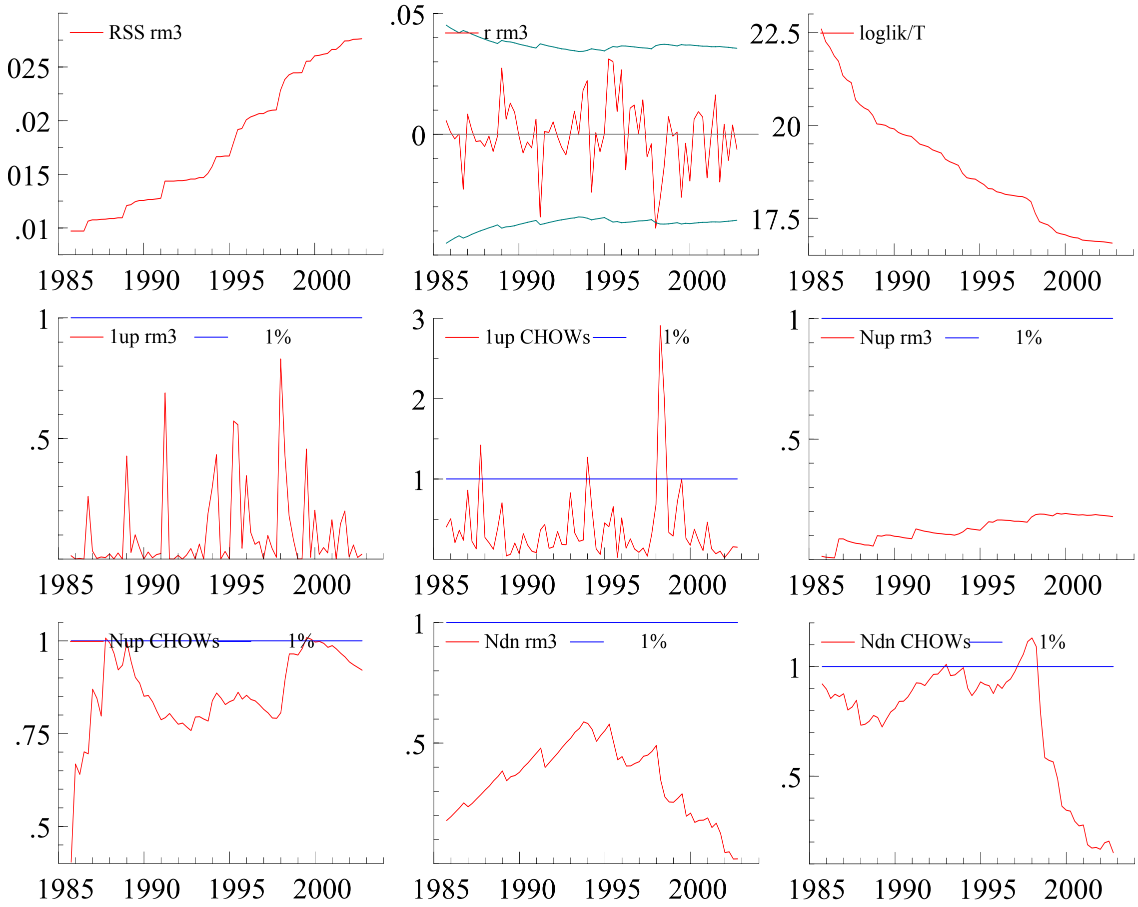
Note: *, ** and *** indicate significance at 1%, 5% and 10% level.
S.E is stands for standard error of equation
RSS is stands for residual sum of square.

Figure 1. Stability Tests: Long-run Cointegration Relation



Note: Chow-test values scaled by their one-off 1% critical values. They are scaled by one-off critical values from the F-distribution at any selected probability level as an adjustment for changing degree of freedom so that the critical values become a straight line at unity.

Figure 2. Stability Tests: Short-run Dynamic Equation



Note: Chow-test values scaled by their one-off 1% critical values. They are scaled by one-off critical values from the F-distribution at any selected probability level as an adjustment for changing degree of freedom so that the critical values become a straight line at unity.