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Broad Money Demand and Financial Liberalization in Malaysia: An Application of the Nonlinear Learning Function and Error-Correction Models

[1]M AZALI & [2]KENT MATTHEWS

[1]*Department of Economics*
Universiti Putra Malaysia
43400 UPM Serdang, Selangor
[2]*Cardiff Business School*
University of Wales Cardiff

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ABSTRAK

Kajian ini bertujuan melakukan pemodelan terhadap kesan liberalisasi dan inovasi kewangan ke atas fungsi permintaan wang meluas di Malaysia. Fungsi pembelajaran tak linear dan model pembetulan ralat telah digunakan. Keputusan ujian keharmonian dan simulasi dinamik telah juga digunakan sebagai spesifikasi penerimaan. Kajian mendapati pengolahan model pembetulan ralat yang merangkumi angkubah tindak balas tidak berupaya mengesan kejadian liberalisasi kewangan bagi fungsi wang meluas di Malaysia.

ABSTRACT

This paper attempts to model the effects of financial liberalization and innovations on the demand for broad money in Malaysia. The nonlinear learning function and error-correction mechanism model were utilized. The results of encompassing tests and dynamic (ex post) simulation confirm the error-correction as the parsimonious specification. The augmented error-correction model with nonlinear interacted variables is unable to detect the effects of financial liberalization on Malaysian broad money demand.

INTRODUCTION

Relatively little research work has been undertaken on the underlying effects of the financial liberalization and innovations on the demand for money in Malaysia. The view that financial liberalization and innovations are important for money demand and thus have important consequences for the conduct of monetary policy, has a pedigree that goes back to the mid-1950s. The precursor to recent studies was the work of Gurley and Shaw (1955, 1960); Cagan and Schwartz (1975); and Friedman (1984).

An important feature in the conduct of monetary policy and hence the monetary transmission mechanism, is the existence of a stable and predictable relationship between monetary aggregates, output, prices and interest rates. However, financial liberalization and financial innovations, have been the prime suspects for the breakdown in the money demand relationship, leading the authority to focus its control on other indicators of monetary policy such as bank credit and interest rate (Ismail and Smith 1993).

Moreover, one must take notice that there are various types of financial liberalization taken place in the context of developing countries. For example, Tseng and Corker (1991) had emphasized on interest rates liberalization. As a result they argued that 'it is important to question which interest rates have been liberalized: if, for example, interest rates on time deposits increase after liberalization, the demand for broad money might rise at any given level of income, but the demand for narrow money might decline. This means that financial deregulation and innovation might cause instability on both monetary aggregate demand functions - cause a one-time or a gradual shift in money holdings and hence alter the sensitivity of money demand to changes in both income and interest rates' (p. 11)[1].

Having mentioned the above issues, certainly, additional work is needed before the impact of financial deregulation and financial innovation on the money demand in Malaysia can be fully understood. The purpose of this paper is to clarify the situation. In so doing, this study adopts the nonlinear learning function model (NLM) recently proposed by Hendry and Ericsson (1991) and Baba, Hendry and Starr (1992) to capture the impact of financial deregulation and financial innovation on income and interest rates, which technique to my best knowledge, has never been tested on the Malaysian money demand function[2]. In addition, the error-correction mechanism model (ECM) is utilized for comparison purposes. The procedures are elaborated in the immediate section. Specifically, this study emphasizes on the demand for real broad money ($m2$) due to the following reasons:

First: As a result of financial liberalization and financial innovation, the Malaysian monetary authority currently monitors the growth of broad monetary aggregate ($m2$). It is argued that the growth of $m2$ reflects the growth of private sector liquidity (BNM 1994). Thus, focussing on $m2$ is justified in order to parallel to the present practice of the Malaysian monetary authority (Mohamed 1996).

Second: A study by Mohamed (1998) has discovered that the short-run narrow money demand function has suffered from one serious problem such as temporal structural instability and thus reducing the robustness of policy implications.

Having mentioned the introduction above, the remainder of the paper is organized as follows. Section II presents the methodology used in estimating the nonlinear model. Section III deals with the series properties. The empirical results are presented and discussed in Section IV. Finally, Section V presents the paper's concluding remark.

METHODOLOGY

A Model of the Nonlinear Learning Process (NLM)

In the literature on financial deregulation and financial innovation it is often suggested that deregulation and innovation take time to exert their full impact on money demand as economic agents need time to learn about newly innovated financial assets and to change their behaviour of money holdings. To model the transition phase of financial adaptation; Hester (1981), Hendry *et al.* (1991), and Baba *et al.* (1992); amongst others, have used the NLM. They have constructed the nonlinear interacted variables using the following nonlinear weighting function $\{w_t\}$ to represent agents learning process about the newly introduced financial assets. The nonlinear weighting function is constructed as:

$$w_t = (1 + \exp[\alpha - \beta(t - t^* + 1)$$
$$\text{for } t \geq t^* \text{ and 0 otherwise.} \qquad (1)$$

where t is time, t^* is the date of introduction of the assets, and α and β correspond to initial knowledge and the rate of learning. Following Hendry *et al.* (1991), Baba *et al.* (1992), they have set $\alpha = 7$ and $\beta = 0.8$ for the US, implying the learning adjustment $w_t = 0.50$ after two years and $w_t = 0.999$ after 3.5 years; while for the UK they set $\alpha = 5$ and $\beta = 1.2$, implying $w_t = 0.50$ after one year and $w_t = 0.999$ after two years, indicating higher initial knowledge and more rapid learning for the UK counterpart. In his work on the Australian data, Hossain (1994) set the α and β values exactly as Hendry *et al.* (1991) had done in the US case. Hendry *et al.* (1991) showed that the inclusion of the learning-adjusted $m1$ retail sight-deposit interest rate in the error-correction model explained sufficiently the rapid growth of $m1$ in the UK and in the US. Baba *et al.* (1992) also found a similar result on the demand for $m1$. On the other hand, the study by Hossain (1994) indicated that the results were qualitatively similar, either using the nonlinear learning adjustment function or using the linear time trend[3].

1. See, Hossain (1994); Fry (1995), Hoque and Al-Mutairi (1996), amongst others.
2. Hendry and Ericsson (1991) adopted this technique in investigating the demand for narrow money in the United Kingdom and the United States. Hossain (1994) utilised this technique on the Australian short-run narrow money demand function.
3. Hossain (1994) employed partial adjustment as his base line model.

Following those studies, we have adjusted the initial values for α and β in order to be well fitted to the Malaysian case. We set the $\alpha = 10$ and $\beta = 0.5$, implying $w_t = 0.50$ after five years and $w_t = 0.999$ after 8.5 years to indicate a lower initial knowledge and slower learning process among the economic agents in Malaysia[4]. The series (wt) were constructed beginning in 1979 and reached the peak at the end of the 1980s, so that the generated weighting series would capture most of the financial deregulation and financial innovation during the 1980s. Next, the generated weighting series were used to define two nonlinear interacted variables for income (*y*) and interest rate (*ir*), respectively: $w^*\Delta\ y$ and $w^*\Delta\ ir$, and finally these variables were included in the augmented error-correction model for estimation purposes. The equation can be written as follows:

$$\Delta(m2\text{-}p)_t = a_0 + a_1\ \Delta y_t + a_2\ \Delta ir_t + a_4\ \Delta\Delta\ p_t + a_5\ ecm2_{t-1} + a_6\ w^*\Delta y_t + a_7\ w^*\Delta ir_t \quad (2)$$

where *m2-p* is real *m2*; Δp_t is an annualized inflation rate, and $ecm2_{t-1}$ is an error-correction term. From equation (2) there are three testable null hypotheses: $a_6 = 0$, $a_7 = 0$ and $a_6 = a_7 = 0$. The first two hypotheses indicate that for each interacted variable has no effect on money demand, whilst the latter shows the combining effects are insignificant on money demand. In this paper, the final estimated ECM is estimated using Hendry-type general-to-specific methodology (Hendry 1979; Hendry *et al.* 1984).

The Time Series Properties

Detailed sources and data description used in this study are presented in Data Appendix. The quarterly data used spanning 1972:q1 to 1993:q4. The Dickey-Fuller (DF)[5], the Augmented Dickey-Fuller (ADF)[6] and the Phillip-Perron (1988) procedures were utilised in order to check the order of integration or the data stationarity. For all tests, the results show that all variables are integrated of order one or stationary after first differences[7]. All variables are specified in natural logarithm. The cost of holding money is measured by the ir, which is the margin between the 3-month Treasury bill rate (*tbr3*) and the 3-month banks' fixed deposit rate (*dr3*). In modeling the long-run broad money demand function, we have tried various measurements of opportunity cost of holding broad money *i.e.* 3-month, 6-month and 12-month Treasury bill rates. However, the results were inconsistent with the standard theoretical sign (negative) in the money demand study[8]. This problem is actually well recognized in the literature of money demand in the developing countries (Aghevli *et al.* (1979); Tseng and Corker (1991); and Tariq and Matthews (1996)). Following Tariq and Matthews (1996) and Johansen and Juselius (1990), the *ir* was constructed as the margin rate between the 3-month Treasure bill rate and the 3-month commercial banks fixed deposit rate[9]. Moreover, the *ir* could be considered as a tightness of holding money. The fixed deposit rate acts as the own rate of interest and the *tbr3* acts as the rate on the alternative asset.

Cointegration test - The Johansen-Juselius's (1990, 1992) maximum likelihood procedure was utilised to test for long-run cointegrating relationships among real broad money (*m2-p*), real income (*y*), interest rate margin (*ir*) and annualised inflation rate (Δp). The estimates of the cointegrating vector was based on a VAR model with two lags[10], a constant, 'centered' seasonal dummies (S1, S2 and S3) to capture the presence of the linear time trend in the nonstationary part of the data generating process, and a shift variable with value zero to 1978:4 inclusive and non-zero thereafter (DUM1) to allow for the effects of financial liberalization. The results of the rank tests are shown in Table 1 below.

The null hypothesis of non-stationary with no cointegration ($r = 0$) was rejected at the 5% level on the basis of the *trace* and the *maximal-eigenvalue* (λ*-max*) test statistics, whereas the null hypothesis of *r* to be, at most, one was not rejected. This led to the conclusion that there

4. This is an ad hoc procedure. The weight (w) was chosen by plotting equation (1) using the trial-and error technique on various combinations of (and (values.
5. See, Dickey and Fuller (1979, 1981).
6. See, Engel and Granger (1987).
7. Full results are available upon request from the author.
8. A similar problem exists when the short-run broad money demand function is estimated.
9. The 3-month Treasury bill rate was chosen because it is well established, while the 3-month fixed deposit rate is the main part of broad money, m2.
10. The Akaike Information Criteria (AIC) test statistics are as follows: 0 lag = 351.4; 1 lag = 555.9; 2 lags = 564.9; 3 lags = 559.7; and 4 lags = 563.0.

TABLE 1
Cointegration with unrestricted intercepts and restricted trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

80 observations from 1974Q1 to 1993Q4. Order of VAR = 2.
List of variables included in the cointegrating vector:
$m2$ y ir Δp
List of I(0) variables included in the VAR:
DUM1 S1 S2 S3
List of eigenvalues in descending order:
.32567 .19297 .065559 .0082307

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	31.5229*	27.4200	24.9900
r<= 1	r = 2	17.1511	21.1200	19.0200
r<= 2	r = 3	5.4245	14.8800	12.9800
r<= 3	r = 4	0.6611	8.0700	6.5000

Cointegration LR Test Based on the Trace of the Stochastic Matrix

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	54.7597*	48.8800	45.7000
r<= 1	r>= 2	23.2368	31.5400	28.7800
r<= 2	r>= 3	6.0857	17.8600	15.7500
r<= 3	r = 4	0.6611	8.0700	6.5000

was at most one cointegrating vector β forming a cointegrating relationship $\beta' x$ where $x'_t = [(m2\text{-}p)_t, y_t, ir_t, \Delta p_t]'$. Normalised for $(m2\text{-}p)_t$ the unrestricted cointegrating vector can be written as:

$$(m2\text{-}p) = 1.1726\ y - 3.0412\ ir - 0.24394\ \Delta p \quad (3)$$
$$(0.3679)^{*}\ (2.7624)\ (0.1285)^{**}$$

where standard errors in bracket; and '*'[**] denotes significant at the 1%[5%] level.

The null hypothesis of a unit income elasticity (α_1=1) also was accepted by the data as indicated by the log likelihood ratio test statistics, asymptotically chi-squared distribution with one degree of freedom; $\chi^2(1)$ = 0.15452 [0.694]; yielding the long-run restricted cointegrating vector:

$$(m2\text{-}p) = 1.0\ y - 3.2482\ ir - 0.29385\ \Delta p \quad (4)$$

or the so-called an error-correction term (ECM2) and can be written as

$$ECM2 = 1.0\ (m2\text{-}p) - 1.0\ y + 3.2482\ ir + 0.29385\ \Delta p \quad (4.1)$$

In summary, the results of cointegration tests suggest that it seems reasonable to proceed with a single-equation analysis for $(m2\text{-}p)_t$. However, before doing so, the explanatory variables were tested for exogeneity by applying the Wu-Hausman test. The computed Wu-Hausman T_2 statistic F(3,71) = 0.595[0.554] supported the hypothesis that the explanatory variables in the cointegrating vector were exogenous.

There are two main results that can be derived from the estimates of long-run imposed restrictions money demand function:

First: Although the imposed unit long-run income elasticity was not rejected, however, the unrestricted income elasticity was found to be 1.1726 which is consistent with the results found in most previous studies in the developing countries, Chowdhury (1997), Tariq and Matthews (1996); Tseng and Corker (1991); and Aghevli *et al.* (1979). The results indicated that the velocity of broad money in Malaysia had declined over time. A likely explanation is that as a result of financial deregulation and innovation, the banking institutions can provide more services, *i.e.* transaction services, and electronic facilities, and thus have a greater impact on the growth of broad money, implying the growing degree of monetisation in the economy.

Second: The estimation result also indicated that a strong exogenity assumption on the explanatory variables was not rejected by the

Wu-Hausman test statistics. In addition, the acceptance of one cointegrating vector in the data allowed an efficient estimation of the short-run dynamic of the demand for broad money in Malaysia.

RESULTS

IV The Estimates of NLM and ECM

The final estimated base line ECM model is summarised in Table 2. However for comparison purposes, we have also estimated the augmented ECM model which includes two nonlinear interacted variables namely, $w^*\Delta y$ and $w^*\Delta ir$ (see Table 3). As mentioned in Section II, the final estimated models were derived using the Hendry-type general-to-specific methodology. By inspection on both tables, the former estimation results indicate better outcomes particularly in the acceptance of the income variable. That means the inclusion of two nonlinear interacted variables to capture for the effects of financial liberalization on the demand for broad money are unable to improve the final specification. The results are supported by the nonrejection of the null hypotheses: $a_6 = 0$, $a_7 = 0$ and $a_6 = a_7 = 0$ using the standard F-test (see, Table 4).

Encompassing Alternative Models

Two different models have been estimated in the last section: [1] the base line ECM model or the error-correction model without the nonlinear interacted variables, and [2] the augmented ECM model - the base line ECM model with the nonlinear interacted variables. The next question to be asked is which equation represents the best approximation of the data generating process. Following an approach developed by Mizon and Richard (1986), this section conducts an F-test, the so-called encompassing *F*-test, which is a test for 'restricted' against 'unrestricted' models. The encompassing *F*-test is conducted on the 'restricted' model (base line ECM model) against the 'unrestricted' models (augmented ECM model) as follows.

TABLE 2
Ordinary Least Squares estimation of the base line error-correction model

Dependent variable is $(\Delta m2\text{-}p)$
80 observations used for estimation from 1974Q1 to 1993Q4

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
constant	.03891	.00917	4.2426[.000]
Δy	.18102	.09660	1.8739[.065]
Δir	-.90363	.30209	-2.9913[.004]
$\Delta ir(-2)$	-.90451	.29742	-3.0412[.003]
$\Delta\Delta p$	-.00586	.00236	-2.4777[.016]
$ecm2(-1)$	-.01551	.00854	-1.8167[.073]

R-Squared	0.3131	R-Bar-Squared	0.2667
S.E. of Regression	0.0194	F-Stat. F(5, 74)	6.7469 [.000]
Mean of Dependent Variable	0.0265	S.D. of Dependent Variable	0.0227
Residual Sum of Squares	0.0279	Equation Log-likelihood	204.8309
DW-statistic	1.4413		

Diagnostic Tests

Test Statistics	LM Version	F Version
A: Serial Correlation	CHSQ (4)= 7.4404[.114]	F(4, 70)= 1.7945[.140]
B: Functional Form	CHSQ (1)= 0.4149[.519]	F(1, 73)= 0.3805[.539]
C: Normality	CHSQ (2)= 3.2765[.194]	Not applicable
D: Heteroscedasticity	CHSQ (1)= 0.3002[.584]	F(1, 78)= 0.2938[.589]

Notes:
A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

where $ecm2 = 1.0^*m2 - 1.0^*y + 3.2482^*ir + 0.29385^*\Delta p$

TABLE 3
The augmented error-correction model with nonlinear interacted variables

Dependent variable is $(\Delta m2\text{-}p)$
80 observations used for estimation from 1974Q1 to 1993Q4

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
constant	0.04124	.00995	4.1441[.000]
Δy	0.17657	.11625	1.5189[.133]
Δir	-0.64338	.38157	-1.6861[.096]
$\Delta ir(-2)$	-0.87181	.30094	-2.8970[.005]
$\Delta\Delta p$	-0.00628	.00242	-2.5972[.011]
$ecm2(-1)$	-0.01763	.00941	-1.8738[.065]
$w^*\Delta y$	0.02294	.18266	0.1256[.900]
$w^*\Delta ir$	-0.79335	.68145	-1.1642[.248]

R-Squared	0.326080	R-Bar-Squared	0.2605
S.E. of Regression	0.019523	F-Stat. F(7, 72)	4.9768[.000]
Mean of Dependent Variable	0.026557	S.D. of Dependent Variable	0.0227
Residual Sum of Squares	0.027443		
DW-statistic	1.4615		

Diagnostic Tests

Test Statistics	LM Version	F Version	
A:Serial Correlation	CHSQ (4)= 6.7641[.149]	F(4, 68)=	1.5701 [.192]
B:Functional Form	CHSQ (1)= 0.0860[.769]	F(1, 71)=	0.0764[.783]
C:Normality	CHSQ (2)= 2.5753[.276]	Not applicable	
D:Heteroscedasticity	CHSQ (1)= 0.2079[.648]	F(1, 78)=	0.2033[.653]

Notes:
A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

TABLE 4
The OLS regression results: The error-correction model with nonlinear interacted variables

$$\Delta(m2\text{-}p)_t = a_0 + a_1\,\Delta y_t + a_2\,\Delta ir_t + a_3\,\Delta ir_{t-2} + a_4\Delta\Delta\,p_t + a_5\,ecm2_{t-1} + a_6\,w^*\Delta y_t + a_7\,w^*\Delta ir_t$$

sub-period	1974:1 – 1987:4 k=56	1974:1 - 1992:4 k=72	1974:1 - 1993:4 k=80
F-test for Hypothesis:			
$a_6 = 0$	F(1,48) = 0.709	F(1,68) = .0200	F(1,72) = 0.150
$a_7 = 0$	F(1,48) = 0.184	F(1,68) = 0.516	F(1,72) = 1.350
$a_6 = a_7 = 0$	F(2,48) = 0.486	F(2,68) = 0.269	F(2,72) = 0.690

Notes : '*' denotes significant at a 10% level.

Restricted base line error-correction model:

$$\Delta(m2\text{-}p)_t = a_0 + a_1\,\Delta y_t + a_2\,\Delta ir_t + a_3\,\Delta ir_{t-2} + a_4\Delta\Delta\,p_t + a_5\,ecm2_{t-1} \quad (5)$$

Unrestricted augmented error-correction model with nonlinear interacted variables:

$$\Delta(m2\text{-}p)_t = a_0 + a_1\,\Delta y_t + a_2\,\Delta ir_t + a_3\,\Delta ir_{t-2} + a_4\Delta\Delta\,p_t + a_5\,ecm2_{t-1} + a_6\,w^*\Delta y_t + a_7\,w^*\Delta ir_t \quad (6)$$

The test results are reported in Table 5 below. The tests in Table 5 indicate that all the null hypotheses cannot be rejected, implying the original restricted specification is not mis-specified. However, whether the respecified 'restricted' error-correction model (equation 5) can be regarded as a satisfactory short-run broad money demand function, depends on its ability to provide adequate out-of-sample (ex post) forecasts. The results are reported in the next subsection.

TABLE 5
Encompassing F-test - Restricted vs. unrestricted models

sample period	Eqn 5 vs. Eqn 6
1974q1-1991q4	F(2, 64) = 0.213[.808]
1974q1-1992q4	F(2, 68) = 0.269[.764]
1974q1-1993q4	F(2, 72) = 0.692[.504]

Ex post Dynamic Forecast Results

A summary of the forecast statistics is detailed in Table 6. The results show that the root-mean-square prediction errors (*rmse*) of the original restricted model are quantitatively similar to the unrestricted models. In addition, all of the equations passed the predictive failure tests. An *F*-test was also conducted to test the null hypothesis that there is no difference in the accuracy of these forecasts (see, Holden, Peel and Thompson 1990; pp. 33-37 for the details of the procedure). However, the latter test also failed to reject the null hypothesis. As an alternative criterion to select the best specification, all equations were re-estimated and then their properties were compared. The estimation results on equation (5) were reported earlier in Table 5, while results on equation (6) were reported in Table 4. Based on these estimation results, it is clear that the original model ('restricted' version) provided the best outcomes. Although they retained the desirable diagnostic residual properties, the estimates of equation (6) indicate that the income variable was insignificant. Therefore, the restricted specification (equation 5) was considered to be the parsimonious model for broad money demand in this study.

CONCLUSION

This study has shown that equation (5) is the preferred error-correction specification for the short-run broad money demand function, while equation (4) for the long-run function. The results of encompassing tests and dynamic (*ex post*) simulations confirm equation (5) as the parsimonious error-correction specification. The inclusion of the nonlinear interacted variables was unable to detect the underlying effects of financial liberalization and innovations on the demand for broad money in Malaysia.

The estimated short-run elasticities of income, cost of holding money, and inflation, are all reasonably estimated by the restricted model as reported in Table 2. Overall, the parsimonious model is rather simple, and it includes basic explanatory variables in the contemporary literature of money demand function.

Given the present results, the following two policy implications can be drawn from this study. First, the evidence supports the present strategy taken by the Malaysian monetary authority in monitoring the growth of the broad monetary aggregate as one of several strategies to curb

TABLE 6
Summary statistics for ex post forecasts

Estimation period	Forecasting period	Predictive failure test	RMSE
Equation (5) 1974:1 - 1992:4	1993:1 – 1993:4	F(4, 70)= 1.597[.185]	0.025
Equation (6) 1974:1 - 1992:4	1993:1 – 1993:4	F(4, 68)= 1.346[.262]	0.025
Significance test among the RMSE	**Hull Hypothesis, Ho:** Equation (5) has a smaller RMSE than equation (6) $F_{(2,2)} = 0.27$	**Conclusion:** No difference in the accuracy of these forecasts	

inflationary pressure. This study shows that inflation has a significant negative impact on the demand for real *m*2. For example, a 1% rise in the price level could bring about a 0.58% decline in the demand for real *m*2, *ceteris paribus*. Hence, monetary policy has an important role in controlling the price stability in Malaysia.

Second, the impact of the financial deregulation and innovation on the models' coefficients had been tested using two formal procedures. The result showed that the recursive estimates of the short-run interest elasticity had gradually decreased over time[11]. (Figs. 1 and 2) Thus, the evidence suggested that the interest sensitivity of money demand had increased, implying a small slope of the LM curve (a flatter LM curve). The flatter the LM curve, the greater would be the rise in real income and the smaller would be the rise in the interest rate (Parkin and Bade 1988; p.256). This result should prove valuable for the effectiveness of monetary policy[12].

Finally, recent development in the money demand literature suggests to estimate Divisia aggregates (Barnet *et al.* 1984). For example, Cuthbertson (1988, p. 97) argues that 'the approach is probably most useful where interest rates are market determined rather than subject to regulation and hence may prove useful in an increasing competitive financial environment.' Hence, the deregulation of interest rates opens up the possibility that future innovations in *m*2 may need to be remodelled within the framework of the 'divisia' approach[13]. I leave this issue for future research studies.

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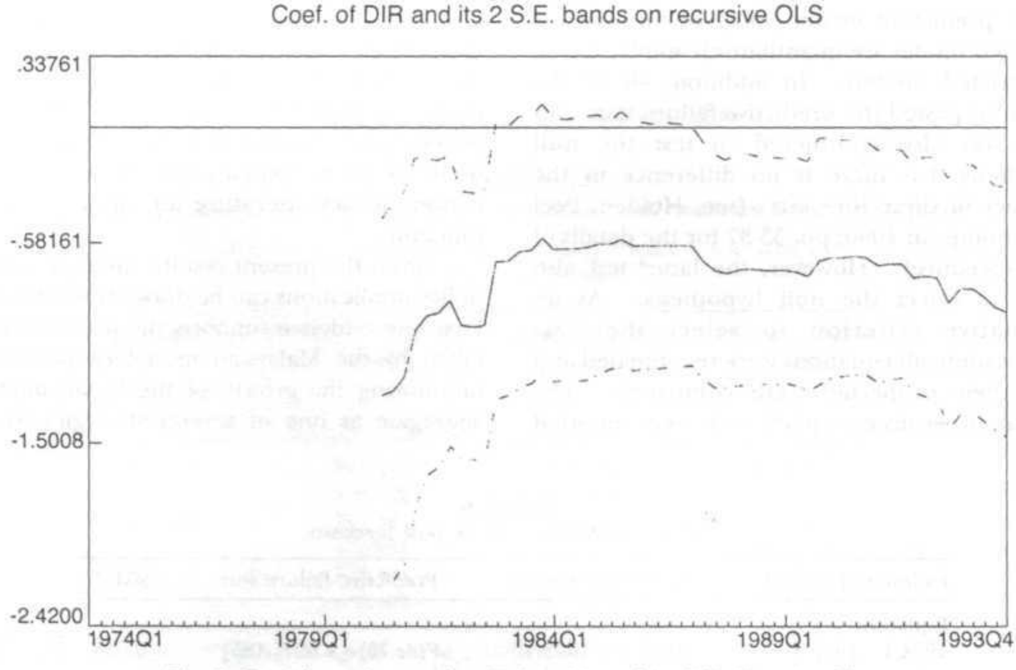

Fig. 1. Recursive estimates of coefficient Δir_t and its 2SE (Equation 5)

11. The estimated slow speed of adjustment is, however, a cause for concern but could indicate that monetary disequilibrium in Malaysia works through wider channel i.e. credit channel.
12. Kandil (1991) estimated the slope of LM curve for Malaysia was about 0.20. Thus, the present finding was consistent with a higher sensitivity of money demand to changes in the interest rate.
13. Interested readers can refer to Habibullah (1999)

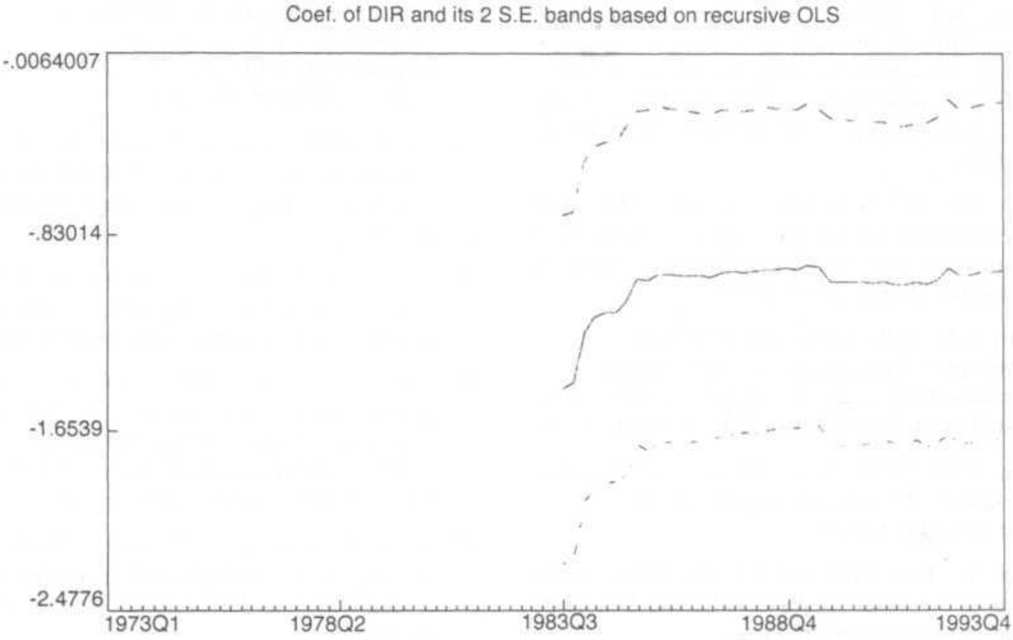

Fig. 2. Recursive estimates of the coefficient of Δir_t (Equation 6)

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DATA APPENDIX

Data used in the paper come from various issues of the International Financial Statsistics published by the International Monetary Fund and the Quarterly Bulletin Bank Negara Malaysia. The quarterly data of the Industrial Production Index (*IPI*, 1990=100) were utilised to interpolate the quarterly *GDP* data (y) using the Vangrevelinghe's method (see Ginsburgh 1973)). Observations spanning 1972:q1 to 1993:q4. The variables which have been used in the paper are as follows: *GDP* - Gross Domestic Product; $m2$ - broad money supply; p - consumer price index (*CPI*, 1990=100); $dr3$ - 3-month deposit rate; and $tbr3$ - 3-month Treasury bill rate.