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Exchange Rate and the Demand for Money in Malaysia

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ABSTRAK

Kajian ini menyelidik hubungan jangka panjang di antara kadar pertukaran wang asing dan permintaan wang di Malaysia. Keputusan ujian nisbah kebolehjadian Johansen-Juselius (1990) menyokong kepentingan kadar pertukaran asing bagi m2 tetapi tidak bagi m1. Keputusan ujian nisbah kebolehjadian Hansen-Johansen (1993) pula mendapati parameter jangka masa panjang adalah tidak stabil disebabkan kesan krisis kewangan di rantau ini. Keseluruhan analisa mendapati hanya sebahagian keputusan empirikal menyokong hubungan di antara kadar pertukaran wang asing dengan permintaan wang.

ABSTRACT

This paper investigates the long run relationship between exchange rate and money demand in Malaysia. The Johansen-Juselius (1990) likelihood ratio tests support the importance of exchange rate in m2 but not in m1 money demand. The Hansen-Johansen (1993) likelihood ratio tests however found some evidence of instability in the long run parameters and this could be due to the recent financial crisis in this region. Overall analysis has provided support to the empirical investigation of the relation between exchange rate and money demand.

INTRODUCTION

This study empirically investigates the long-run relationship between exchange rate and money demand in Malaysia. The precursor to this study was the work of Mundell (1963). Mundell argued that in addition to the interest rate and income, the demand for money is likely to depend upon the exchange rate. Therefore, an important feature of this study is, firstly, to conduct a specific test using the likelihood ratio (LR) test proposed by Johansen and Juselius (J-J) (1990) whether the exchange rate can be considered as an additional determinant of the demand for money in Malaysia. Secondly, if exchange rate is accepted in the cointegrating space of money demand, this study proceeds with the specific test developed by Hansen and Johansen (H-J) (1993) for testing the long-run parameters constancy.

There are a number of seminal studies on various issues relating to the demand for money in Malaysia, for example, Semudram (1981); Rahim (1986); and Ghaffar and Habibullah (1987). Most of these studies used partial adjustment specification. Moreover none of them explored the series properties and the cointegration technique. A recent paper by Tseng and Corker (1991), however, investigate on different issue such as the impact of financial liberalisation by focusing on the source of instability during the 1980s. This study attempts to determine whether the exchange rate can be considered as an additional determinant of the demand for money and its long-run parameters stability.

Having mentioned the introduction above, the following sections present the model, empirical results and finally the study's concluding remarks.

THE MODELS AND THE SOURCES OF DATA

Two different models are estimated. Firstly, the base-line model using the Goldfeld-type (1973) approach:

$$\log m_t = a + b \log y_t + c \log ir_t + \varepsilon_t \quad (1.0)$$

and secondly, the augmented model to include the nominal exchange rate:

$$\log m_t = a + b \log y_t + c \log ir_t + d \log ex_t + \varepsilon_t \quad (2.0)$$

where m is the real money stock, y is the real income, ir is an opportunity cost variable[1]; and ex is the nominal exchange rate; with the following theoretical expected sign: $b > 0$; $c < 0$; $d < 0$[2]. Two definitions of money stock are utilised namely, narrow money ($m1$) and broad money ($m2$)[3]. The real gross domestic product (*GDP*) is used as a scale variable. The 3-month Treasury Bill rate is used as a proxy of an opportunity cost and finally the nominal exchange rate is measured by the US dollar (*USD*) per unit of Malaysian Ringgit (*RM*). The Consumer Price Index (*CPI*) is used as a deflator.

The quarterly data used spanning 1987:q1 to 1998:q2. The sample period 1987:q1 is chosen as a starting point because neither quarterly data of Gross Domestic Product (*GDP*) nor Gross National Product (*GNP*) is available in Malaysia before this period. All data are collected from the Bank Negara Malaysia (Central Bank of Malaysia) Quarterly Bulletins except the GDP is collected from the published reports by the Department of Statistics, Malaysia.

EMPIRICAL RESULTS

The integration properties of the individual series are investigated by using the augmented Dickey-Fuller (ADF) test[4]. The lag length is determined based on the Schwarz Bayesian Criterion (SBC)[5]. The results show that all variables are stationary in their first differences. The results are summarised in Table 1.0. Clearly, the results indicate that all series are stationary after first differences.

As mentioned before, both equations (1.0) and (2.0) are estimated using the Johansen-Juselius (1990) maximum likelihood cointegration procedures. The choice of lag length k or the order of VARs system is based on the SBC procedure. The results indicate that

TABLE 1.0
Summary of augmented Dickey-Fuller (ADF) test statistics

Series	Levels		First differences	
	Include an intercept but not a trend	include an intercept and a linear trend	include an intercept but not a trend	Include an intercept and a linear trend
m1	-1.8779[1]	-1.1319[1]	-3.8462[1]*	-4.2511[1]*
m2	-0.4848[1]	-3.0008[1]	-4.9913[1]*	-4.8226[1]*
y	-1.7409[2]	-2.1882[2]	-11.668[1]*	-11.976[1]*
ir	-1.7037[1]	-1.7363[1]	-4.7199[1]*	-4.5754[1]*
ex	-0.7149[3]	-0.4339[3]	-3.7519[1]*	-4.3592[1]*

Notes:
Numbers in brackets are the lag lengths based on SBC.
* denotes significant at the 5% level.

1. *ir* is computed as log (1 + *ir*)
2. A simple interpretation on d < 0 is that as result of depreciation of the Malaysian Ringgit (a decrease in ex), the demand for cash balances in Malaysia increases.
3. M1 is defined as currency and demand deposits held by the non-bank private sector held at the commercial banks, plus net issues of NCD to the private sector and repo transactions affected by the commercial banks (Bank Negara Malaysia, 1994; 410).
4. See Engle and Granger (1987).
5. See Schwartz (1978).

TABLE 2.0
Cointegration analysis (with unrestricted intercept and no trends)

	Series in cointegrating Vector	Null	Alternative	λ_{max}	95% critical values	λ_{trace}	95% critical values
Set 1	*m1, y, ir*	$r = 0$	$r = 1$	77.56*	21.12	86.14*	31.54
		$r \leq 1$	$r = 2$	5.94	14.88	8.58	17.86
		$r \leq 2$	$r = 3$	2.64	8.07	2.64	8.07
Set 2	*m2, y, ir*	$r = 0$	$r = 1$	27.23*	21.12	32.79*	31.54
		$r \leq 1$	$r = 2$	3.82	14.88	5.56	17.86
		$r \leq 2$	$r = 3$	1.74	8.07	1.74	8.07
Set 3	*m1, y, ir, ex*	$r = 0$	$r = 1$	82.16*	27.42	101.96*	48.88
		$r \leq 1$	$r = 2$	11.59	21.12	19.80	31.54
		$r \leq 2$	$r = 3$	7.92	14.88	8.20	17.86
		$r \leq 3$	$r = 4$	0.28	8.07	0.28	8.07
Set 4	*m2, y, ir, ex*	$r = 0$	$r = 1$	31.83*	27.42	60.98*	48.88
		$r \leq 1$	$r = 2$	19.99	21.12	29.15	31.54
		$r \leq 2$	$r = 3$	8.22	14.88	9.16	17.86
		$r \leq 3$	$r = 4$	0.94	8.07	0.94	8.07

Notes:
r is the number of cointegrating vector.
* denotes significant at the 95% level.
Test is carried out using CATS in RATS package

the order of VARs at 3 are acceptable by the data representation with unrestricted intercept and no trends for Sets 1 and 2. Whilst, the order of 2 is acceptable for Sets 3 and 4 with unrestricted intercept and no trends. In Table 2.0, the results of cointegration analysis for four set of variables are summarised. The first two sets of variables belong to equation (1.0). Whilst the last two sets belong to equation (2.0) where the nominal exchange rate is included in *m*1 and *m*2 money demand, respectively.

Based on the maximal eigenvalues (λ_{max}) and trace statistic (λ_{trace}), both tests strongly reject the null of no cointegration (r = 0) for each set of variables of interest. Furthermore, both tests also accept that at most the presence of one cointegrating vector (CV) in each set of variables. Hence, there is no significant evidence of more than one cointegrating vector for all sets of variables.

As indicated in the Introduction, the J-J likelihood ratio test is conducted to determine whether the exchange rate belongs to the cointegrating space of each money demand function. This test is based on the estimated eigenvalues of restricted λ^* (without exchange rate) and unrestricted λ (with exchange rate) ith cointegrating vector[6], as follows:

$$-2\ln(Q) = T\sum_{i=1}^{r}\ln\{(1-\lambda_i^*)/(1-\lambda_i)\} \quad (3.0)$$

Asymptotically, this statistic has a χ^2 distribution with $r(p\text{-}s)$ degrees of freedom, where r is the number of cointegrating vector, p is the dimension of unrestricted cointegrating space and s is the dimension of restricted cointegrating space. The restriction embedded in the null hypothesis is binding if the calculated value of the test statistics exceeds that in a χ^2 table. The test results are summarised in Table 3.0.

The tests indicate that the exchange rate can be excluded from the *m*1 cointegrating space. Whilst in the *m*2 cointegrating space, it is permissible to include the exchange rate in the model. Based on these findings, the following discussion will only focus on testing the stability of long-run parameters of m2 money demand where nominal exchange rate is included in the cointegrating vector. To test whether the estimated long-run parameters are stable over time in the cointegrating space x'=[*m*2, *y*, *ir*, *ex*],

6. See, Bahmani-Oskooee et al. (1998) for more recent application of this technique.

TABLE 3.0
The J-J likelihood ratio tests of restricted and unrestricted cointegrating vectors

Series in	Normalised Cointegrating Vector	Restricted Eigenvalue λ^*	Unrestricted Eigenvalue λ	χ^2, $(p\text{-}s)r$	Remark
Set 1	[1.0, -2.5, 3.1]	0.8284		$\chi^2(1)$ =	exchange rate can be
vs.				0.75	excluded from *m*1
Set 3	[1.0, -2.6, 3.3, -0.1]		0.8455		cointegrating vector
Set 2	[1.0, -2.9, 2.8]	0.4615		$\chi^2(1)$ =	exchange rate can be
vs.				4.595*	included in *m*2
Set 4	[1.0, -2.8, 3.4, -0.3]		0.5149		cointegrating vector

Notes:
The critical value of $\chi^2(1)$ = 3.84 (2.71) at the 5% (10%) significance level.

TABLE 4.0
Testing the long-run parameters constancy

Sample	No. of cv	Eigenvalue (t)	H-J statistics@	Remark
1987q1 - 1998q2	1	0.5149 (44)	-	
1987q1 - 1998q1	1	0.5877 (43)	- 6.99	accept Ho
1987q1 - 1997q4	1	0.7356 (41)	- 25.49*	reject Ho
1987q1 - 1997q3	1	0.7328 (41)	-24.45*	reject Ho
1987q1 - 1997q2	1	0.7120 (40)	- 20.86*	reject Ho
1987q1 - 1997q1	1	0.7247 (39)	- 22.09*	reject Ho

Notes:
@ The critical value of $\chi^2(3)$ = 7.81 at the 5% sigificance level.

the following H-J likelihood ratio test statistics is utilised:

$$t\sum_{i=1}^{r}\ln\left[\frac{1-\lambda_i^*(t)}{1-\lambda_i(t)}\right] \qquad (4.0)$$

which has a χ^2 distribution with $(p\text{-}r)r$ degrees of freedom, where p is the dimension of cointegrating space and r is the number of cointegrating vector. In equation (4.0), λ^* is the largest eigenvalue from the corresponding subsamples and λ is the largest eigenvalue from the whole sample. The intuition behind this test is that small values for the test statistics imply that the estimated long-run parameters are stable over time. The test results are summarised in Table 4.0.

As reported in Table 4.0, the statistics shows the following results: (1) most of the cointegrating vectors take the sign pattern that is consistent with money demand; (2) in all selected subsamples and the whole sample, the cointegrating vector remains at 1; (3) the H-J test rejects the long-run parameter stability in all subsamples after 1997:4. This result implies that in spite of the acceptance of exchange rate as an additional determinant in *m*2 money demand, the recent East Asian financial crisis[7] has probably caused instability of the long-run parameters. However, there is no evidence of a structural shift in broad money demand prior to the financial crisis.

CONCLUSION

The Johansen-Juselius (1990) likelihood ratio tests strongly support the importance of exchange rate in *m*2 but not in m1 money demand function in Malaysia. The positive sign on the exchange rate and negative sign for treasury bill in the normalised *m*2 vector perhaps indicate that the

7. As a result of this crisis, the Malaysia Ringgit depreciated nearly 60% against the US dollar.

US dollar as well as treasury bill are substitutes for monetary assets. Hence the possibility of currency substitution between Malaysian Ringgit and the dollar cannot be ruled out. Thus providing some support to McKinnon's (1982) hypothesis of currency substitution.

The Hansen-Johansen (1993) likelihood ratio tests provide some evidence of instability in the long-run parameters after 1997q:4 and this could be due to the recent financial crisis in this region. In conclusion, the whole analysis has provided a partial support to the empirical investigation of a stable long-run relationship between exchange rate and money demand in Malaysia.

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