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MONEY, INCOME AND THE LUCAS CRITIQUE: THE CASE FOR MALAYSIA

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ABSTRACT

The objective of this study is to determine the usefulness of the monetary aggregates in Malaysia for policy action purposes. Money M1 and M2 were tested for weak exogeneity, strong exogeneity and superexogeneity (which implies Lucas critique) within a seasonal error-correction model framework. Our weak exogeneity and superexogeneity tests suggest that money M1 and M2 are not subject to the Lucas critique and thus imply that both monetary aggregates are useful intermediate targets for monetary policy purposes. The importance of money as intermediate targets is further strengthened as our seasonal error-correction model indicates that money (M1 and M2) and income exhibit stable long-run relationships.

ABSTRAK

Objektif kajian ini adalah untuk menentukan kebergunaan agregat kewangan Malaysia untuk tujuan dasar. Wang M1 dan M2 diuji terhadap 'weak exogeneity', 'strong exogeneity' dan 'superexogeneity' (membayangkan 'Lucas critique') menggunakan rangkakerja model 'seasonal error-correction'. Hasil ujian 'weak exogeneity' dan 'superexogeneity' mencadangkan bahawa wang M1 dan M2 tidak tertakluk kepada 'Lucas critique' dan ini menandakan bahawa agregat kewangan tersebut adalah berguna sebagai sasaran pertengahan untuk tujuan dasar kewangan. Kepentingan wang sebagai sasaran pertengahan seterusnya disokong oleh hasil daripada model 'seasonal error-correction' yang menunjukkan bahawa wang (M1 dan M2) dan pendapatan menggambarkan hubungan jangka panjang yang stabil.

INTRODUCTION

The aftermath of the recent financial liberalisation has created new problems for the monetary authorities of developing countries. The relationship between monetary aggregates, in particular, narrow money M1 and national income has been questioned. There is evidence of a breakdown in the relationship between M1 and income in developing countries, and this has led monetary authorities to focus on broader monetary aggregates as monetary indicators for the purpose of policy actions. Tseng and Corker (1991, 1993) have concluded from their study on nine Asian[1] countries that the changing financial system has altered the relationships between money, income and interest rates. Tseng and Corker pointed out that financial liberalisation leads to one time or more gradual shifts in the level of money holdings, as well as to changes in the measured income and interest rate elasticity of money demand. Earlier, Gurley and Shaw (1960) pointed out that the increased availability of interest-bearing financial assets as a result of an expanding financial sector can raise the sensitivity of money holdings to changes in interest rates. The implications of the growth of these money substitutes are important for monetary policy since with a high interest elasticity of money demand, monetary policy become less effective. However, by mid-1990s, as a result of further financial liberalization and innovation, the link between broad monetary aggregates and other macroeconomics was found to be unstable. Consequently, monetary aggregates have been de-emphasized as monetary policy tools instead, the policy tool; has been shifted to interest rate targeting (Bank Negara Malaysia, 1989).

Our question is: Is money irrelevant in Malaysia? This is an empirical question. Therefore, the purpose of this study is to determine whether monetary aggregates are still useful for the purpose of monetary policy action in Malaysia. The study addresses the issue of whether the Lucas critique is relevant in the case of monetary aggregates used for policy variables in Malaysia.

METHODOLOGY

The Concept of Lucas Critique

The concept of exogeneity and its testable applications was introduced by Engle *et al.* (1983) and Engle and Hendry (1993). Engle *et al.* (1983) have proposed three types of exogeneity: weak exogeneity, strong exogeneity and superexogeneity. The test for exogeneity is important because in empirical applications, while only weak exogeneity is needed for estimation purposes and for testing, and strong exogeneity for forecasting, superexogeneity is required for policy analysis. According to Engle *et al.* (1983), the concept of superexogeneity is closely associated with the Lucas (1976) critique. Lucas (1976) argues that an econometric model is unstable and will perform poorly in different time periods because the underlying structure changes as expectation-generating mechanism and/or policy regime changes over time. Therefore, a relevant economic series or an economic model needs to be invariant to these changes to be useful for policy analysis.

Favero and Hendry (1992) have shown that the concept of superexogeneity can be use to examine whether a policy variable is subject to the Lucas (1976) critique. More recently, the relevance of Lucas critique on the performance of economic modelling has been subjected to rigorous empirical investigations and testings in the literature (see Favero and Hendry, 1992; Fischer, 1989; Fischer and Peytrignet, 1991; Caporale, 1996; Kwan and Kwok, 1995; Kwan *et al.*, 1996). However, the majority of the studies conclude that the Lucas critique is not of empirical significance in accounting for the failures of the econometric models (see also Fischer, 1988). Thus, in our case, if a monetary aggregate possesses the superexogeneity status, that is, the coefficient of money variable is invariant to policy changes, then policy evaluation using this approach is possible and thus useful to the monetary authority.

Lets consider the following simple regression model,

$$y_t = a + bx_t + \varepsilon_t \qquad (1)$$

where y_t and x_t have normal distribution with means $E(y_t)=\mu_y$, $E(x_t)=\mu_x$ and variances and covariances given by $var(y_t)=\sigma_y^2$, $var(x_t)=\sigma_x^2$, and $cov(y_t,x_t)=\sigma_{yx}$. The conditional distribution of y_t given x_t is,

$$y_t|x_t \sim IND(a + bx_t, \sigma^2) \qquad (2)$$

where 'IND' denotes independently and normally distributed, $b = (\sigma_{yx}/\sigma_x^2)$, and $\sigma^2 = [\sigma_y^2 - (\sigma_{yx}/\sigma_x^2)]$. The joint distribution of y_t and x_t can be written as,

$$f(y_t, x_t) = g(y_t|x_t)h(x_t) \quad (3)$$

where $g(y_t|x_t)$ involves the parameter Φ and $h(x_t)$ is the marginal distribution of x_t. Based on equation (3), a variable is said to be weakly exogenous for estimating a set of parameters Φ, if inference on Φ conditional on x_t involves no loss of information. Weak exogeneity represents a necessary condition for satisfactory single-equation regression model. Furthermore, in a dynamic context, weak exogeneity allows feedback from the endogenous to the exogenous variables and therefore, weak exogeneity may tell us nothing about the direction of causality of y_t to x_t or x_t to y_t. In other words, weak exogeneity implies that the marginal distribution $h(x_t)$ does not involve the parameter Φ. On the other hand, if x_t is weakly exogenous and is not *Granger caused* by any of the lagged values of y_t, it is said to be strongly exogenous. Thus, Granger non-causality (from y_t to x_t) is considered to be a necessary condition for strong exogeneity. As for superexogeneity, if x_t is weakly exogenous and the parameters in $g(y_t|x_t)$ remain structurally invariant to changes in the marginal distribution of x_t (i.e. to changes in regime or policy interventions), then x_t is said to be superexogenous (see Engle *et al.*, 1983).

Testing the Lucas Critique

To construct a test for the null hypothesis that money, x_t, is weakly exogenous and/or superexogenous (Lucas critique), we first have to determine the conditional model and then estimate a marginal model (an instrumental variable estimates of x_t) for x_t, and then tests for the presence of the predicted values of x_t in the conditional model. The significance of the residuals or the fitted estimates from the instrumental variables regression may be tested with a *t*- or *F*-tests.

In this study the following conditional model is chosen:

$$\Delta_4 y_t = c_0 + \sum_{i=1}^{q} \phi_i \Delta_4 y_{t-i} + \sum_{j=0}^{p} \lambda_j \Delta_4 x_{t-j} + \theta \mu_{t-1} + \varphi \upsilon_{t-1} + \gamma_1 \eta_{t-2} + \gamma_2 \eta_{t-3} + \varepsilon_t \quad (4)$$

Equation (4) is known as a seasonal error-correction model specified by Hylleberg *et al.* (1990). The parameters μ_{t-1}, υ_{t-1}, η_{t-2} and η_{t-3} are lagged residuals from the following equations (5), (6) and (7) respectively,

$$y_{1t} = a_1 + \alpha_1 x_{1t} + \mu_t \quad (5)$$
$$y_{2t} = a_2 + \alpha_2 x_{2t} + \upsilon_t \quad (6)$$
$$y_{3t} = a_3 + \alpha_3 x_{3t} + \alpha_4 x_{3t-1} + \eta_t \quad (7)$$

where in each case the x_{it} and y_{it} (i=1,2,3) represent the zero, biannual and annual frequencies which are estimated with an intercept, a_i (i=1,2,3). Furthermore, y_i's and x_i's are transformed variables such that, y_{1t} and x_{1t} equal $(1+B+B^2+B^3)y_t$ and $(1+B+B^2+B^3)x_t$ respectively; y_{2t} and x_{2t} equal $-(1-B+B^2-B^3)y_t$ and $-(1-B+B^2-B^3)x_t$ respectively; y_{3t} and x_{3t} equal $-(1-B^2)y_t$ and $-(1-B^2)x_t$ respectively. The significance of θ, φ, and γ_i's imply that y and x are cointegrated at the long-run, biannual and annual frequencies respectively.

There are three reasons for estimating equation (4) directly instead of adopting the Engle and Granger (1987) two-step procedure proposed by Engle *et al.* (1993). First, according to the result of the Granger Representation Theorem, cointegration imply the existence of an error-correction model and the converse is also true, that is, the existence of an error-correction model implies cointegration of the variables (see Holden and Thompson, 1992). Secondly, the unit root test on the residuals from the Engle-Granger cointegrating regression has low power. Recognizing the weakness of the Engle-Granger two-step procedure, Kremers *et al.* (1992) suggest that the standard *t*-ratio for the coefficient on the error-correction term in a dynamic equation is a more powerful test for cointegration than those of the Dickey-Fuller type tests (the residual-based cointegration test). And thirdly, Franses (1996) proposes the regression-based procedure such as equation (4) as an indirect test for cointegration, that is, by estimating the above error-correction representation directly and use the *t*-values on θ, φ, γ_1 and γ_2 to infer seasonal cointegration. As a matter of fact, due to the low power of all unit root tests, Hurn (1993) proceeded in estimating the seasonal error-correction model and examined the significance of the error-correction terms to infer seasonal cointegration among money and income in South African monetary data.

Next, is to construct an instrumental variable estimates of x_t. In this study, the following general autoregressive model for money supply (the instrumental variable equation) is estimated,

$$\Delta_4 x_t = \alpha_0 + \sum_{i=1}^{L} \beta_i \Delta_4 x_{t-i} + DUM + \omega_t \quad (8)$$

where dummy variables, DUM act as proxies for possible structural breaks. The estimated ϖ_t is then substituted in the conditional model specify by equation (4) as follows,

$$\Delta_4 y_t = c_0 + \sum_{i=1}^{q} \phi_i \Delta_4 y_{t-i} + \sum_{j=0}^{p} \lambda_j \Delta_4 x_{t-j} + \theta\mu_{t-1} + \varphi\upsilon_{t-1} + \gamma_1\eta_{t-2} + \gamma_2\eta_{t-3} + \delta_1\varpi_t + \varepsilon_t \qquad (9)$$

If ϖ_t is significant in term of the *t*-statistic in the dynamic error-correction model, then the null hypothesis that money is weakly exogenous is rejected. On the other hand, to test for superexogeneity or Lucas critique, the estimated ϖ_t and the square estimated ϖ_t^2 are included in equation (4) and test for their joint significance as follows,

$$\Delta_4 y_t = c_0 + \sum_{i=1}^{q} \phi_i \Delta_4 y_{t-i} + \sum_{j=0}^{p} \lambda_j \Delta_4 x_{t-j} + \theta\mu_{t-1} + \varphi\upsilon_{t-1} + \gamma_1\eta_{t-2} + \gamma_2\eta_{t-3} + \delta_1\varpi_t + \delta_2\varpi_t^2 + \varepsilon_t \qquad (10)$$

A significant *F*-test indicates a rejection of superexogeneity.

For strong exogeneity which includes weak exogeneity and Granger non-causality from lagged $\Delta_4 y_t$ to $\Delta_4 x_t$, the Granger causality test is used. Between y_t and x_t, the following structural Granger causal model is estimated

$$\Delta_4 y_t = \alpha_0 + \sum_{i=1}^{k} \alpha_i \Delta_4 y_{t-i} + \sum_{i=1}^{k} \beta_i \Delta_4 x_{t-i} + \kappa_{1t} \qquad (11)$$

and

$$\Delta_4 x_t = \alpha_0 + \sum_{i=1}^{k} \alpha_i \Delta_4 y_{t-i} + \sum_{i=1}^{k} \beta_i \Delta_4 x_{t-i} + \kappa_{2t} \qquad (12)$$

Money x_t is said to be strongly exogenous when the null hypothesis that α_i's are zero in equation (12) can be rejected.

Description and Sources of Data Used

In this study, quarterly monetary and income data for Malaysia for the period 1981:1 to 1994:4 were used in the analysis. Monetary data used in the analysis are the various monetary aggregates employed by the central bank for monetary indicator purposes, particularly, the narrow money M1 and broader M2. Usually M1 comprises currency in circulation and demand deposits held by the private sector. Broad money M2 includes M1 plus savings and fixed (time) deposits at the commercial banks.

As for the income data, which is only available in annual form, we have used total exports as a proxy for nominal income for Malaysia.[2] The rationale of using exports as proxy for income in the Asian developing countries has been supported by numerous empirical studies, for example by Tyler (1981), Feder (1983), Kavoussi (1984), Ram (1987), Moschos (1989) and Odedokun (1991). Furthermore, Dutt and Ghosh (1994, 1996) found that exports and economic growth are cointegrated in the majority of the developing countries. These studies have empirically detected positive and significant effects of export expansion on economic growth.[3]

All data were collected from various issues of the SEACEN Financial Statistics - Money and Banking published by the SEACEN Centre, Kuala Lumpur, Malaysia. Another important source of data was the International Financial Statistics published by International Monetary Fund (IMF). All variables were transformed into natural logarithms.

DISCUSSION OF EMPIRICAL RESULTS

Results of Seasonal Integration and Cointegration

Before we estimate equation (4), the first step is to verify the order of seasonal integration of each of the quarterly series – money M1, money M2 and income. The standard procedure for determining the order of seasonal integration of a time series is the application of the Hylleberg *et al.* (1990) test (HEGY test) for seasonal unit roots.[4] Table 1 presents the HEGY test for the three series involved in the analysis. Results of the HEGY test on the level of the series (see Panel (A)) show that none of the test statistics is significant at the five percent level. This implies that the level of money and income series in Malaysia is seasonally integrated of order (1,1). Next, we test whether the filter Δ_4 or $\Delta\Delta_4$ is appropriate to render the series stationary. Franses (1996) notes that in some cases, seasonal differencing by applying the filter Δ_4 is adequate to achieve stationarity in an I(1,1) variable. However, this is an empirical question and cannot be determined a *priori*. Empirical studies have shown that for some developing countries – South Africa and India, money and income series are adequately represented by the filter $\Delta\Delta_4$ to achieve stationarity (see Hurn, 1993; Moosa, 1997).

Table 1

Results of HEGY Tests for Seasonal Unit Roots

Series	π_1	π_2	π_3	π_4	$\pi_3 \cap \pi_4$	p	LM(4)
A. Series in level							
M1	-0.90	-1.91	-1.79	-1.47	3.31	8	4.61
M2	-0.83	-0.90	-1.04	-1.93*	2.63	10	7.31
Income	-1.96	-2.44	-2.30	-0.68	3.11	10	6.10
B. Series in Δ_4							
M1	-1.20	-3.90*	-3.45*	-3.46*	15.08*	5	4.63
M2	-0.42	-3.65*	-3.69*	-3.69*	13.60*	5	4.75
Income	-2.81	-3.55*	-5.27*	-1.04	15.68*	4	5.05
C. Series in $\Delta\Delta_4$							
M1	-3.16*	-4.12*	-5.78*	0.24	16.79*	4	4.68
M2	-3.55*	-3.72*	-5.41*	-0.15	14.72*	4	4.30
Income	-4.11*	-3.04*	-5.85*	-1.04	1.94*	1	5.33

Notes: All regressions in levels were estimated with an intercept as deterministic component. The 5 percent critical value are $t{:}\pi_1 = -2.96$, $t{:}\pi_2 = -1.95$, $t{:}\pi_3 = -1.90$, $t{:}\pi_4 = -1.72/1.68$, $F{:}\pi_3 \cap \pi_4 = 3.04$. All regressions in Δ_4 and $\Delta\Delta_4$ were estimated with an intercept as deterministic component. The 5 percent critical value are $t{:}\pi_1 = -2.96$, $t{:}\pi_2 = -1.95$, $t{:}\pi_3 = -1.90$, $t{:}\pi_4 = -1.72/1.68$, $F{:}\pi_3 \cap \pi_4 = 3.04$ (see Tables 1a and 1b in Hylleberg *et al.* (1990)). The LM Chi-square statistic for serial correlation with 4 lags is 9.48 with four degree of freedom (5 percent).
Asterisk (*) denotes statistically significant at 5 percent level.

Nevertheless, in Table 1 we have reported the HEGY tests for the series in Δ_4 (Panel (B)) and $\Delta\Delta_4$ (Panel (C)). Results of the seasonal unit root test on Δ_4 series clearly indicate that in all cases, the series are non-stationary. The HEGY tests results on $\Delta\Delta_4$ series suggest that all test statistics are significantly different from zero at the five percent level, implying that $\Delta\Delta_4 y_t \sim I(0,0)$. In other words, this implies that one-period differencing of the seasonal differences is adequate to make the income and money series stationary. This also implies that in estimating equation (1), for example, y_t and x_t should be in the form of $\Delta\Delta_4 y_t$ and $\Delta\Delta_4 x_t$ which would satisfy the stationarity property of the model.

The results of the above unit root tests indicate that income and money series are integrated of order one but at some specific frequencies. Having established that income and money series are seasonally integrated, our next attempt is to investigate whether income and money series are seasonally cointegrated. In our case, in the quarterly series, cointegration between money and income integrated at the biannual frequency is said to exist if there is at least one linear combination of the series that is stationary at that frequency. For the annual frequency case, cointegration is said to exist if there is at least one linear combination of the series, all integrated at the annual frequency and the series lagged one quarter which is stationary at that particular frequency.

Results of Estimating the Seasonal Error-correction Model

The results of estimating the seasonal error-correction models for Malaysia are presented in Table 2. When we estimate equation (4), the ECM terms at different frequencies are first derived by estimating the cointegrating regressions (5), (6) and (7) for allowing cointegration at zero, bi-annual and annual frequencies respectively. In estimating the cointegrating regression at zero frequency, we include an intercept, seasonal dummies and time trend as additional variables. For co-integration at bi-annual and annual frequencies, the cointegrating regressions include the intercept and seasonal dummies. The lagged residuals from these cointegrating regressions are then added to equation (4). For all error-correction models estimated, we allow for cointegration at all frequencies. However, the final seasonal error-correction models presented in Table 2 were derived according to the Hendry's 'general-to-specific' specification search and the congruency of the model with the data generating process (see Hendry, 1987) are observed from a battery of diagnostic tests which include the test for serial correlation, heteroskedasticity, normality and functional form. The diagnostic tests, namely: the LM(4) test for serial correlation, ARCH (4) test for autoregressive conditional heteroskedasticity, Jarque-Bera test for normality of the residuals and Ramsey RESET test, to test whether the original functional form is incorrect, show that the estimated error-correction models for Malaysia passes these tests at the five percent significance level. Thus, the above diagnostic tests indicate well-fitting seasonal error-correction models that fulfill the conditions of serial non-correlation, homoskedasticity, normality of residuals and no specification errors.

Table 2
Results of Seasonal Error-correction Models

Independent variables	M1	M2
Constant	0.0027	-0.0018
	(0.4382)	(0.2464)
μ_{t-1}	-0.1646	-0.0875
	(5.1237)*	(3.9249)*
ν_{t-1}	-	-
ω_{t-2}	-0.3442	-0.3410
	(3.0722)*	(2.6371)*
ω_{t-3}	0.2122	0.1839
	(1.8265)	(1.4072)
$\Delta\Delta_4 M_{t-1}$	0.4118	-
	(1.8487)	
$\Delta\Delta_4 M_{t-3}$	-	0.5666
		(1.7774)
$\Delta\Delta_4 Y_{t-2}$	-0.3639	-0.3503
	(3.0444)*	(2.4214)*
$\Delta\Delta_4 Y_{t-5}$	-0.1896	-0.1926
	(1.7388)	(1.5157)
R-squared	0.607	0.477
SER	0.042	0.048
DW	2.298	2.123
LM $\chi^2(4)$	2.093	2.891
	[0.718]	[0.576]
ARCH $\chi^2(4)$	1.829	1.745
	[0.767]	[0.782]
NORM $\chi^2(2)$	0.325	0.392
	[0.849]	[0.821]
RESET $\chi^2(2)$	0.378	0.369
	[0.827]	[0.831]

Notes: SER and DW denote standard error of regression and Durbin-Watson statistic respectively. The diagnostic tests presented above are broadly defined as follows: LM(4) is the lagrange multiplier test for residual serial correlation of the fourth-order process. ARCH (4) is the test for fourth-order autoregressive conditional heteroscedasticity. NORM (2) is a test for the normality of the residuals. RESET (2) is used to test whether the coefficients of powers of predicted dependent variables (Y^2, Y^3) are jointly zero. This test may also be regarded as tests of heteroscedasticity but usually regarded as general tests for detection of missing explanatory variables or incorrect functional form.
Numbers in parentheses (.) are *t*-statistics and numbers in the square brackets [.] are *p*-values. Asterisk (*) denotes statistically significant at 5 percent level.

Generally, the results of estimating the seasonal error-correction models show that in all cases, the error-correction terms at two seasonal cycles in the parsimonious models are significantly different from zero at five percent level and show correct sign for both M1 and M2. The results strongly suggest the existence of a long-run relationship between money and income at frequencies other than zero, implying that the income-money relationship should be modelled as a seasonal error-correction model. Thus, in agreement with Moosa (1995), failing to do this, the estimated money-income equation will be subject to mis-specification error.

Therefore, for Malaysia, the results from the seasonal error-correction model suggest that income and money series are cointegrated at both zero and annual frequencies. According to Moosa (1997), what is important from these results is that a cointegration at the zero frequency implies the existence of a long-run relationship between money (M1 and M2) and income.

Results of Exogeneity Tests

The results of weak exogeneity, strong exogeneity and superexogeneity tests are summarised in Table 3. In Table 3 we have included the estimated instrumental variable regressions (see Panel D) used to estimate ϖ_t. The summary of the results of tests for weak exogeneity (Panel A), strong exogeneity (Panel B) and superexogeneity (Panel C), with both the *t*- and *F*-statistics for ϖ_t and ϖ_t^2 are shown at the upper portion of the table. The results clearly indicate that in all cases, the null hypothesis that money (both M1 and M2) is weakly exogenous, strongly exogenous and super exogenous cannot be rejected at the five percent level of significance. When the residuals ϖ_t from the money supply equation are added to the income equation, the coefficient of ϖ_t is not statistically significant at the five percent level. This indicates that monetary aggregate is weakly exogenous in the income equation. As a consequence, the use of a single equation regression in estimating the impact of money supply on income is justified. And when both ϖ_t and ϖ_t^2 were included in the income equation, the results of the *F*-test indicate that their coefficients are statistically insignificant at the five percent level, therefore cannot reject the joint hypothesis of superexogeneity. This finding suggests that monetary aggregate is not subject to the Lucas critique. On the other hand, for strong

Table 3
Results of Exogeneity Tests

	M1	M2
A. Weak exogeneity test:		
t:δ_1	0.4353	0.1029
B. Strong exogeneity test ($y \rightarrow x$), lag=4:		
F-test:	0.183	0.359
	[0.945]	[0.835]
C. Superexogeneity test:		
t:δ_1	-0.5408	-0.0593
t:δ_2	-1.2618	0.6977
F-test:	0.892	0.248
	[0.419]	[0.781]
D. Instrumental variable equations:		
Constant	0.0076	0.0023
	(1.8822)	(0.9204)
$\Delta\Delta_4 M_{t-2}$	0.5428	
	(4.1464)*	
$\Delta\Delta_4 M_{t-4}$	-0.8168	-0.5928
	(5.6372)*	(4.6240)*
$\Delta\Delta_4 M_{t-8}$	-0.5130	-0.5866
	(3.1359)*	(4.3344)*
Δr_{t-3}	0.0137	0.0157
	(2.1513)*	(4.2374)*
D84:4	-0.0720	
	(2.7500)*	
D85:2,3,4		-0.0267
		(2.7324)*
D85:2, 86:1	-0.0509	
	(2.7747)*	
D93:4, 94:1		0.0511
		(4.4185)*
R-squared	0.655	0.698
SER	0.025	0.015
DW	1.759	2.172
LM $\chi^2(4)$	1.473	7.166
	[0.831]	[0.127]
ARCH $\chi^2(4)$	1.234	3.381
	[0.872]	[0.496]
NORM $\chi^2(2)$	2.797	0.665
	[0.247]	[0.716]
RESET $\chi^2(2)$	3.366	1.667
	[0.186]	[0.434]

Notes: r denotes short-term interest rates (3-month Treasury bill rate). D denotes dummy variable. For example D84:4 denotes quarter 4 1984 equals one and zero otherwise. Dummy D84, D85 and D86 to take into account the regime of tight monetary policy during the recession of 1985. D93 and D94 was needed to produce homoscedastic residuals. Numbers in parentheses (.) are t-statistics and numbers in the square brackets [.] are p-values. Asterisk (*) denotes statistically significant at 5 percent level.

exogeneity is neither necessary nor sufficient condition for weak exonegeity. Therefore, even the finding of Granger causality from y_t to x_t does not invalidate the testing for Lucas critique.

CONCLUSION

This study investigates the long run relationship between money and income in Malaysia using the seasonal error-correction modelling approach. The major results of this paper may be summarized as follows. First, the estimated seasonal error-correction models suggest that money and income are cointegrated at both frequencies – the zero frequency and the annual frequency in Malaysia. Furthermore, the existence of the seasonal cointegration at zero frequency between income and money series implies that there are stable long-run relationships between the two variables. Second, our weak exogeneity tests suggest that the estimated single equation seasonal error-correction model for income in Malaysia is well specified. Third, the strong and superexogeneity tests indicate that using monetary aggregates as policy indicators are not subject to the Lucas critique. In other words, all our exogeneity tests - weak exogeneity, strong exogeneity and superexogeneity tests suggest that the use of the seasonal error-correction model for making policy evaluation is possible.

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ENDNOTES

1. The Asian countries included in the study were Indonesia, Korea, Malaysia, Myanmar, Nepal, Philippines, Singapore, Sri Lanka and Thailand.

2. See Habibullah (1997a, 1997b, 1998a, 1998b, 1999a, 1999b) and Habibullah and Smith (1997) for recent studies where export was used as proxy for income in Asian developing countries.

3. Furthermore, the use of export will minimize any spurious results that will arise when using income that had been generated using some interpolation technique. Nevertheless, one has to be cautious when interpretating the results.

4. For further discussions on the use of HEGY procedure for testing for seasonal unit roots in ten Asian countries, see for example Habibullah (1999c).

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