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The Relationship between Broad Money and Stock Prices in Malaysia: An Error Correction Model Approach

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ABSTRAK

Tujuan kajian ini adalah untuk menyelidik hubungan empirik antara penawaran wang dan harga-harga saham di Bursa Saham Kuala Lumpur (KLSE) dengan menggunakan data bulanan yang merangkumi Januari 1984 hingga September 1992. Khususnya, kecekapan pasaran terhadap penerimaan maklumat di Bursa Saham Kuala Lumpur diuji dengan melihat hubungan sebab antara penawaran wang, M3, dan harga-harga saham dengan teknik 'cointegration.' Hasil daripada 'Error Correction model' mencadangkan bahawa hipotesis kecekapan pasaran terhadap penerimaan maklumat boleh ditolak untuk Bursa Saham Kuala Lumpur.

ABSTRACT

The purpose of this study is to investigate the empirical relationship between money supply and stock prices in the Kuala Lumpur Stock Exchange (KLSE), using monthly data that span from January 1984 to September 1992. Specifically, we test for market informational efficiency in KLSE by testing the causal relationships between money supply, M3 and stock prices using the cointegration technique. Results from our Error Correction models suggest that the informational efficiency markets hypothesis can be rejected for the KLSE.

INTRODUCTION

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

Secondly and more importantly is the following question; Do different measures of money supply yield different effects on stock prices? Kraft and Kraft (1977a, 1977b) conclude that the detection of lead-lag relationship between money supply and stock prices are insensitive to the choice of the definition of money supply used. However, several other empirical studies have shown that different choices of money supply measures can have different impacts on stock prices. A brief summary of the impact of alternative definitions of money supply used on stock prices in the recent money supply-stock market nexus is presented in Table 1. We can clearly see from Table 1 that the presence (or the absence) of lead-lag relationships between money supply and stock prices are sensitive to the choice of the definition of money supply used. For example, take the case of Mookerjee's (1987) study, where for Canada, the stock market is efficient with respect to narrow money supply M1, but with broad money supply M2, the results suggest that money supply is the leading indicator for stock price. Results from Thornton (1993), Ho (1983) and Jones and Uri (1987) tend to point to the conclusion that stock markets are sensitive to different measures of money supply used. Therefore, we can conclude that different measures of money supply used can yield different impacts on the stock prices.

In this study, we want to determine whether broad money supply M3 can be a leading indicator for the stock prices in Malaysia. Although the Central Bank of Malaysia has given greater emphasis on the use of broad money M3 as guide for monetary policy purposes, nevertheless the effectiveness of M3 as a monetary instrument is still subject to empirical verification (Bank Negara Malaysia 1990). For example, in a recent study, Ghosh and Gan (1994) queried the role of broad money

M3 as monetary instrument and they concluded that the broad concept (M3) does not serve well with the Malaysian economy. Instead the more relevant stock of money seems to be the conventional and narrow one (M1).

TABLE 1. Summary of previous studies on money supply and stock market relationships

Authors	Period of study	Money	Countries	Conclusions
Mookerjee (1987)	Monthly (1975:1-1985:3)	M1	France, USA, Germany, Netherlands.	Independent
			Japan, Italy, Switzerland.	Unidirectional $M \rightarrow S$
			Canada.	Unidirectional $S \rightarrow M$
			UK	Bidirectional $M \Leftrightarrow S$
		M2	France, USA Germany, Switzerland. Japan, Italy,	Independent
			Canada.	Unidirectional $M \rightarrow S$
			UK, Netherlands	Unidirectional $S \rightarrow M$
	Quarterly (1975:1-1985:1)	M1	France, USA, Japan, Switzerland, Netherland, UK, Germany, Belgium.	Independent
			Italy.	Unidirectional $M \rightarrow S$
			Canada	Unidirectional $S \rightarrow M$

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Table 1 (Continued)

Authors	Period of study	Money	Countries	Conclusions
		M2	France, USA, Japan, Switzerland, Netherland, Germany, Belgium.	Independent
			Italy, Canada.	Unidirectional $M \rightarrow S$
			UK	Unidirectional $S \rightarrow M$
Ho (1983)	Monthly (1975:1-1980:12)	M1	Hong Kong. Australia, Singapore,	Independent
			Thailand.	Bidirectional $M \Leftrightarrow S$
			Japan, Philippines.	Unidirectional $M \rightarrow S$
		M2	Singapore.	Bidirectional $M \Leftrightarrow S$
			Australia, Hong Kong, Japan, Philippines, Thailand.	Unidirectional $M \rightarrow S$
	Monthly (1974:5-1983:10)	M0	USA.	Unidirectional $M \rightarrow S$
		M1	USA.	Unidirectional $M \rightarrow S$
		M2	USA.	Independent
	Quarterly (1963:1-1990:4)	M0	UK.	Independent
		M5	UK.	Unidirectional $S \rightarrow M$

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

Therefore, the primary purpose of this study is to investigate the relationship between broad money supply M3 and stock prices using monthly data. Specifically, this study tests for market informational efficiency in Malaysia by testing the causal relationship between stock prices and money supply using the cointegration approach. In this study we use a broader definition of money supply, that is, M3. Apart from using the Composite stock price index, in this study we also use disaggregated data for stock price indexes, namely; Industrial, Plantation, Finance, Property and Tin.

METHODOLOGY

THE GRANGER CAUSALITY APPROACH

Traditionally, the causality test developed by Granger (1969) is used to test the informational efficiency of the stock market. Granger's definition of causality relies on the predictability of a time series. Formally, the above proposition can be stated as follows: if $\sigma^2(x/x.y)<\sigma^2(x/x)$, then y is said to cause x. The term $\sigma^2(x/x.y)$ is the prediction error variance of x derived from the information set that includes past values of x and y. The term $\sigma^2(x/x)$ is the variance of the prediction error of x based on information contained only in the past values of x. If, however, $\sigma^2(y/y.x)<\sigma^2(y/y)$ then x is said to cause y. Bidirectional causality is said to occur when the above outcomes occur simultaneously. Finally, if $\sigma^2(x/x)<\sigma^2(x/x,y)$ and $\sigma^2(y/y)<\sigma^2(y/y,x)$, then the two series are not temporally related over time and are therefore independent.

A direct test of Granger causality between stock prices (S) and money supply (M) amounts to estimating the following equations

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

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

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

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

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

If, however, the estimated coefficients of the lagged variables of both stock price and money supply as a group in equations (1) and (2) are significantly different from zero, then bidirectional causality is implied between stock prices and the money supply. This finding would also imply stock market inefficiency.

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

THE ERROR CORRECTION MODEL APPROACH

When estimating equations (1) and (2), the series are required to be in their stationary form. Conventionally, the variables are transformed in their first-difference form in order to induce stationarity or using some filter rule as suggested by Box and Jenkins (1970). Furthermore, Granger and Newbold (1977) have pointed out that the danger in using the first-difference form of the data is that potential valuable long-run information contained in the variable expressed in levels are lost. More recently, Engle and Granger (1987) have demonstrated that if two non-stationary variables are cointegrated, a vector autoregression in the first-difference is misspecified. It was shown in Granger (1988) that, if St, Mt are both I(1), but are cointegrated then they will be generated by an Error Correction model of the following form;

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

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

where one of θ_1, $\theta_2 \neq 0$ and ε_{1t}, ε_{2t} are finite-order moving averages. Thus, in the Error Correction Model, there are two possible sources of causation of S_t by M_{t-1} either through the z_{t-1} term, if $\theta_1 \neq 0$, and through ΔM_t term if they are present in the equation. Without z_{t-1} being explicitly used, the model will be mis-specified and the possible value of lagged M_t in forecasting S_t will be missed.

Rewriting equations (1) and (2) in order to take into account the error correction term, we have the following Error Correction model due to Granger (1988),

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

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

where z_{t-1} is the lagged residuals from the cointegration regression between stock price and money supply in level. Granger (1988) pointed out that, based on equation (5), the null hypothesis that M does not Granger cause S is rejected not only if the coefficients on the lagged money supply variables are jointly significantly different from zero, but also if the coefficient on z_{t-1} is significant. The Error Correction

Model also provides for the finding that M Granger cause S, if z_{t-1} is significant even though the coefficients on lagged money supply variables are not jointly significantly different from zero. Furthermore, the importance of α's and β's represent the short-run causal impact, while θ gives the long-run impact. In determining whether S Granger cause M, the same principal applies with respect to equation (6).

The concept of cointegration was first introduced by Granger (1981). The cointegration methodology provides a way in which the long run information of the integrated series in level is conserved into equations that comprise stationary components called the error correction model that gives valid statistical inferences. For any I(1) series, it is always true that the linear combination of the two series will also result in an I(1). However, if there exists a constant A, such that $z_t=S_t-AM_t$ is stationary or I(0), then S_t and M_t will be said to be cointegrated, with A called the cointegrating parameter. If this were not the case, then the variables assumed to be generating the equilibrium can drift apart without bound, which is contrary to the equilibrium concept. If S_t and M_t are I(1) but cointegrated, then the relationship $S_t=AM_t$ is considered a long run or 'equilibrium' relationship, and z_t given above measure the extent to which the system S_t, M_t are out of equilibrium (Granger 1986). Hence, the existence of a linear combination of two I(1) series that is I(0) suggests that the series generally move together over time, such that the relationship holds in the long run.

DATA USED IN THE STUDY

In this study, we used monthly time series data for the Kuala Lumpur Stock Exchange *(KLSE)* stock price indices, namely the Composite, Industrial, Finance, Property, Plantation and Tin stock indexes. The KLSE stock indices were collected from various issues of the Investors Digest published monthly by KLSE. On the other hand, money supply M3 comprised of currency in circulation and demand deposits held by non-bank private sector; savings deposits, fixed deposits, negotiable certificate of deposits and repos at commercial banks, finance companies, Bank Islam, merchant banks and discount houses. Data on M3 are taken from various issues of *Quarterly Bulletin* published by Bank Negara Malaysia. In this study the data used spans from January 1984 until September 1992. All data used in the analysis is are transformed into natural logs.

EMPIRICAL RESULTS

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

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

$$\Delta S_t = \delta_0 + \alpha S_{t-1} + \sum_{i=1}^{L} \delta_i \Delta S_{t-i} + v_t \tag{7}$$

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

$$L_4 = \text{int}\{4(T/100)^{1/4}\} \text{ and } L_{12}=\text{int}\{12(T/100)^{1/4}\} \tag{8}$$

where T is the total number of observations.

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

$$\Delta S_t = \delta_0 + \theta_t + \beta S_{t-1} + \sum_{i=1}^{L} \delta_i \Delta S_{t-i} + \tau_t \tag{9}$$

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

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

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

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

Table 2 presents the results of the unit root tests on the levels and first-difference of the series. Following Schwert (1987, 1989), the truncation lag length chosen was based on the integer portion of the two values of L, that is, $L_4 = \text{int}\{4(T/100)^{1/4}\}$ and $L_{12} = \text{int}\{12(T/100)^{1/4}\}$, and T is the number of observation. With $T=105$, we have $L_4=4$ and $L_{12}=12$. The results for estimating equation (9) shows that none of the series are able to reject the null hypothesis of unit root. In all cases the test statistic t_β is larger than the critical value of -3.45 tabulated in MacKinnon (1991) at five percent level of significance. This result implies the hypothesis that the series are trend-stationary processes can be rejected. On the other hand, the test statistic t_α derived from estimating equation (7) show that the null hypothesis of unit root cannot be rejected for all series. These results clearly indicate that all series are non-stationary in their level form.[1]

On the other hand, the lower half of Table 2 shows the results of unit root tests for first-difference of the series. As shown in Table 2, none of the series are able to reject a unit root in first-difference. The t(test statistics for all series are significantly different from zero at five percent level. We therefore conclude that all series are of the same order of integration, that is, they are all I(1) processes.

TABLE 2. Results of ADF tests for order of integration

Series	L_4=4		L_{12}=12	
A. Level Form	t_α	t_β	t_α	t_β
Composite	-1.11	-3.12	-0.68	-2.97
Industrial	-1.05	-2.79	-0.93	-2.82
Finance	-1.44	-3.08	-1.25	-3.32
Property	-1.79	-2.40	-1.96	-2.70
Plantation	-2.48	-2.85	-1.76	-2.07
Tin	-2.84	-3.06	-1.98	-2.25
M3	1.60	-0.73	1.18	-1.91
B. First-Difference				
Composite	-4.36	-4.88	-2.73	-4.75
Industrial	-4.68	-5.01	-2.73	-4.87
Finance	-4.44	-4.91	-2.54	-4.74
Property	-4.50	-4.59	-2.15	-4.40
Plantation	-4.63	-5.15	-3.09	-4.95
Tin	-3.98	-4.59	-2.81	-4.50
M3	-3.53	-8.72	-1.15	-8.61

Notes: Critical values are from MacKinnon (1991). For t_α and t_β at 5 percent level are -2.86 and -3.41 respectively. Following Lutkepohl (1982) we used Akaike's AIC Criterion to differentiate the optimal lag length between the two L_4 and L_{12}. The optimal lag length chosen minimises $AIC(L) = \ln \det \Sigma_k + (2d^2L)/T$, where L=4 or L=12, d= the number of variables in the equation, det Σ_k = determinant, and Σ_k= estimated residual variance-covariance matrix for lag L.

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

$$S_t = \gamma_0 + \gamma_1 M_t + \eta_t \tag{11}$$

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

$$\Delta\eta_t = \varphi\eta_{t-1} + \varepsilon_t \tag{12}$$

The null hypothesis is H_0: $\varphi=0$, that is S_t and M_t are not cointegrated by means of t-statistic of parameter φ. The critical value is tabulated in MacKinnon (1991). If t_φ is smaller than the critical value then S_t and M_t is said to be cointegrated. Apart from using the above residual-based tests for cointegration, we follow Engle and Granger (1987) in reporting the following cointegrating regression Durbin-Watson (CRDW) statistic computed as follows;

$$\text{CRDW} = \left[\sum_{t=2}^{T} (\eta_t - \eta_{t-1})^2\right] / \left[\sum_{t=2}^{T} \eta_t^2\right] \tag{13}$$

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

The bivariate cointegration tests are presented in Table 3. For CRDW, in all cases, the null hypothesis of no cointegration cannot be rejected. The calculated CRDW values are smaller than that of the critical value tabulated in Engle and Yoo (1987) at five percent level of significance. Similar results can also be concluded from t_φ test statistics. In all cases, the calculated t_φ test statistics are larger than the critical value tabulated in MacKinnon (1991). Thus, the above results seem to suggest that broad money supply M3 and stock prices in the Kuala Lumpur Stock Exchange are not cointegrated and therefore consistent with the efficient markets hypothesis. However, we subject the above analysis with further tests.

TABLE 3. Results of cointegration tests

Cointegrating Regressions	CRDW	t_φ, L_4=4	AIC	t_φ, L_{12}=12	AIC
Composite=f(M3)	0.14	-3.05	-5.01	-2.40	4.89
M3=f(Composite)	0.09	-2.60	-5.63	-1.97	-5.52
Industrial=f(M3)	0.13	-2.44	-5.11	-2.19	-4.99
M3=f(Industrial)	0.09	-1.93	-5.79	-1.68	-5.68
Finance=f(M3)	0.21	-2.94	-5.04	-2.84	-4.91
M3=f(Finance)	0.10	-2.16	-5.24	-1.77	-5.10
Property=f(M3)	0.09	-2.23	-4.69	-2.47	-4.55
M3=f(Property)	0.02	-0.67	-6.30	-0.34	-6.19
Plantation=f(M3)	0.21	-2.69	-5.25	-1.94	-5.03
M3=f(Plantation)	0.01	-0.16	-6.50	0.20	-6.33
Tin=f(M3)	0.13	-2.97	-4.70	-2.12	-4.60
M3=f(Tin)	0.00	-0.02	-7.36	0.35	-7.28

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

RESULTS WITH ERROR CORRECTION MODEL (ECM)

More recently, it has been recognised that the univariate analysis presented above has low power (for example, ADF and CRDW) and have led Jenkinson (1986) and Banerjee et al. (1986) to recommend estimation of an Error Correction model as the starting point for modelling and testing. Jenkinson (1986) pointed out that the Engle-Granger two-step estimation procedure is a form of static cointegrating regression in which the residual exhibit an autoregressive pattern. Furthermore, Sargan and Bhargava (1983) showed that the power of the CRDW test becomes very low as ρ approaches unity.[2]

Therefore, as an alternative test for testing cointegration, the Error Correction Model (ECM) is the more appropriate approach. The ECM approach is derived from an important theorem presented by Engle and Granger (1987) that if a set of variables are cointegrated then there always exist an error correcting formulation of the dynamic model and vice versa. Using this approach, the residual from the cointegrating regression equation (11) are substituted into equations (5) and (6) and these equations are then re-estimated using OLS. Parameters θ_1 and θ_2 are then evaluated whether they are significantly different from zero. The significance of the error correction term (z_{t-1}) is sufficient enough to infer cointegration among the variables in question. Banerjee et al. (1986) have suggested that the *t*-statistic of the error correction term as a more powerful statistic for testing the null of unit root. Furthermore, they also showed that under the alternative of cointegration this *t*-statistic is more powerful than those of the Dickey-Fuller type tests.

The results of the Error Correction models estimated for each of the stock price indexes and money supply M3 are presented in Table 4 through 9 respectively for Composite, Industrial, Finance, Property, Plantation and Tin. In estimating the Error Correction regressions, we have selected K=N=4 and variables ECM_{t-1} represent the lagged residuals from the cointegrating regressions. For each series, we estimated the unrestricted Error Correction models (*a* and *c*) with K=N=4, and the restricted Error Correction models (*b* and *d*) after eliminating the insignificance variables but maintaining ECM_{t-1}.

Looking through Tables 4 to 9, we can clearly see that (i) the ECM_{t-1} variable is significantly different from zero in all regression equations estimated with stock price as dependent variable, but not otherwise; (ii) the efficiency of the restricted Error Correction model imposed by excluding the insignificant variables is demonstrated by the decrease in the standard error of the regression (SEE) over the unrestricted regression; (iii) in all stock price equations, the error correction term ECM_{t-1}, has the correct negative sign and is significant, lending support to the finding that stock price and money supply M3 are cointegrated, and in this case, money supply M3 Granger cause stock price; and (iv) in all money supply equations, the ECM_{t-1} variables has wrong positive sign and are not significantly different from zero (except for Tin), which would imply an unstable dynamic adjustment mechanism and the possibility of omitted variables.

TABLE 4. Error Correction models for composite and money supply

Dependent/ Independent Variables	ΔComposite a	b	ΔM3 c	d
Constant	-0.016 (1.108)	-0.012 (1.216)	0.007 (3.463)***	0.008 (5.597)***
$\Delta\text{Composite}_{t-1}$	0.139 (1.380)		0.010 (0.707)	
$\Delta\text{Composite}_{t-2}$	0.169 (1.679)*	0.168 (1.725)*	-0.025 (1.633)	-0.024 (1.624)
$\Delta\text{Composite}_{t-3}$	-0.015 (0.143)		-0.005 (0.348)	
$\Delta\text{Composite}_{t-4}$	0.043 (0.421)		-0.003 (0.215)	
$\Delta M3_{t-1}$	-0.554 (0.797		0.122 (1.144)	
$\Delta M3_{t-2}$	0.024 (0.034)		0.104 (0.960)	
$\Delta M3_{t-3}$	0.979 (1.429)		0.086 (0.815)	0.159 (1.591)
$\Delta M3_{t-4}$	1.182 (1.714)*	1.402 (2.127)**	-0.024 (0.231)	
ECM_{t-1}	-0.140 (3.087)***	-0.128 (3.050)***	0.001 (0.079)	0.001 (0.252)
R^2	0.16	0.12	0.07	0.05
SEE	0.07996	0.07929	0.01237	0.01213

Notes: Statistically significant at 1(***), 5(**) and 10(*) percent level. Critical values for t-statistics at one, five and ten percent level are 2.576, 1.960 and 1.645 respectively.

TABLE 5. Error Correction models for industrial and money supply

Dependent/ Independent Variables	ΔIndustrial		ΔM3	
	a	b	c	d
Constant	-0.005 (0.420)	-0.006 (0.607)	0.007 (3.494)***	0.009 (5.656)***
$\Delta \text{Industrial}_{t-1}$	0.215 (2.077)**	0.219 (2.225)**	0.009 (0.596)	
$\Delta \text{Industrial}_{t-2}$	0.102 (0.969)		-0.028 (1.731)*	-0.027 (1.741)*
$\Delta \text{Industrial}_{t-3}$	-0.008 (0.081)		0.005 (0.331)	
$\Delta \text{Industrial}_{t-4}$	-0.007 (0.070)		0.007 (0.470)	
$\Delta M3_{t-1}$	-0.606 (0.903)		0.120 (1.139)	
$\Delta M3_{t-2}$	0.049 (0.073)		0.099 (0.919)	
$\Delta M3_{t-3}$	0.489 (0.739)		0.087 (0.827)	0.158 (1.590)
$\Delta M3_{t-4}$	0.946 (1.433)	0.943 (1.502)	-0.015 (0.147)	
ECM_{t-1}	-0.095 (2.210)**	-0.088 (2.334)**	-0.002 (0.337)	-0.001 (0.137)
R^2	0.12	0.10	0.07	0.05
SEE	0.07740	0.07582	0.01234	0.01211

Notes: Statistically significant at 1(***), 5(**) and 10(*) percent level. Critical values for t-statistics at one, five and ten percent level are 2.576, 1.960 and 1.645 respectively.

TABLE 6. Error Correction models for finance and money supply

Dependent/	ΔFinance		ΔM3	
Independent Variables	a	b	c	d
Constant	-0.10 (0.754)	-0.011 (1.105)	0.007 (3.458)***	0.010 (8.709)***
ΔFinance$_{t-1}$	0.106 (1.020)		0.012 (0.780)	
ΔFinance$_{t-2}$	0.223 (2.191)**	0.225 (2.323)**	-0.030 (2.047)**	-0.027 (1.879)*
ΔFinance$_{t-3}$	-0.130 (1.212)		-0.009 (0.579)	
ΔFinance$_{t-4}$	0.022 (0.212)		-0.001 (0.112)	
ΔM3$_{t-1}$	-0.586 (0.828)		0.104 (0.972)	
ΔM3$_{t-2}$	0.210 (0.296)		0.106 (0.974)	
ΔM3$_{t-3}$	0.398 (0.579)		0.084 (0.798	
ΔM3$_{t-4}$	1.089 (1.597)	1.175 (1.815)*	-0.017 (0.168)	
ECM$_{t-1}$	-0.155 (2.881)***	-0.161 (3.355)***	0.005 (0.854)	0.008 (1.392)
R^2	0.17	0.14	0.10	0.06
SEE	0.07982	0.07837	0.01215	0.01200

Notes: Statistically significant at 1(***), 5(**) and 10(*) percent level. Critical values for t-statistics at one, five and ten percent level are 2.576, 1.960 and 1.645 respectively.

TABLE 7. Error Correction models for property and money supply

Dependent/ Independent Variables	ΔProperty		ΔM3	
	a	b	c	d
Constant	-0.017 (1.007)	-0.014 (1.111)	0.007 (3.442)***	0.10 (8.661)***
$\Delta\text{Property}_{t-1}$	0.164 (1.566)		0.004 (0.309)	
$\Delta\text{Property}_{t-2}$	0.250 (2.387)**	0.270 (2.739)***	-0.025 (1.911)*	-0.024 (1.990)**
$\Delta\text{Property}_{t-3}$	-0.077 (0.703)		-0.004 (0.314)	
$\Delta\text{Property}_{t-4}$	-0.006 (0.058)		-0.003 (0.264)	
$\Delta M3_{t-1}$	-0.601 (0.707)		0.102 (0.945)	
$\Delta M3_{t-2}$	0.208	0.096	(0.243)	(0.884)
$\Delta M3_{t-3}$	1.063 (1.297)	1.114 (1.420)	0.077 (0.728)	
$\Delta M3_{t-4}$	0.818 (0.992)		-0.013 (0.125)	
ECM_{t-1}	-0.082 (2.255)**	-0.079 (2.392)**	0.004 (0.847)	0.006 (1.373)
R^2	0.15	0.11	0.09	0.06
SEE	0.09518	0.09423	0.01221	0.01200

Notes: Statistically significant at 1(***), 5(**) and 10(*) percent level. Critical values for t-statistics at one, five and ten percent level are 2.576, 1.960 and 1.645 respectively.

TABLE 8. Error Correction models for plantation and money supply

Dependent/ Independent Variables	ΔPlantation		ΔM3	
	a	b	c	d
Constant	-0.009 (0.780)	-0.014 (1.582)	0.008 (3.658)***	0.009 (5.613)***
ΔPlantation$_{t-1}$	0.144 (1.389)	0.134 (1.364)	0.022 (1.303)	
ΔPlantation$_{t-2}$	0.018 (0.180)		-0.023 (1.332)	-0.019 (1.151)
ΔPlantation$_{t-3}$	0.023 (0.223)		0.000 (0.024)	
ΔPlantation$_{t-4}$	0.065 (0.636)		-0.018 (1.048)	
ΔM3$_{t-1}$	-0.264 (0.436)		0.120 (1.143)	
ΔM3$_{t-2}$	-0.607 (0.999)		0.057 (0.545)	
ΔM3$_{t-3}$	0.417 (0.692)		0.093 (0.877)	0.134 (1.315)
ΔM3$_{t-4}$	1.198 (1.991)**	1.149 (2.014)**	-0.062 (0.592)	
ECM$_{t-1}$	-0.148 (2.702)***	-0.143 (2.988)***	0.005 (1.223)	0.006 (1.443)
R^2	0.14	0.11	0.09	0.05
SEE	0.07037	0.06904	0.01220	0.01207

Notes: Statistically significant at 1(***), 5(**) and 10(*) percent level. Critical values for t-statistics at one, five and ten percent level are 2.576, 1.960 and 1.645 respectively.

TABLE 9. Error Correction models for tin and money supply

Dependent/ Independent Variables	ΔTin		ΔM3	
	a	b	c	d
Constant	-0.025 (1.460)	-0.017 (1.414)	0.008 (3.683)***	0.010 (8.736)***
ΔTin_{t-1}	0.108 (1.080)		-0.000 (0.030)	
ΔTin_{t-2}	0.120 (1.196)		-0.026 (2.074)**	-0.025 (2.056)**
ΔTin_{t-3}	0.072 (0.698)		-0.005 (0.394)	
ΔTin_{t-4}	0.245 (2.361)**	0.250 (2.523)**	0.005 (0.426)	
$\Delta M3_{t-1}$	0.341 (0.417)		0.096 (0.905)	
$\Delta M3_{t-2}$	-0.183 (0.223)		0.083 (0.785)	
$\Delta M3_{t-3}$	1.217 (1.524)	1.259 (1.641)	0.073 (0.703)	
$\Delta M3_{t-4}$	0.690 (0.858)		-0.056 (0.540)	
ECM_{t-1}	-0.132 (3.151)***	-0.103 (2.719)***	0.006 (1.362)	0.007 (1.950)*
R^2	0.15	0.11	0.10	0.07
SEE	0.09367	0.09277	0.01215	0.01188

Notes: Statistically significant at 1(***), 5(**) and 10(*) percent level. Critical values for t-statistics at one, five and ten percent level are 2.576, 1.960 and 1.645 respectively.

CONCLUSION

The present paper has applied recent developments in the theory of non-stationary regressors to analyse the empirical relationship between money supply M3 to stock prices in the Kuala Lumpur Stock Exchange. The results suggest that (i) all stock price indexes and money supply I are non-stationary in their level form, (ii) money supply M3 and stock prices are cointegrated suggesting the presence of an error-correction representation, relating the changes in the variables to lagged changes and a lagged combination of levels, and (iii) the error correction model suggest that M3 *Granger cause* stock prices, but not otherwise. These results is inconsistent with efficient markets hypothesis.

The above results suggest that to the viewpoint of the market participants, they will be able to predict stock prices in the Kuala Lumpur Stock Exchange using information on the growth of broad money supply M3 as the trading rule and can consistently earned excess returns. As to the monetary authority, broad money supply *M3* can be a useful monetary instrument in affecting the stock market when the need arises.

NOTES

[1] The test statistics t_α and t_β are t-statistics of parameters α and β in equations (7) and (9) respectively.

[2] From Table 3, we compute ρ using the expression CRDW = 2 (1-ρ), and the first - order autoregressive coefficient is very close but not equal to one in each of the cointegrating regression. These values ranges from 0.90 for Finance = f(M3) to 0.99 for M3 = f (Tin).

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