ANALISIS 7(1&2), 143-153 (2000)

A NOTE ON THE RELATIONSHIPS BETWEEN THE STOCK MARKET AND MACROECONOMIC VARIABLES IN MALAYSIA: AN EMPIRICAL RE-EXAMINATION OF GRANGER NON-CAUSALITY TEST

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ABSTRACT

The purpose of the present paper is to determine whether stock returns are leading indicator for future economic activity in Malaysia. In this study we employ the Granger non-causality test recently proposed by Toda and Yamamoto (1995) to test the causal relationships between the KLSE stock prices and six macroeconomic variables for the sample period 1981:1 to 1994:4. Our results indicate that stock prices are independent with respect with macroeconomic variables, except with money supply.

ABSTRAK

Tujuan kertas kerja ini adalah untuk menentukan sama ada pulangan saham merupakan petunjuk utama untuk meramal masa hadapan aktiviti ekonomi Malaysia. Dalam kajian ini ujian bukan-penyebab Granger yang dicadangkan oleh Toda dan Yamamoto (1995) digunakan untuk menguji hubungan penyebab di antara harga saham di KLSE dengan enam pemboleh ubah makroekonomi untuk jangka masa 1981:1 hingga 1994:4. Keputusan kajian menunjukkan bahawa harga saham tidak dipengaruhi oleh pemboleh ubah-pemboleh ubah makroekonomi kecuali penawaran wang.

INTRODUCTION

The main purpose of this paper is to complement the existing literature on the stock market-macroeconomic nexus in two respects. Firstly, to determine whether stock returns are a leading indicator for future economic activity in Malaysia. It is believed that the improvement in the performance of the stock markets will result in an improvement in the economy measured by the positive growth in the gross national product. Thus, if the stock market is found to be

leading economic growth, the authority may want to use either or both the fiscal and the monetary policies to promote the stock market performance in order to enhance economic growth. However, whether stock markets lead or lag real economic activity is an empirical question. Secondly, the more recent developments in econometrics on the properties of time series has enabled researchers to investigate the relationships between integrated economic variables with ease and can provide precise estimates, in the sense that spurious regression problems can be avoided. The more recent Granger non-causality test proposed by Toda and Yamamoto (1995) provide a simplistic approach in determining the association between integrated series without having to worry about the order of integration or the cointegrating rank in a VAR system.

METHODOLOGY

Stock Returns and Economic Activity: Some Empirical Evidence

Among the many macroeconomic variables, the money supply-stock market nexus has been widely tested in the literature. Early studies by Palmer (1970) and Sprinkel (1971) have indicated that money supply leads stock prices. On the other hand, the evidence that stock market leads money supply was found by Cooper (1974) and Rozeff (1974). However, more recent studies add more controversy to this episode. For example, Thornton (1993) claims that stock price leads money supply in the United Kingdom. For the United States, Malliaris and Urrutia (1991) conclude that money supply tends to lead the stock market. For Taiwan, Lin (1993) found out that the growth in money supply can be used to predict the Taiwanese stock market. Lin's study also showed that both the Korean and Singaporean stock markets are related to the money supply. For the former, money supply leads the stock market, but for the latter, stock market leads money supply. In another study, Ho (1983) found that money supply is a useful information in predicting stock markets in Hong Kong, Japan, the Philippines, Australia and Thailand.

The importance of other macroeconomic variables apart from money supply has been pointed out by Fama (1981). Fama asserts that there is strong relationship between stock returns with other macroeconomic variables, notably, inflation and national output as well as industrial production. Malliaris and Urrutia (1991) found that the performance of the stock market may be used as a leading indicator for real economic activities in the United States. For the United Kingdom, Thornton (1993) also found that stock returns tend to lead real income. For Hong Kong, Mok (1993) found interest rates and stock returns are independent, but evidence indicates that the relationship between stock returns and exchange rates are bidirectional in nature. For the United States, Bahmani-Oskooee and Sohrabian (1992) point out that there is a two-way relationship between the U.S. stock market and the exchange rates. However, Abdalla and Murinde (1997) found that the results for India, Korea and Pakistan suggest that exchange rates Granger cause stock prices which is consistent with

the earlier study by Aggarwal (1981). But, for the Philippines, Abdalla and Murinde found out that the stock prices lead the exchange rates. This is consistent with Smith's (1992) finding that stock returns have a significant influence on exchange rate in Germany, Japan and the United States.

As for Malaysia, the relationships between the stock market and money supply and output has been extensively researched by Habibullah and Baharumshah (1996, 1997, 1998, 1999), Habibullah (1998a, 1998b), Habibullah et al. (1998), and Habibullah and Smith (1998). Using a variety of approaches, in particular the Engle and Granger (1987) two-step procedure, the error-correction method due to Kremers et al. (1992) and the more popular Johansen and Juselius (1990) multivariate cointegration analysis, except for Habibullah and Baharumshah (1996, 1998), all the other studies suggest that the efficient market hypothesis for the Kuala Lumpur Stock Exchange (KLSE) can be rejected.[1] These results indicate that there are long-run relationships between stock returns and money and output. In other words, stock returns, money supply and real income are cointegrated and therefore implies that there is at least one-way causation between these variables. Using the error-correction model approach suggested by Kremers et al. (1992)[2] , Habibullah (1998b) found out that money supply (M1, M2 and M3) and real GNP lead the stock prices on the KLSE.[3]

The Estimating Model

It has been noted that the traditional Granger (1969) causality test for inferring leads and lags among integrated variables will end up in spurious regression results, and the F-test is not valid unless the variables in levels are cointegrated. New developments in econometrics offer the error-correction model (due to Engle and Granger (1987)) and the vector autoregression error-correction model (due to Johansen and Jesulius, 1990) as alternatives for the testing of non-causality between economic time series. Unfortunately, these tests are cumbersome and sensitive to the values of the nuisance parameters in finite samples and therefore their results are unreliable (see Toda and Yamamoto, 1995; Zapata and Rambaldi, 1997). Furthermore, pretests are necessary to determine the number of unit roots and the cointegrating ranks before proceeding to estimate a VECM.

Toda and Yamamoto (1995) propose a simple procedure requiring the estimation of an 'augmented' VAR, even when there is cointegration, which guarantees the asymptotic distribution of the *MW*ald statistic. All one needs to do is to determine the maximal order of integration $dmax$ which we expect to occur in the model and construct a VAR in their levels with a total of $l = (k + d\text{max})$ lags. Lag length k is chosen based on some lag selection criterion. According to Toda and Yamamoto, the *MW*ald statistic is valid regardless whether a series is $I(0)$, $I(1)$ or $I(2)$, non-cointegrated or cointegrated of an arbitrary order.

To examine the causality from stock prices to macroeconomic variables, we

$$\begin{bmatrix} m_t \\ s_t \\ g_t \\ p_t \\ r_t \\ e_t \end{bmatrix} = A0 + A1 \begin{bmatrix} m_{t-1} \\ s_{t-1} \\ g_{t-1} \\ p_{t-1} \\ r_{t-1} \\ e_{t-1} \end{bmatrix} + A2 \begin{bmatrix} m_{t-2} \\ s_{t-2} \\ g_{t-2} \\ p_{t-2} \\ r_{t-2} \\ e_{t-2} \end{bmatrix} + A3 \begin{bmatrix} m_{t-3} \\ s_{t-3} \\ g_{t-3} \\ p_{t-3} \\ r_{t-3} \\ e_{t-3} \end{bmatrix} + \begin{bmatrix} \varepsilon_m \\ \varepsilon_s \\ \varepsilon_g \\ \varepsilon_p \\ \varepsilon_r \\ \varepsilon_e \end{bmatrix} \quad (1)$$

build upon the following system of six (h=6) variables; money supply (m), stock price (s), national income (g), price level (p), interest rate (r), and real effective exchange rate (e). Using Schwarz Bayesian Criterion (SBC) as the lag selection criteria, and say, the lag length chosen indicates that k=2. If $dmax$=1, then we must estimate a VAR(3). Suppose we want to test that st does not *Granger cause* m_t, we then test that s_{t-1} and s_{t-2} do not appear in the mt equation. The system to be estimated is

where A's are six by three matrices of coefficients with A_0 an identity matrix, and the null hypothesis is H_0: $a_{12}^{(1)} = a_{12}^{(2)} = 0$, where $a_{12}^{(i)}$ are the coefficients of s_{t-i}, i=1,2, in the first equation of the system. The existence of a causality from stock price to money supply can be established through rejecting the above null hypothesis which requires finding the significance of the *MW*ald statistic for the group of the lagged independent variables identified above. A similar testing procedure can be applied to the alternative hypothesis that money supply does not *Granger cause* stock price, by testing H_0: $\alpha_{21}^{(1)} = \alpha_{21}^{(2)} = 0$, where $\alpha_{21}^{(i)}$ are the coefficients of m_{t-i}, i=1,2, in the second equation of system equation (1) where the system is being estimated as a VAR(3).[4]

Sources and Description of Data Used

In this study, we used quarterly data series for seven macroeconomic variables for the period 1981:1 to 1994:4. For stock price we proxy using the KLSE Composite Index compiled from various issues of the *Investors Digest* published by Kuala Lumpur Stock Exchange. Three month Treasury bill rate was used to proxy for interest rate and the consumer price index was used to proxy for the price level. For the money supply, we employ both narrow money *m1* and broad money *m2*. The variables were compiled from various issues of the *Quarterly Bulletin* published by Bank Negara Malaysia. Data on real effective exchange rate is provided in Bahmani-Oskooee and Mirzaie (1999)[5] . As for income variable, since the GNP series is only available annually, we follow Gandolfo's (1981) technique to interpolate quarterly data series from annual observations[6]. All variables were transformed into natural logarithm.

The Empirical Results

Table 1
Augmented Dickey-Fuller Unit Root Test Results for the Stock Price Index and Seven Macroeconomic Variables

Variable	*Series in levels*		*Series in first differences*	
	t_u	t_t	t_u	t_t
$m1_t$	0.98	-0.40	-3.84**	-4.05**
$m2_t$	-0.91	-2.16	-3.89**	-3.88**
s_t	-1.20	-2.23	-4.72**	-4.68**
g_t	0.03	-1.97	-3.25**	-3.25*
p_t	-1.36	-1.95	-2.79	-2.94
r_t	-1.96	-2.08	-4.70**	-4.68**
e_t	-0.47	-2.17	-3.24**	-3.21*

Notes: Series *m1*, *m2*, *s*, *g*, *p*, *r* and *e* denote money supply *m1* and *m2*, stock price, nominal income, price level, interest rate and exchange rate respectively. The test statistics, t_u and t_t are for models with constant term, and with constant term and a time trend respectively. Asterisks (**), (*) denote statistically significant at the five and ten percent level respectively.

As our first step, we determine the order of integration for each of the seven macroeconomic variables used in the analysis. Using the standard augmented Dickey-Fuller (ADF) unit root test, we tested both the levels and the first differences of the series. The results are tabulated in Table 1. Clearly the results suggest that all macroeconomic variables except one are characterised as integrated of order one, that is, $m1_t \sim I(1)$, $m2_t \sim I(1)$, $s_t \sim I(1)$, $g_t \sim I(1)$, $r_t \sim I(1)$ and $e_t \sim I(1)$, whereas the price level is probably integrated of order two, that is, $p_t \sim I(2)$.

Having determined that $dmax=2$, we then proceeded to estimate the lag structure of a system of VAR in levels and our results indicate that the optimal lag length based on SBC is one, that is, $k=1$. We then estimate a system of VAR ($h=dmax+k=3$) and compute the *MW*ald test statistic following the steps shown in footnote 5 in Zapata and Rambaldi (1997). The results of the *MW*ald test statistic as well as its *p*-values are presented in Table 2 for *m1* and Table 3 for *m2*. Results in Table 2 (see column 4 and 5) suggest that the null hypothesis of *Granger non-causality* from stock price to money supply *m1*, income, price level, interest rate and exchange rate, and *Granger non-causality* from money supply *m1* or *g* or *p* or *r* or *e* to stock prices cannot be rejected at the five percent significance level. However, in Table 3 (see column 4 and 5), only in the case of money supply *m2* that the null hypothesis of *Granger non-causality* from broad money to stock price can be rejected at the five percent significance level. But, the null hypothesis of *Granger non-causality* that runs from stock price to money supply *m2* cannot be rejected at the five percent significance level. The results suggest that KLSE stock market are independent of all these macroeconomic variables except one.

Table 2
Results of Long-Run Causality Due to Toda-Yamamoto (1995), with *m1* in VAR

Null hypothesis	Test statistics when d_{max}=1		Test statistics when d_{max}=2	
	MWald statistics	*p*-values	*MWald* statistics	*p*-values
Stock price versus money supply *m1*:				
Stock price does not *Granger cause* money supply *m1*.	0.263	0.607	0.048	0.826
Money supply *m1* does not *Granger cause* stock price.	0.132	0.715	0.003	0.952
Stock price versus nominal income:				
Stock price does not *Granger cause* nominal income.	0.148	0.700	0.010	0.919
Nominal income does not *Granger cause* stock price.	0.887	0.346	0.763	0.382
Stock price versus price level:				
Stock price does not *Granger cause* price level.	0.001	0.972	0.275	0.599
Price level does not *Granger cause* stock price.	0.015	0.900	0.130	0.717
Stock price versus interest rate:				
Stock price does not *Granger cause* interest rate.	0.986	0.320	0.830	0.362
Interest rate does not *Granger cause* stock price.	1.762	0.184	2.119	0.145
Stock price versus exchange rate:				
Stock price does not *Granger cause* exchange rate.	0.225	0.635	1.426	0.232
Exchange rate does not *Granger cause* stock price.	0.032	0.857	0.004	0.948

Notes: Asterisk (*) denotes statistically significant at the five percent level.

In the case of broad money *m2*, money supply tends to lead the stock market. The above results imply that the stock market cannot be consider as a leading indicator for future economic activity in Malaysia.

In order to test the robustness of the results with respect to the order of integration, we have also reported the *MWald* test statistic for *dmax=1* in Tables 2 and 3 (see columns 2 and 3). Nevertheless, the results in Table 3 is consistent

Table 3
Results of Long-Run Causality Due to Toda-Yamamoto (1995), with *m2* in VAR

Null hypothesis	Test statistics when d_{max}=1		Test statistics when d_{max}=2	
	MWald statistics	*p*-values	*MWald* statistics	*p*-values
Stock price versus money supply *m2*:				
Stock price does not *Granger cause* money supply *m2*.	2.239	0.134	1.512	0.218
Money supply *m2* does not *Granger cause* stock price.	4.469	0.034*	3.862	0.049*
Stock price versus nominal income:				
Stock price does not *Granger cause* nominal income.	1.599	0.205	1.000	0.317
Nominal income does not *Granger cause* stock price.	0.859	0.353	0.550	0.458
Stock price versus price level:				
Stock price does not *Granger cause* price level.	0.708	0.399	0.207	0.648
Price level does not *Granger cause* stock price.	3.287	0.070	2.827	0.092
Stock price versus interest rate:				
Stock price does not *Granger cause* interest rate.	2.741	0.100	3.075	0.079
Interest rate does not *Granger cause* stock price.	0.356	0.550	0.834	0.361
Stock price versus exchange rate:				
Stock price does not *Granger cause* exchange rate.	0.002	0.957	0.293	0.587
Exchange rate does not *Granger cause* stock price.	0.749	0.386	0.520	0.470

Notes: Asterisk (*) denotes statistically significant at the five percent level.

with our earlier finding with respect to money supply and other macroeconomic variables, regardless whether *dmax=1* or *dmax=2*.[7] The results overwhelmingly indicate that only broad money *m2* leads stock prices in Malaysia for the period under study. With regard to interest rate, price level, nominal income, money supply *m1*, the results generally indicate that they are independent series with the stock market.

CONCLUSION

The main objective of the present paper is to determine the lead and lag relationships between the Malaysian stock market and six key macroeconomic variables. We endeavour to investigate the question: Can the Malaysian stock market act as a barometer for the Malaysian economy? This is of course an empirical question. To test this hypothesis, we employ the methodology of *Granger non-causality* recently proposed by Toda and Yamamoto (1995) for the sample period 1981:1 to 1994:4.

In this study, the KLSE Composite Index was used as a proxy for the Malaysian stock market. The six important macroeconomic variables included in the study are money supply *m1* and *m2*, nominal income (gross national product), price level (consumer price index), interest rate (3-month Treasury bill rate) and the exchange rate (real effective exchange rate).

The results suggest that the stock market does not lead economic activity in Malaysia and that only broad money supply *m2* tends to lead the stock market in Malaysia, but not otherwise. This implies that broad money supply *m2* can be a useful intermediate indicator for monetary policy purposes in Malaysia. The importance of *m2* as policy tool has been noted by Bank Negara Malaysia. According to the Governor of Bank Negara Malaysia (Bank Negara Malaysia, 1985) the role of *m1* as policy tool has been de-emphasized as a result of financial liberalization and innovation in the 1980s. Consequently, broad money supply, in particular, *m2* and *m3* have been found to be more useful monetary tools for enhancing economic growth in Malaysia. Our results seem to support the contention that *m2* is an important monetary tool in Malaysia.

ENDNOTES

1. If Malaysia'a stock market is informationally inefficient with respect, say, to money supply, abnormal profit may be obtained consistently by using information on the changes in money supply. Such result will indicate that monetary policy using money supply as tools should be formulated and implemented to improve the situation of Malaysia's stock market. Using the Eagle-Granger two-step procedure, Habibullah and Baharumshah (1996, 1998) could not find any long-run relationships between stock market and money supply and output.
2. Kremers et al. (1992) have demonstrated that the standard t-ratio for the coefficient on the error-correction term in the dynamic equation is a more powerful test for cointegration than those of the Dickey-Fuller type tests. For recent application of this approach on Asian monetary data, see Habibullah (1999).

3. However, using the traditional Granger (1969) causality approach, Habibullah and Baharumshah (1998, 1999) found out that simple-sum and divisia monies and stock prices are independent.
4. For recent application of this approach, see for example Shah and Sun (1998).
5. The availability of real effective exchange rate limit the perior under study to 1994:4.
6. According to Gandolfo (1981), quaterly (q) figures for output (Q) can be computed as follows: $qQ_1 = 0.0547Q_{t-1} + 0.2344Q_t - 0.0391Q_{t+1}$; $qQ_2 = 0.0078Q_{t-1} + 0.2656Q_t - 0.0234Q_{t+1}$; $qQ_3 = -0.0234Q_{t-1} + 0.2656Q_t + 0.0078Q_{t+1}$; $qQ_4 = -0.0391Q_{t-1} + 0.2344Q_t + 0.0547Q_{t+1}$.
7. Without prior testing for the order of intefration, Yamada (1998) found that export does not *Granger cause* productivity in the majority of the OECD countries whether using *dmax=1* or *dmax=2*.

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