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MALAYSIAN STOCK PRICE AND MACROECONOMIC VARIABLES: AUTOREGRESSIVE DISTRIBUTED LAG (ARDL) BOUNDS TEST

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This study examines the response of the Malaysian stock market on selected macroeconomic variables, namely industrial production, inflation, money supply (M1), interest rate and exchange rate over the period 1980:Q1 to 2011:Q3. By using the autoregressive distributed lag (ARDL) bounds test, this study documented the presence of a long-run relationship between share prices and economic activity. The long-run coefficients suggest that Malaysian share prices are influenced positively by money supply and interest rates, and negatively by inflation. The results from the error correction mechanism indicate that real returns are Granger caused by real money growth and real interest rates. When the exchange rate is included in the estimation, significant relationship has been observed and this implies that exchange rate fluctuations can cause movement in stock prices. This study reveals that the exchange rate is a proper determinant that has explanatory power over stock returns. From the policy perspective, the results suggest that, monetary policies aimed at stabilizing inflation can impact the stock market positively. Since the movement of stock market is highly elastic to inflation, the relationship needs to be taken into account in developing policy for the benefit of the Malaysian economy.

Keywords: stock market, macroeconomic variables, autoregressive distributed lag (ARDL) bounds test

INTRODUCTION

There has long been interest in using macroeconomic variables to make reliable predictions for stock markets, for instance, Chen, Roll and Ross (1986), Thornton (1993), Mukherjee and Naka (1995), Mansor (1999), Wong, Khan and Du (2006), Chen (2009), and Humpe and Macmillan (2009). According to Chen (2009), other than financial variables, macroeconomic variables such as interest-rate term structures, inflation rates and money supply are good indicators to make predictions on stock market movements because they affect future consumption and investment. Hence, these variables are commonly used to predict future economic events that may affect the stock market. If stock returns can be predicted by macroeconomic variables which are publicly available, then investment decisions can be made by utilising past macroeconomic information. This exploitable opportunity would benefit market participants in formulating market-timing strategies. From a researcher's point of view, the relationship between stock prices and macroeconomic variables offers a viable research opportunity. The most common theory used in research aimed at exploring the linkage between macroeconomic variables and stock market returns is the Arbitrage Pricing Theory (APT) which posits that multiple risk factors can fully explain financial asset returns (Ross, 1976).

Earlier studies modelled short-run relationship based on APT theory. Generally, they showed that macroeconomic variables do indeed have a systematic effect on stock market returns (Chen, Roll and Ross, 1986; Schwert, 1990). On the other hand, recent study by Humpe and Macmillan (2009) associated stock price to future expected cash flows and future discount rate of the cash flows. This approach is known as discounted cash flow or Present Value Model (PVM) which postulates that the macroeconomic variables that influence future expected cash flows should be able to influence stock price as well. Hence, the PVM model is used to examine the long-run relationship between stock market and macroeconomic variables.

Macroeconomic variables selected to predict stock market movements often differ slightly across studies. Traditional macroeconomic variables that are often selected are interest rates, inflation rates, money supply and industrial production. However, Dornbusch and Fischer (1980) argued that the exchange rate is not a viable variable to explain stock market movement. Exchange rates affect the international competitiveness and trade position, real output of the country, and the current and future cash flows of companies, which can be inferred from the stock price movements. Similarly, Humpe and Macmillan (2009) opined that exchange rates only have limited influence on share prices and thus should not be included when predicting stock market movements. They reasoned that domestic economy is responsive to currency development. Thus the impact of foreign income due to exports measured in domestic currency will be reflected in the economy in the medium run. Solnik's study (1987) also posited that exchange rate fluctuations do not have any significant impact over stock prices. On the contrary, Jorion (1990) found a moderate relationship between the stock returns of US multinational companies and the effective exchange rate of US dollar variables. Likewise, Roll (1992) also found a positive relationship between US stock prices and exchange rates. All these studies used the regression and correlation method.

With the availability of sophisticated econometric tools, Bahmani-Oskooee and Sohrabian (1992) who used the cointegration and Granger causality test found bidirectional causality in the short run, but no long-run relationship between the monthly values of S&P 500 index and US dollar effective exchange rate for the period of 1973–88. Nieh and Lee (2001) reported that there is no long-run significant relationship between stock prices and exchange rates in the G-7 countries, which is in tandem with the findings of Bahmani-Oskooee and Sohrabian (1992). Other notable studies on the cointegration and causality of macroeconomic variables and stock returns include Mansor (1999), Aisyah, Noor Zahirah and Fauziah Hanim (2009), and Rasiah (2010).

Moving on to the local scenario, the capitalisation of the Malaysian stock market has expanded and reached RM1.285 trillion. The average trading activity also rose in 2011 with a daily average trading volume of 1.34 billion units and trading value of RM1.79 billion units. The Malaysian domestic stock prices were relatively resilient although there were uncertainties in the global financial market and managed to outperform the MSCI Emerging Asia Index and MSCI World Index in 2011.[1] With stable growth in the past few years, the Malaysian stock market is expected to play a major role in a global financial market, thus providing an attractive investment opportunity for foreign investors. However, fundamental investors will not invest without looking at all the macroeconomic variables that influence the country's economic development to forecast future trends of stock returns and invest accordingly.

This study attempts to establish the relationships between the Malaysian equity market and macroeconomic variables namely industrial production, inflation, money supply, interest rate and exchange rate. Additionally, the study also attempts to establish whether the linkages between economic variables and stock returns are of similar intensity and direction in the absence and presence of the variable of exchange rate compared to the findings in past studies. Based on our belief that the differences between the two models – "model with exchange rates" and "model without exchange rates" are significant, this paper will be markedly different from all previous studies as it attempts to evaluate the causalities using two different models simultaneously.

In relation to this, the first model is estimated without exchange rate, while in the second model, exchange rate is included as an explanatory variable. This study also adds to previous literature on matters concerning interest rates of our country's treasury bills and their influence in the price movements of the stock market. In our knowledge, this has also not been investigated in previous studies. We believe that the macroeconomic variables used here are reflective of the general economic and financial status of Malaysia. Moreover, the study utilises real share prices published by International Monetary Fund (IMF) instead of the stock prices of Kuala Lumpur Composite Index (KLCI) to eliminate the effects of price changes over time.

DATA AND SELECTION OF VARIABLES

Data

The main variables that are representative of stock market movement are the industrial production index, consumer price index, money supply (M1), interest rate of treasury bills and exchange rate. The M1 series is converted to real M1 by dividing consumer price index, while Treasury bill series is adjusted with inflation. All the data series from IMF are quarterly data from 1980:Q1 to 2011:Q3, while the series of industrial production index and consumer price index are adjusted for seasonality by using the Hodrick-Prescott filter method to remove the fluctuations and patterns that are associated with the business cycle. A brief description for each adjusted variable used is presented in Table 1 below. In order to streamline the data, all variables were converted to natural logarithm, except for the Treasury bill rates which are in percentages. The use of natural logarithm mitigates correlations among the variables. It also helps in reducing heteroscedasticity as it compresses the scale in which variables are measured. The time series plot of the data is shown in Figure 1 to provide an overview of the data set.

Table 1: Data description

Variable	Concept	Description	Units
ln *SP*	Natural logarithm of Malaysian share price index	Malaysian share prices	Index, 2005=100
ln *IP*	Natural logarithm of industrial production	Industrial production	Index, 2005=100
ln *CPI*	Natural logarithm of consumer prices	Consumer prices	Index, 2005=100
ln *M*1	Natural logarithm of M1	Money supply	National currency in millions
TB	Interest rates of government treasury bills	3 months treasury bill rates	Percent per annum
ln *ER*	Natural logarithm of exchange rate	Official exchange rate	National currency per US Dollar

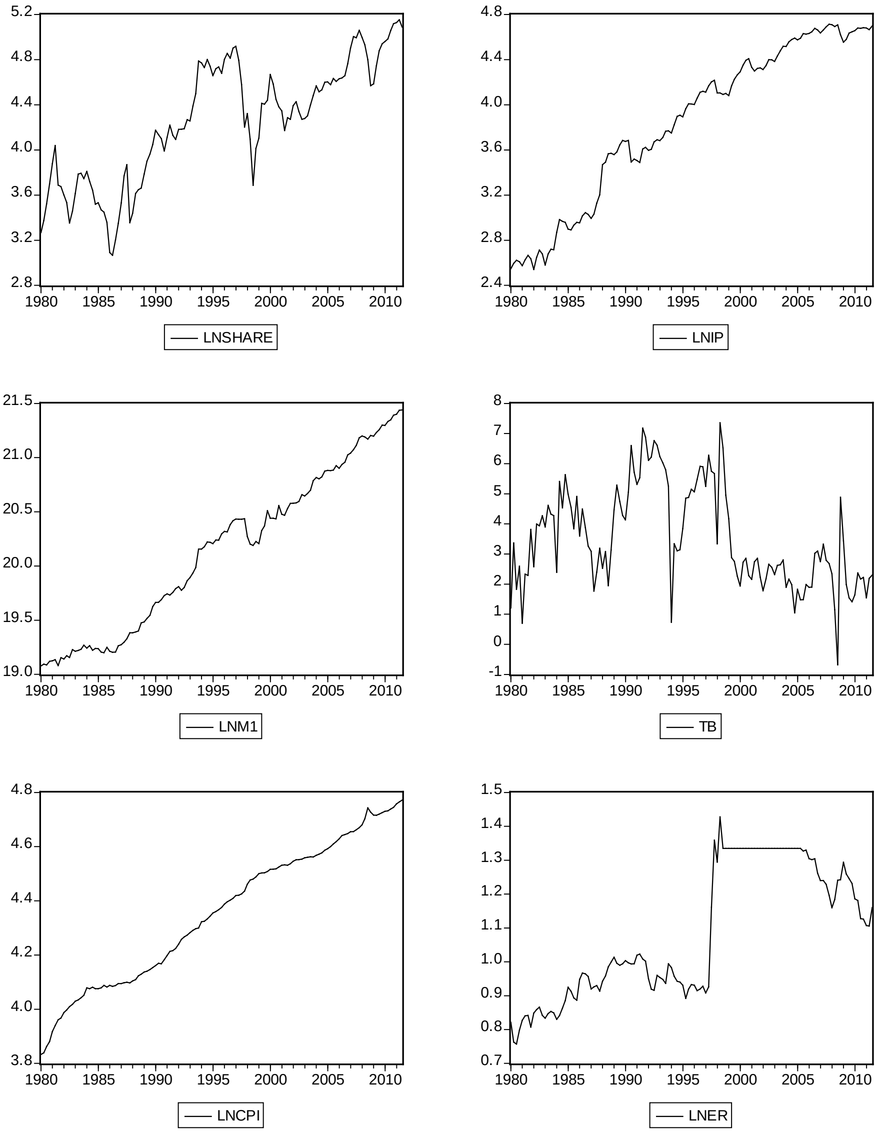

Figure 1: Time series plots of the data set.

Descriptive Statistics

Table 2 reports the summary statistics for the quarterly series of the share prices and macroeconomic variables. All variables exhibit a positive mean return and the treasury bills rate is highly volatile with high standard deviation. Share prices, industrial production and consumer price index have return distributions that are negatively skewed implying that they have a long left tail. The Jarque-Bera normality test rejects the assumption of normality.

Table 2: Summary statistics for the quarterly series

Statistic	ln *SP*	ln *IP*	ln *CPI*	ln *M*1	*TB*	ln *ER*
Mean	4.2515	3.8416	4.3551	20.1439	3.5474	1.0830
Std. Dev.	0.5362	0.7043	0.2585	0.7365	1.6622	0.1951
Skewness	–0.2932	–0.4532	–0.1282	0.0673	0.3238	0.1870
Kurtosis	2.0376	1.8808	1.7895	1.7175	2.3089	1.4557
Jarque-Bera	6.7198**	10.9764*	8.1022**	8.8002**	4.7465**	13.3611*

Selection of Variables

Since, there has not been any formal theoretical guidance to choose an appropriate group of macroeconomic factors to predict stock price changes, the choice is made on the general hypothesis that changes in any of these variables can shift investor's perceptions of future cash flows and therefore affect current asset-prices as evidenced in past research. According to Fama (1981), Chen, Roll and Ross (1986) and Cheung and Ng (1998), financial resources are closely related to aggregate output such as Gross Domestic Product (GDP) or industrial production. In this study, we use the industrial production index since changes in industrial production would influence profits and dividends.

In addition, unanticipated inflation also has a similar effect on stock prices as there would be nominal expected cash flows and nominal rate of interest. Unanticipated inflation also provides information about future levels of expected inflation and this is the main reason to expect a relationship between stock returns and unexpected inflation. Unanticipated inflation usually leads to a decrease in stock prices at the time of the announcement and may reduce corporate income due to rapid increase in costs and the slow adjustment in output prices (DeFina, 1991). Discount rates may also be affected by inflation and thus, the value of future company cash flows is significantly reduced (Humpe and Macmillan, 2009). Therefore, inflation would have a negative effect on stock prices through unexpected changes in the price level.

Another factor that is closely related to stock prices is monetary policy and the best-known monetary variable is money supply as posited in a number of studies such as Palmer, 1970; Urich and Wachtel, 1981; Chaudhuri and Smile,

2004. There are a few measurements for money supply such as the M1 where account balances, cash, coins, and traveller's checks circulating in the economy are used. The M2 includes all the M1 variables and all savings account balances, certificates of deposit, money market account balances, and deposits in foreign banks. The M1 is mainly used as a medium of exchange, whereas the M2 is used as a store of value. Although the M2 is a broader measure of money supply, it is less liquid than the M1. As the M1 is liquid, it is an important indicator for liquidity and economic activity in the economy. Moreover, borrowings and loans will only be reflected in M1. When economic conditions are strong, the growth rate of M1 would increase very quickly as a result of increased investor confidence and economic activity. Therefore, M1 is a precise money supply measure to be used as an indicator for performance of the equity markets.

In actuality, the influence of money supply on stock prices is an offshoot of its influence on the aggregate economy. The unexpectedly high money growth is associated with higher interest rates and this affects stock prices negatively. On the other hand, money supply may increase the stock prices through its impact on economic activities. If the changes in money supply lead to stock price changes, it can be considered as a reliable predictor in stock price changes.

Interest rate stands for another macroeconomic variable which many researchers use in examining the relationship between stock market prices and macroeconomic forces (Chen, Roll and Ross, 1986; Wong, Khan and Du, 2006; Humpe and Macmillan, 2009) as interest rate is one of the channels through which stock prices respond to monetary issues. As interest rates relates to economic activities primarily through consumption and investment, reduced interest rates will lower the borrowing costs for investment and capital. A lower cost of investment leads to an increase in economic activity, while lower cost of capital increases the present value of future cash flows. Thus, interest rates affect stock prices directly by changing the discount rate in the valuation model. Moreover, a drop in the interest rates also promotes current over future consumption. On the other hand, an increase in interest rate also increases the cost of borrowing and the cost of capital for firms and reduces consumer demand. Hence, the government's treasury bills interest rate has been selected because it serves as the opportunity cost of holding shares and acts as a benchmark for measuring interest rate.

The link between exchange rates and equity returns is based on a simple and intuitive financial theory. In Malaysia, Malaysia Ringgit to US dollar is the major international trading currency. Exchange rates offer important information in assessing the stock market because they affect the cost of imports that constitute a large part of the production inputs for Malaysia as an emerging market. Exchange rates, thus, affect importers, exporters, or other firms, which face foreign competition.

The flow oriented exchange rate model hypothesises that exchange rates may have positive or negative effects on stock prices. During appreciation of the local currency, the firm value of exporting firms will decrease and this will negatively affect the share prices of the firm while importing firms stand to benefit and the value of the firm will increase. Adler and Dumas (1984) assert that even domestic firms, which have minimal international trading activities, can still be affected by exchange rate fluctuations if their input and output, or product demand depends on the foreign market. Therefore, exchange rate is one of the factors used in this study.

METHODOLOGY

This study employs the autoregressive distributed lag (ARDL) bounds test proposed by Pesaran, Shin and Smith (2001). By using this testing procedure, the cointegration relationship can be identified by estimating the model using ordinary least squares (OLS) technique, once the lag order of the model is selected. Moreover, the test is relatively more efficient in small or finite sample data sizes. Another advantage of this bounds test is it can be used irrespective of whether the regressors in the model are purely $I(0)$, purely $I(1)$ or mutually cointegrated. However, the procedure will crash in the presence of $I(2)$ series. Therefore, before estimating the ARDL model, the order of integration for the variables must be known. In this study, the Phillips-Perron unit root test is performed before we proceed to the bounds test for cointegration. To maintain brevity of this article, the methodology of Phillips-Perron unit root test is not presented here (see Phillips and Perron, 1988 for more details).

In order to examine the influence of exchange rate in testing the relationship between share price index and other explanatory variables, this study estimates two ARDL models:

$$\begin{aligned}\Delta \ln SP_t = {} & \lambda_{1,0} + \sum_{i=1}^{p_1} \lambda_{1,1i} \Delta \ln SP_{t-i} + \sum_{i=0}^{p_1} \lambda_{1,2i} \Delta \ln IP_{t-i} + \sum_{i=0}^{p_1} \lambda_{1,3i} \Delta \ln CPI_{t-i} \\ & + \sum_{i=0}^{p_1} \lambda_{1,4i} \Delta \ln M1_{t-i} + \sum_{i=0}^{p_1} \lambda_{1,5i} \Delta TB_{t-i} + \lambda_{1,6} \ln SP_{t-1} + \lambda_{1,7} \ln IP_{t-1} \\ & + \lambda_{1,8} \ln CPI_{t-1} + \lambda_{1,9} \ln M1_{t-1} + \lambda_{1,10} TB_{t-1} + \varepsilon_{1,t}\end{aligned} \tag{1}$$

$$\begin{aligned}\Delta \ln SP_t = {} & \lambda_{2,0} + \sum_{i=1}^{p_2} \lambda_{2,1i} \Delta \ln SP_{t-i} + \sum_{i=0}^{p_2} \lambda_{2,2i} \Delta \ln IP_{t-i} + \sum_{i=0}^{p_2} \lambda_{2,3i} \Delta \ln CPI_{t-i} \\ & + \sum_{i=0}^{p_2} \lambda_{2,4i} \Delta \ln M1_{t-i} \sum_{i=0}^{p_2} \lambda_{2,5i} \Delta TB_{t-i} + \sum_{i=0}^{p_2} \lambda_{2,6i} \Delta \ln ER_{t-i} \\ & + \lambda_{2,7} \ln SP_{t-1} \lambda_{2,8} \ln IP_{t-1} + \lambda_{2,9} \ln CPI_{t-1} + \lambda_{2,10} \ln M1_{t-1} \\ & + \lambda_{2,11} TB_{t-1} + \lambda_{2,12} \ln ER_{t-1} + \varepsilon_{2,t}\end{aligned} \tag{2}$$

where Δ is the first difference operator, $\varepsilon_{i,t}$ $(i = 1, 2)$, is a disturbance term assuming white noise and normally distributed and ln is natural logarithmic transformation. To facilitate referencing, the above-mentioned models are named as Model 1 and Model 2. In Model 1, *SP* is the Malaysian share price index with four explanatory variables including industrial production index (*IP*), consumer price index (*CPI*), money supply in national currency (*M*1) and interest rate for Malaysia government treasury bills (*TB*). While in Model 2, the RM/USD nominal exchange rate (*ER*) is added as an explanatory variable to examine the importance of foreign exchange rate to share price index. Since the data are quarterly, in selecting an approximate lag length (*p*) for the ARDL model, a set of the model was estimated with maximum lag length of four. A lag length is preferred where the model has a minimum Akaike information criterion (AIC) value.

In testing the cointegration relationship between share price index and the explanatory variables, the models are estimated by OLS technique. Then, Wald test is performed to obtain the F-statistic value to check whether there is long-run relationship between share price index and those explanatory variables. The null hypothesis (H_0) and the alternative hypothesis (H_A) for the models are stated as follows:

Model 1: $$H_0 : \lambda_{1,6} = \lambda_{1,7} = \lambda_{1,8} = \lambda_{1,9} = \lambda_{1,10} = 0;$$
$$H_A : \lambda_{1,6} \neq \lambda_{1,7} \neq \lambda_{1,8} \neq \lambda_{1,9} \neq \lambda_{1,10} \neq 0$$

Model 2: $$H_0 : \lambda_{2,7} = \lambda_{2,8} = \lambda_{2,9} = \lambda_{2,10} = \lambda_{2,11} = \lambda_{2,12} = 0;$$
$$H_A : \lambda_{2,7} \neq \lambda_{2,8} \neq \lambda_{2,9} \neq \lambda_{2,10} \neq \lambda_{2,11} \neq \lambda_{2,12} \neq 0$$

For some significance level, if the calculated F-statistic value is lower than the lower bound critical value, then the null cannot be rejected and this implies that no long-run relationship can be concluded. On the other hand, if the F-statistic value is higher than the upper bound critical value, then the null hypothesis of no cointegration can be rejected. Thus, a long-run equilibrium relationship occurred among the variables in the function. However, if the F-statistic value falls between the upper and lower bounds, then a conclusive inference cannot be made.

In addition, this study considers the general to specific approach to derive the simplest ARDL model to complement previous studies. Following Tang (2003) in applying this general to specific approach, the first difference variables that have the absolute *t*-statistic less than one are dropped sequentially to ascertain the explanatory variables to be included in the model. In this practice, the higher lag order of first difference variables should be dropped first, and remain at least a first difference variable in the specification. Then, the final model is checked by diagnostic test for robustness. Equation (1) and (2) are the general ARDL models and the general to specific approach is applied to the equations to derive the simplest ARDL model.

From the estimated ARDL model, the long run and short run estimated coefficients provide some useful information regarding the relationship. The long run elasticity are the coefficient of the one lagged explanatory variables in level multiplied with a negative sign and then divided by the coefficient of the one lagged dependent variable in level (Bardsen, 1989). For instance, the long-run industrial production and relative share price elasticity in Model 1 is calculated as $-\left(\lambda_{17}/\lambda_{16}\right)$. The estimated coefficients of the first differenced variable in the model represent the short-run elasticity.

Once cointegration is established, we estimate the long-run ARDL model for the share price (SP_t) as follows:

Model 1:

$$\ln SP_t = \delta_{1,0} + \sum_{i=1}^{p_{11}} \delta_{1,1i} \ln SP_{t-i} + \sum_{i=0}^{q_{11}} \delta_{1,2i} \ln IP_{t-i} + \sum_{i=0}^{q_{12}} \delta_{1,3i} \ln CPI_{t-i} + \sum_{i=0}^{q_{13}} \delta_{1,4i} \ln M1_{t-i} + \sum_{i=0}^{q_{14}} \delta_{1,5i} TB_{t-i} + \xi_{t,i} \quad (3)$$

Model 2:

$$\ln SP_t = \delta_{2,0} + \sum_{i=1}^{p_{21}} \delta_{2,1i} \ln SP_{t-i} + \sum_{i=0}^{q_{21}} \delta_{2,2i} \ln IP_{t-i} + \sum_{i=0}^{q_{22}} \delta_{2,3i} \ln CPI_{t-i} + \sum_{i=0}^{q_{23}} \delta_{2,4i} \ln M1_{t-i} + \sum_{i=0}^{q_{24}} \delta_{2,5i} TB_{t-i} + \sum_{i=0}^{q_{25}} \delta_{2,6i} \ln ER_{t-i} + \xi_{2,t} \quad (4)$$

In Equation (3) and Equation (4), all the variables are as previously defined. The orders of the lag of explanatory variables are selected by AIC. The estimated residual series of the model is known as error correction term (*ECT*).

Next, the error correction model associated is estimated with one lagged *ECT* to obtain the short-run dynamic parameters. The error correction model is based on the re-parameterization of the estimated long-run ARDL model and it is stated as follows:

Model 1:

$$\Delta \ln SP_t = \mu_{1,0} + \sum_{i=1}^{P_{11}} \mu_{1,1i} \Delta \ln SP_{t-i} + \sum_{i=0}^{Q_{11}} \mu_{1,2i} \Delta \ln IP_{t-i} + \sum_{i=0}^{Q_{12}} \mu_{1,3i} \Delta \ln CPI_{t-i} + \sum_{i=0}^{Q_{13}} \mu_{1,4i} \Delta \ln M1_{t-i} + \sum_{i=0}^{Q_{14}} \mu_{1,5i} \Delta TB_{t-i} + \theta_1 ECT_{1,t-1} + e_{1,t} \quad (5)$$

Model 2:

$$\Delta \ln SP_t = \mu_{2,0} + \sum_{i=1}^{P_{21}} \mu_{2,1i} \Delta \ln SP_{t-i} + \sum_{i=0}^{Q_{21}} \mu_{2,2i}\, \Delta \ln IP_{t-i} + \sum_{i=0}^{Q_{22}} \mu_{2,3i}\, \Delta \ln CPI_{t-i}$$
$$+ \sum_{i=0}^{Q_{23}} \mu_{2,4i}\, \Delta \ln M1_{t-i} + \sum_{i=0}^{Q_{24}} \mu_{2,5i}\, \Delta TB_{t-i} + \sum_{i=0}^{Q_{25}} \mu_{2,6i}\, \Delta \ln ER_{t-i} + \theta_2 ECT_{2,t-1} + e_{2,t} \quad (6)$$

In Equation (5) and (6), the short run effects are captured by the coefficients of the first differenced variables. The coefficients are tested by Wald test to check whether there is Granger causality between share price index and those explanatory variables. A negative and significant coefficient obtained for one lagged *ECT* will establish the presence of cointegration and it also represents the adjustment speed.

EMPIRICAL RESULTS AND DISCUSSION

Before estimation of the cointegration relationship by ARDL bounds test, we confirm the integration properties of the six variables using the Phillips-Perron test, which examines the null hypothesis of stationarity. The results are reported in Table 3. For the log-first difference variables of share price, industrial production, consumer price index, money supply and exchange rate, the obtained test statistics are all greater than the critical value at the 1% level of significance, implying that the null hypothesis of unit root is rejected; hence, we conclude that these variables are integrated of order one. For the variable of treasury bills, it is stationary at level as the test statistic is greater than the 1% critical value. In the bounds test procedure, the asymptotic distribution of the F-statistic is non-standard under the null hypothesis of no cointegration relationship, which means that the assumption can be examined irrespective of whether the explanatory variables are $I(0)$ or $I(1)$. Therefore, the treasury bills in $I(0)$ will not be a limitation to proceed to bounds test for cointegration.

The results obtained from the bounds test for cointegration are reported in Table 4. As mentioned earlier, if the estimated F-test statistic is higher than the critical value of the upper bound or $I(1)$, then the null hypothesis of no cointegration is rejected. If the F-test statistic is lower than the lower bound or $I(0)$ critical value, then the null hypothesis cannot be rejected. Refer to Table 4, for Model 1, the calculated F-test statistic is 5.61 for the general model, and 5.49 for the specific model which shows that both are greater than the 1% critical value. This implies that there is a cointegration relationship among the variables. For Model 2, the calculated F-test statistics are significant for both the general and specific model. This shows that exchange rates also have a long-run relationship with the share prices. The general and the specific model for Model 1 and 2 pass through a number of diagnostic tests.[2] As displayed in Table 4, the computed Breusch–Godfrey serial correlation Lagrange multiplier (LM) test for AR[2] is 0.92 for Model 1 and 1.46 for Model 2, which is statistically insignificant at conventional significance levels and this suggests that the disturbances are serially uncorrelated. The adequacy of the models is indicated by the insignificant test value of the Ramsey RESET test and the White heteroskedasticity (HET) test shows that the residuals of the models have a constant variance. The ARCH (1) test values show the absence of heteroscedasticity in the disturbance term.

The estimated ARDL general and specific models for Model 1 and 2 are reported in Panel A of Table 5. In selecting an approximate lag length (*p*), a set of the ARDL model was estimated with lag length of one, two, three and four. As a result, for both the Model 1 and 2, a lag length with one is preferred which minimised AIC. Equation (1) and (2) are estimated with one lag on the first difference variables to obtain the general model for Model 1 and 2 respectively. Then the general to specific process started with the estimated equation. In the general model, the first difference variables with absolute *t*-statistic less than one is dropped sequentially. For instance, the coefficient of $\Delta \ln IP_t$ of Model 1 has the smallest absolute *t*-statistic which is less than one, hence, it is dropped from the estimation of the model. Then the model is estimated again with the remaining variables. The dropping process stops when all the coefficients of the first difference variable have *t*-statistic value greater than one.

For Model 1, the variables of $\Delta \ln IP_t$, $\Delta \ln IP_{t-1}$, $\Delta \ln CPI_t$ and $\Delta \ln CPI_{t-1}$ were dropped from the general to specific exercise. The estimated long-run elasticity is presented in the Panel B of Table 5. From the specific model, the estimated long-run elasticities of the determinants are 0.1338 (industrial production), –3.6293 (consumer price), 1.7822 (money supply) and 0.0671 (treasury bills). While for Model 2, the specific model remains with the first difference variables of $\Delta \ln M1_t$, ΔTB_t, ΔTB_{t-1}, $\Delta \text{In}\, ER_{t-1}$ and $\Delta \text{In}\, ER_{t-1}$. The estimated long-run elasticities of the determinants for Model 2 are similar with Model 1, where the common variables have the same pattern. For exchange rate, its long-run elasticity with share price is in the negative form.

Panel A of Table 6 presents the error correction estimations for the money demand model. The results are based on the re-parameterization of the estimated ARDL (2, 0, 2, 4, 2) for Model 1 and ARDL (2, 0, 0, 0, 2, 2) for Model 2. Based on the results, the lagged error-correction term carries its expected negative sign and is highly significant for both the models. A significant error correction term implies a long-run causality from the determinants variables to share return. While the short-run dynamic in the model is captured by the lagged differences variables. For Model 1, money supply and interest rate Granger cause share return in the short-run and long-run. For Model 2, besides money supply and interest rate, exchange rate also Granger causes share return in the short-run and long-run. The stability of the models between share return and its determinants are assessed through diagnostic checking. As displayed in Panel B of Table 6, the models passed through a number of diagnostic tests.

Table 3: Phillips-Perron unit root test statistics

Variables	Level	1st Difference	Outcome
ln *SP*	–2.9661	–9.2306*	*I*(1)
ln *IP*	–1.5127	–9.6988*	*I*(1)
ln *CPI*	–3.0774	–8.7248*	*I*(1)
ln *M*1	–2.6754	–11.5166*	*I*(1)
TB	–4.7920*	–18.5666*	*I*(0)
ln *ER*	–1.49298	–9.82132*	*I*(1)
Significance Level	Critical Value		
1%	–4.0325	–4.0331	
5%	–3.44588	–3.4462	
10%	–3.14788	–3.1480	

Notes: Null hypothesis of the Phillips-Perron unit root test is the series has a unit root. *SP* is the real Malaysian share price index; *IP* is the real industrial production index, *CPI* is the real consumer price index; *M*1 is the real money supply; *TB* is the real interest rate of Malaysian treasury bills; and ER is the RM/USD nominal exchange rate. * denotes 1% significance level.

Table 4: Bounds test for the existence of cointegration relationship

	Model 1		Model 2	
	General Model	Specific Model	General Model	Specific Model
F-test Statistic	5.6128*	5.4938*	5.5745*	4.9445*
Outcome	Cointegrated	Cointegrated	Cointegrated	Cointegrated
1% Critical Value	*k* = 5		*k* = 6	
I(0)	3.41		3.15	
I(1)	4.68		4.43	
Diagnostic Tests				
BG (2)	0.9215	0.8989	1.4594	1.6939
JB	70.8872*	83.3078*	58.1421*	48.9872*
ARCH (1)	0.3882	0.2942	0.0013	0.0005
HET	0.8378	0.6523	1.4016	1.2058
RESET	0.2384	0.0710	0.5067	2.0407

Notes: Source of critical values for bound test: Table C1 (iii) of Pesaran, Shin and Smith (2001) – Unrestricted intercept and no trend. The diagnostic test statistics are the F-statistic value for the tests of: BG (*n*) = Breusch-Godfrey Serial Correlation Lagrange multiplier test for the *n*th order autocorrelation; JB = Jarque–Bera test for normality of residuals; ARCH (*m*) = Engle's *m*th order autoregressive conditional heteroskedasticity test; HET = White's test for heteroskedasticity; and RESET = Ramsey's test for functional form misspecification. * denotes 1% significance level.

Table 5: Estimated ARDL model for bounds test and the long-run elasticity relative to the Malaysian share prices

Panel A: Estimated ARDL model for bounds test

Variable	Model 1		Model 2	
	General Model	Specific Model	General Model	Specific Model
Constant	–4.7270*	–4.7799*	–3.8536*	–3.6196*
Δ1n SP_{t-1}	0.1664***	0.1655***	0.1057	–
Δ1n IP_t	0.1759	–	0.1095	–
Δ1n IP_{t-1}	–0.2027	–	–0.1771	–
Δ1n CPI_t	–1.6126	–	–2.3058	–
Δ1n CPI_{t-1}	2.9744	–	3.7200	–
Δ1n $M1_t$	0.9864*	0.9887*	0.7225*	0.7514*
Δ1n $M1_{t-1}$	0.6431**	0.5285***	0.4601	–
$\Delta \mathrm{TB}_t$	–0.0301	–0.0172	–0.0419**	–0.0323*
$\Delta \mathrm{TB}_{t-1}$	–0.0288*	–0.0340*	–0.0326*	–0.0414*
Δ1n ER_t	–	–	–0.6213**	–0.7555*
Δ1n ER_{t-1}	–	–	–0.8427*	–0.9094*
1n SP_{t-1}	–0.3030*	–0.2871*	–0.3138*	–0.2648*
1n IP_{t-1}	0.0684	0.0384	0.1497***	0.1270***
Δ1n CPI_{t-1}	–1.1241*	–1.0419*	–1.0884*	–1.1088*
1n $M1_{t-1}$	0.5238*	0.5116*	0.4686*	0.4546*
TB_{t-1}	0.0193**	0.0193**	0.0178***	0.0157***
1n ER_{t-1}	–	–	–0.1517	–0.1116

Panel B: Long-run elasticity

		ln *SP*	ln *IP*	ln *CPI*	ln *M*1	*TB*	ln *ER*
Model 1	General Model	–1.0000	0.2258	–3.7105	1.7291	0.0637	–
	Specific Model	–1.0000	0.1338	–3.6293	1.7822	0.0671	–
Model 2	General Model	–1.0000	0.4769	–3.4680	1.4932	0.0566	–0.4833
	Specific Model	–1.0000	0.4794	–4.1867	1.7166	0.0591	–0.4213

Notes: *, ** and *** denote 1%, 5% and 10% significance level, respectively.
SP is the real Malaysian share price index; *IP* is the real industrial production index, *CPI* is the real consumer price index; *M*1 is the real money supply; *TB* is the real interest rate of Malaysian treasury bills; and ER is the RM/USD nominal exchange rate.

From the estimation of the ARDL models, the long-run relationship between industrial production and share price is weak (insignificant for Model 1 and 10% significant for Model 2). In addition, the Granger causality test results showed that industrial production does not contribute significantly to the stock return in the short-run. The insignificant positive impact implies that innovation on industrial production has less influence on the firm value. Although this result is uncommon, it is supported by the bivariate analysis of Mansor (1999) where industrial production has no significant long-run relationship with stock price and it does not Granger causes Malaysian stock returns.

In the case of consumer price index, the result is in line with Chen, Roll and Ross (1986) who theorised the relationship as negative. As one of the determinants, consumer price index has a significant long-term relationship with share prices. Furthermore, consumer price index has the highest sensitivity among other determinants. An increase in the consumer price index will cause the share prices to have a largely negative movement. Therefore, this result is a call for policy makers to focus more on consumer price index to maintain the stability of the stock market. For money supply, the results obtained from this study are similar with the results of the study by Mukherjee and Naka (1995) and Rasiah (2010). Money supply shows a positive influence on share prices in short-run and long-run. As clarified earlier, the increase in share prices is influenced by economic stimulus provided by money growth. This result is also in common with the portfolio theory which suggests that an increase in money supply causes a portfolio shift from non-interest bearing money to financial assets including stocks.

The long-run relationship between share prices and interest rate of treasury bills is found to be positive. Moreover, in the short-term, changes of interest rate is found to Granger cause share returns. The positive impact contradicts to the theory that interest rates and share prices should move in opposite directions. Based on the cause for changes in interest rates, this paper provides an alternative point of view.

Inflation rate in Malaysia has been accelerating since 1990s and hit the highest rate in the third quarter of 2008. At the same time, the Malaysian economy also experienced sustained rapid growth. In this situation, the government may apply inflation targeting policy to control the inflation rate. This monetary policy follows the principle proposed by Taylor (1993) to adjust interest rates in response to the changes in the inflation rate and output gap. In particular, this rule states that for each one-percent increase in inflation, the central bank should raise the nominal interest rate by more than one percentage point. If the purpose of the central bank in rising the interest rate is to limit inflation pressures due to strong levels of economic growth, then it would have an overall positive impact on the stock market.

Table 6: Granger causality test results

Panel A: Granger Causality Test							
	Regressors	$\Delta \ln IP$	$\Delta \ln CPI$	$\Delta \ln M1$	ΔTB	$\Delta \ln ER$	ECT_{t-1}
Model 1:	$\Delta \ln SP$	0.0786	0.1851	4.9427*	5.0996*	–	–0.8502* (–4.1992)
Model 2:	$\Delta \ln SP$	0.2111	0.1567	10.6194*	9.2660*	10.9592*	–1.0270* (–5.2487)

Panel B: Diagnostic Checking		
Diagnostic Tests	Model 1	Model 2
BG (2)	0.2119	0.4744
JB	37.2310*	85.3939*
ARCH (2)	1.2763	0.0011
HET	1.0426	0.8718
RESET	0.3376	1.4582

Note: Panel A shows the F-statistic values of the Wald test. Panel B shows the F-statistic value for the diagnostic tests. The *ECT* is obtained from the estimation of the long-run ARDL model as Equation (3) for Model 1 and Equation (4) for Model 2. The selected lag length for the ARDL Model 1 is (2, 0, 2, 4, 2), while Model 2 is (2, 0, 0, 0, 2, 2). Figure in parenthesis is the *t*-statistic for the coefficient of $ECT_{i,t-1}$. * denotes 1% significance level. For definition of the variables and diagnostic test, see Table 3 and Table 4 respectively.

For exchange rates, the result obtained from the estimation of Model 2 has shown that it is an important factor in predicting stock prices. Although it does not have a significant long-run relationship with the share price index, exchange rate movements are found to Granger cause share return in the short-run. The result resonates with the flow oriented exchange rate models as discussed by Dornbusch and Fischer (1980) who postulate that exchange rate movements can cause movements in stock prices. From the macroeconomic point of view, stock prices represent the discounted present value of a firm's expected future cash flows, then movements in the exchange rate that affect a firm's cash flow will be reflected in that firm's stock price. As the Malaysian economy is export-oriented, the exchange rates play a crucial role in the trading activities of exporting firms, as well as their firm value. Therefore, the results imply that exchange rate is an important factor in predicting stock market movement, especially in countries with an export-oriented economy.

CONCLUSION

Using the bounds testing procedure and error correction Granger causality tests, the study investigates whether selected macroeconomic variables have predicting or explanatory power over Malaysian share prices. The use of the bound test of cointegration indicates that share prices are cointegrated with a set of selected macroeconomic variables, namely, industrial production, consumer price index, money supply, treasury bills and exchange rates. Moreover, the long-run coefficients suggest that Malaysian share prices are influenced positively by money supply and interest rate and negatively by inflation. On the other hand, the results from the error correction mechanism indicate that real share returns are Granger caused by real money growth and real interest rate growth. When exchange rate is included in the estimation, the results imply that exchange rate fluctuations can also cause movement in stock prices. Based on the empirical result of this study, it can be concluded that domestic macroeconomic activities have influenced the Malaysian stock market. Besides utilising these traditional variables, future research in this area may include various other macroeconomic variables that can contribute to the existing literature. From a policy perspective, the results suggest that, monetary policies aimed at stabilising inflation can generate positive effects to the stock market. Since the movement of stock market is highly elastic to inflation, it needs to be accounted for, so that it benefits our economy.

NOTES

1. Securities Commission Malaysia Annual Report 2010. Accessed on 26 February 2013, from Securities Commission Malaysia Web site: http://www.sc.com.my/main.asp?pageid=381&menuid=490&newsid =&linkid=3037&type/
2. Violation of normality in the residual series is shown by the Jarque-Bera test. In our case, the problem with the residual distribution is mainly due to one or two large errors. From the residual plot, the large errors can be observed around the period of Asian financial crisis in 1997; hence, they can be explained as unique events.

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