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EFFECTS OF MACROECONOMIC VARIABLES ON STOCK PRICES INMALAYSIA: AN APPROACH OF ERROR CORRECTION MODEL

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ABSTRACT

This paper attempts to examine the short-run and long-run causal relationship between Kuala Lumpur Composite Index (KLCI) and selected macroeconomic variables namely inflation, money supply and nominal effective exchange rate during the pre and post crisis period from 1987 until 1995 and from 1999 until 2007 by using monthly data. The methodology used in this study is time series econometric techniques i.e. the unit root test, cointegration test, error correction model (ECM), variance decomposition and impulse response function. The findings show that there is cointegration between stock prices and macroeconomic variables. The results suggest that inflation, money supply and exchange rate seem to significantly affect the KLCI. These variables considered to be emphasized as the policy instruments by the government in order to stabilize stock prices.

Keywords: Kuala Lumpur Stock Exchange, Money Supply, Nominal Effective Exchange Rate, ECM

1. INTRODUCTION

Malaysia is one of the countries that is improving very fast after the financial crisis in 1997. For the recent GDP in year 2007, it was estimated to be $357.9 billion with a growth rate of 5% to 7% since 2007. In addition, the Malaysian economy strengthened in 2006, with real gross domestic product (GDP) expanding by 5.9%.

In early 1980s, after the commodity crisis due to second oil crisis, it caused slowdown of the Malaysian economy. It led to rapid drop in commodity prices and increases the domestic and external debt. The Malaysian government had initiated different forms of monetary and fiscal policies to solve the imbalances in the economy. The monetary policy was selectively restrictive during the early 1980s, with the gradual increase in the general level of interest rates as a measure to counteract fiscal expansionary (Cheng, 2004).

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Prior to 1985 recession, the Malaysian government promoted the manufacturing sector and emphasised more on electric and electronic products. But in 1985, Malaysia had to face electronic crisis whereby the price of electronic dropped and it simultaneously affected the Malaysian GDP. In 1986 Malaysian economy rose again which resulted the growth of GDP by 1.3 per cent. The table below shows a clear picture of Malaysian economy from certain periods.

Table 1
Comparisons of GDP, Exchange Rate & Inflation by Years

Year	GDP (in millions)	Exchange Rate (RM/USD)	Inflation Index (Base Year 2000)
1980	54,285	2.17	51
1985	78,890	2.48	64
1990	119,082	2.70	70
1995	222,473	2.50	85
2000	343,216	3.80	100
2005	494,544	3.78	109

Source: World Economic Outlook Database

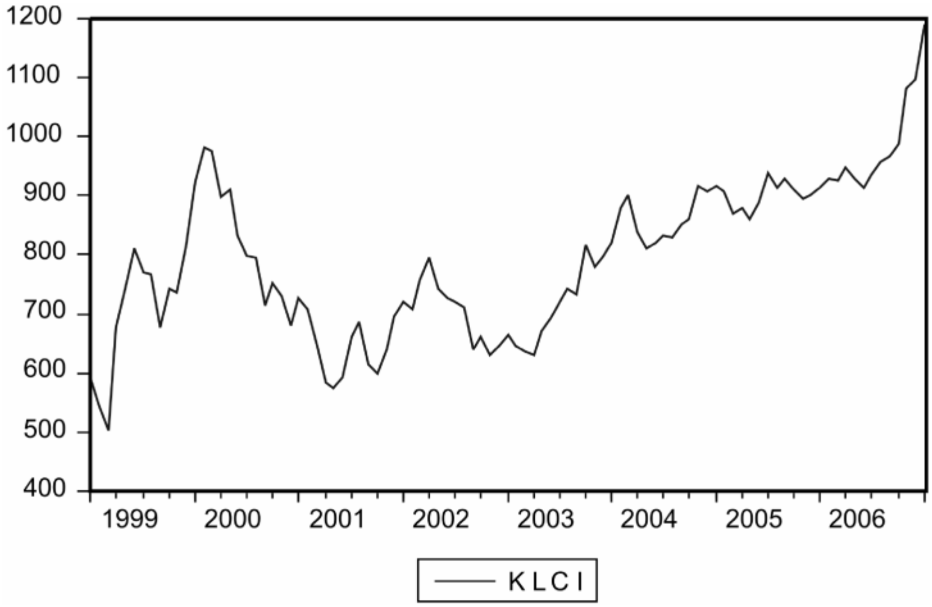
However, the economic conditions were not that favourable during the financial crisis in 1997. Instability in the international financial markets in turn spilled over into the domestic financial markets. Continued waves of adjustment in both the currency and stock markets, coupled with the decline in domestic and export demand subsequently prompted a shift to more growth promoting policies. One of the institutions that affected was Malaysian stock market.

The major stock exchange in Malaysia is the Kuala Lumpur Stock Exchange (KLSE). It consists of a main board, a second board, and MESDAQ. In our paper we will focus on a main index of KLSE which is Kuala Lumpur Composite Index (KLCI). KLCI was introduced in 1986 as a benchmark for a stock market index which would provide as an accurate performance indicator of the Malaysian stock market as well as the country's economy. It contains 100 companies from the Main Board with approximately 500 to 650 listed companies in the Main Board which comprise of multi-sectors companies across the year 2000 to 2006. Before the financial crisis happened in 1997-1998, the performance of KLCI was at the peak level. For example in 1993 and 1996, KLCI's point reached more than 1200 points. But from the table 2, we can see that, the KLCI point declined roughly at 500 points from the year 1996 to 1997 due to financial crisis.

There were some changes in the KLCI during the post crisis (financial crisis 1997). The KLCI achieved more than 1000 point at the end of 2006 with 1080.66 point after the climbing up from the financial crisis. The rationale behind this increase was due to the robust global growth during the year resulted in strong demand for electronics and primary commodities. This strong external environment was supported by strong domestic activity as private consumption rose in line with incomes and private investment increased to expand productive capacity to meet demand.

Apart from these reasons, some other reasons that boosted the Malaysian economy was raising of private consumption, a revival in the domestic investment and a strong export growth that had helped Malaysian economy rebound from the Asian financial crisis of 1997.

Table 2
Trend of KLCI, Post Crisis Period 1999-2006



This paper aims at studying the effect of macroeconomic variables that effect stock prices in the period of pre and post crisis in order to derive and appropriate policy instrument. The macroeconomic variables that theoretically have significant effect on stock prices that we have chosen for this paper are inflation rate, money supply and exchange rate. Indeed, there are other variables that affect stock prices but we limit our discussion on these variables for means of efficiency in modelling as incorporating many variables result in lost of degree of freedom.

2. LITERATURE REVIEW

In an efficient capital market, stock prices adjust rapidly according to the new information available; therefore, the stock prices reflect all information about the stocks. This means that an investor cannot use the readily provided information to predict the stock prices movements and make profits by trading shares. The efficient market hypothesis states that stock prices should contain all relevant information for both policy makers and stock brokers in the respective industry. We also know that the stock prices reflect expectations of the future performances of corporate and profits. As a result, if stock prices reflect these assumptions in real, then it should be used as a major indicator for the economic activities. So, the dynamic relationship between stock prices and macroeconomic variables can be used to make nation's macroeconomic policies (Mysami, Howe, Hamzah, 2004).

Mishkin (2007) defines a stock as a security that is claimed on the earnings and assets of corporations (shares of stock) which are traded. This concept is widely used in financial market throughout the world. A stock market index used to monitor the behavior of a group of stocks.

Gordon Growth Model had simplified the valuation of stock as follow:

$$P_0 = \frac{D_0 \times (1+g)^1}{(1+k_e)^1} + \frac{D_0 \times (1+g)^2}{(1+k_e)^2} + \dots\dots\dots + \frac{D_0 \times (1+g)^\infty}{(1+k_e)^\infty}$$

where D_0, is the initial dividend paid, g is the expected constant growth rate in dividends and k_e is the required return of equity.

This model is useful for finding the stock value with the assumptions that dividend are assumed to continue growing at a constant rate and the growth rate is assumed to be less than the required return on equity, k_e.

The Tobin's q theory tries to relate monetary policy (money supply and interest rates) that can affect the economy through its effects on the valuation of equities (stock). Tobin defines q as the market value of the firms which is highly relative to the replacement cost of capital and new plant as well as capital equipment. Companies can get a higher price for their stock trading relative to the cost of the facilities and equipment. Investment spending will rise because the firms can buy a lot of new investment goods with issuance of new stocks. On the contrary, when q value is low, firm will not purchase new investment goods because market value of the firms is low relative to the cost of capital. When companies want to acquire capital, they can buy another firm in cheaper price and acquire old capital instead. This can be explained as:

$$M\uparrow \text{ » stock prices}\uparrow \text{ » } q\uparrow \text{ » } I\uparrow \text{ » } Y\uparrow$$

There have been many attempts in the past to find out relationship between stock prices and macroeconomic variables. All these studies have found significant short-run and long-run relationships between stock prices or stock returns and macroeconomic variables.

Maysami and Koh (2000) examine the dynamic relations between macroeconomic variables (exchange rate, long and short term interest rates, inflation, money supply, domestic exports, and industrial production) and Singapore stock markets using the vector error correction model which covered the period from 1988 to 1995. They found that all the macroeconomic variables have cointegrating relations with the changes in Singapore's stock market levels.

Humpe and Macmillan (2007) study the influence of a number of macroeconomic variables on stock prices in US and Japan. They found the data for US are consistent with a single cointegrating vector, where stock prices are positively related to industrial production and negatively related to both the consumer price index and long term interest rate. They also find an insignificant (although positive) relationship between US stock prices and the money supply. However for Japanese data, they found two cointegrating vectors. One vectors that stock prices are influenced positively by industrial production and negatively by the money supply. For the second cointegrating vector they found industrial production to be negatively influenced by the consumer price index and a long term interest rate.

Gan, Lee, Yong and Zhang (2006) investigate the relationship between stock prices and macroeconomic variables for New Zealand. The variables that used are long-run and short-run interest rate, inflation rate, exchange rate, GDP, money supply and domestic retail oil price. Their findings suggest that there exist a long term relationship between stock prices and macroeconomic variables in New Zealand. However, the Granger causality test suggests that

New Zealand stock exchange is not a good indicator for macroeconomic variables in New Zealand, this result however, is inconsistent with other studies. The authors conclude that it is due to the fact that the ratio of capitalisation to GDP is very small in the case of New Zealand, thus any impact of capital market is also low. The impact of inflation rate on stock prices is found to be negative for this study, however, the impact of money supply is found to be negative because money supply in New Zealand is influences by foreign investors, so when interest rate is high as compare to other countries, investors would like to keep their money in banks rather than involving in risky investment, on the other hand, when the interest rate is low they might prefer to invest into other markets, so in the case of New Zealand, the impact of money supply is always negative.

Mysami, Howe and Hamzah, (2004) find a positive relationship between inflation rate and stock returns. This is contrary to other studies that suggest a negative relationship. The reason given by the authors is the active role of government to preventing prices escalation after the economy continued to progress after the 1997 financial crisis. The relationship between short-run and long-run interest rate is found to be positive and negative respectively. This is because long-run interest rate serves to be a better proxy for nominal risk-free component which is used in the discount rate for stock valuation models and may also serve as a proxy for expected inflation in the discount rate. The relation between money supply and stock return is also found to be positive. Their finding is consistent with the findings of Mukherjee and Naka (1995) who examine the effect of stock prices on six macroeconomic variables by using a vector error correction model (VECM) which covered 240 monthly observations for each variable from January 1971 to December 1990. They find positive relationship between Tokyo stock prices, the exchange rate, money supply and industrial production whereas the relationship between Tokyo stock prices and inflation and interest rates is mixed.

Azman-Saini, Habibullah, Law and Dayang-Afizzah (2006) in their study by using Granger non-causality found that Malaysian stock prices are led by the exchange rate during the crisis period. During the crisis period, the Malaysian Ringgit depreciated against US dollar and it significantly influences the Malaysian stock prices.

Meanwhile, another study based on Korea stock prices by Kwon and Shin (1999) indicates that there is cointegration between exchange rates, trade balance and money supply with stock prices, this is also supported by the study of Ibrahim (1999). Ibrahim shows that the interactions between seven macroeconomic variables and the stock market in Malaysia. The study suggests cointegration between consumer prices, credit aggregates, official reserves and stock prices and also stock prices are Granger-caused by changes in the official reserves and exchange rates in the short-run.

Some studies also claim that there are no long-run relationship between stock prices and exchange rates. Bahmani-Oskooee and Sohrabian (1992), Nieh and Lee (2001) conclude that there are no long-run relationship between stock prices and exchange rates. This might be due to different set of variables chosen and also different methods used in the analysis. Ahmed (2008) in his study by using Johansen's approach of cointegration, Toda and Yamamoto approach by using Granger causality test revealed that causal links between aggregate macroeconomic variables and stock indices in the long-run.

Fifield, Power and Sinclair (2002) investigated that the global and local economic factors explain returns in emerging stock markets. Their findings show that local economic variables namely GDP, inflation, money and interest rates significant in explaining emerging stock markets.

In an empirical study conducted by Ralph and Eriki (2001) on Nigerian stock market found that there exists a negative relationship between stock prices and inflation. Besides, they also show that the stock prices are also strongly motivated by the level of economic activity measured by GDP, interest rate, money stock, and financial deregulation.

In another study, Zhao (1999) look over the relationships among inflation, output (industrial production) and stock prices in the Chinese economy covering the period from 1993 to March, 1998. The results show a significant and negative relation between stock prices and inflation. It also gives a clear picture where output growth negatively and significantly affects stock prices.

Tsoukalas (2003) observes the relationships between stock prices and macroeconomic factors like exchange rate, industrial production, money supply and CPI from the year 1975 to 1998 by using vector autoregressive model (VAR) in the emerging Cypriot equity market. The results indicate a good relationship between stock prices and the aforesaid macroeconomic factors. According to him, because of higher demand for services like tourism and off-shore banking, it is not surprising to see the strong relationship between stock prices and exchange rate in Cypriot economy. The author adds that relationships between stock prices and rest other macroeconomic variables such as industrial production, money supply, and consumer prices reflect macroeconomic policies implemented by Cypriot monetary and fiscal authorities.

Chaudhuri and Smiles (2004) investigate the long-run relationship between stock prices and changes in real macroeconomic activities (real GDP, real private consumption, real money, and real oil price) in the Australian stock market from the year1960 to 1998. They find long-run relationships between stock prices and real macroeconomic activities. At the same time, their results indicate that foreign stock markets such as the American and New Zealand market significantly affect the Australian stock return movement.

In a similar type of study, Vuyyuri (2005) find the cointegrating relationship and the causality between the financial variables (interest rates, inflation rate, exchange rate, stock return) and the real sectors (as the proxy by industrial productivity) of Indian economy by using monthly observations from 1992 through 2002. Johansen multivariate cointegration test supported the long-run equilibrium relationship between the financial sector and the real sector, and the Granger test showed unidirectional Granger causality between the financial sector and real sector of the economy.

Similarly, Maghyereh (2002) examines the long-run relationship between the Jordanian stock prices and selected macroeconomic variables, again by using Johansen's cointegration analysis with the monthly data from 1987 to 2000. The results indicate that macroeconomic variables reflect in stock prices in the Jordanian capital market.

Nasseh and Strauss (2000) investigate the relationship between stock prices and domestic and international macroeconomic activity in six countries in European continent; France Germany, Italy, Netherlands, Switzerland, and the U.K. by using a cointegration approach. Their paper consists with quarterly data during 1962 to 1995. They find that Industrial Production

Indies (IP) and Business Surveys of Manufacturing Order (BSM) can explain movement of stock prices in long-run. They also find the negative influence of interest rates on stock prices. However, short-run interest rate is positively affected on stock prices.

Patra and Poshakwale (2006) find the interesting results on relationship between Athens Stock Exchange General Index and fives macroeconomic variables. They used monthly data on Athens Stock Exchange General Index, consumer price index, money supply, exchange rate, and trading volume to examine the short-run dynamic adjustments and the long-run equilibrium relationships between selected macroeconomic variables, trading volume and stock returns in the emerging Greek stock market during the periods 1990 to 1999. Empirical results using Granger causality tests show that changes in inflation, money supply, and trading activity have significant short-run effects on the stock returns in the Athens stock market. The results also imply that except for the exchange rate, lagged changes in inflation, money supply and trading volume can be used in predicting short term movements in stock prices in the Athens Stock Exchange. However, they find that there is no short-run or long-run equilibrium relationship between the exchange rates and stock prices. They point out that the lack of relationship between stock prices and exchange rate can be interpreted by the attempts of Greek government in order to join the European Monetary Union (EMU). Overall, the results of this research are consistent with the theoretical arguments and practical developments that occurred in the Greek stock markets during the sample period. The results also imply that the Athens Stock Exchange is inefficient because publicly available information on macroeconomic variables and trading volumes can be potentially used in predicting stock prices.

Ratanapakorn and Sharma (2007) use Granger causality approach in order to investigate the long-term and short-term relationships between the US Stock Price Index (S&P 500) and six macroeconomic variables over the period 1975 until 1999. In the long-run relationship, they find that the stock prices negatively related to the long-term interest rate, and positive relationship between stock prices and the money supply, industrial production, inflation, the exchange rate and the short-term interest rate. They conclude that in the Granger causality sense, every macroeconomic variable causes the stock prices in the long-run but not in the short-run.

The positive relationship between stock prices and inflation is also seen in the Pacific-Basin: Australia, Hong Kong, Indonesia, Japan, South Korea, Malaysia, the Philippines, Singapore, and Thailand in Al-Khazali and Pyun (2004). This paper find the negative relationships between stock returns in real terms and inflation in the short-run, while cointegration tests on the same markets display a positive relationship between the same variables over the long-run. They suggest that stock prices in Asia, like those in the U.S. and Europe, appear to reflect a time-varying memory associated with inflation shocks that make stock portfolios a reasonably good hedge against inflation in the long-run.

For the case of Malaysia, Ibrahim and Yusoff (2001) find a negative relationship between stock prices and money supply in the long-run but the analysis actually between the stock prices (KLCI) and macroeconomic variables which are real output as a measure of industrial production (IP), money supply (M2), price level as a measure of consumer price index (CPI) and exchange rate. KLCI is positively related to CPI and negatively related to M2. The positive association between KLCI and CPI seems to support the view that the stock prices are a good hedge against inflation.

In another study, Ibrahim and Aziz (2003) analyze the linkage between stock prices and four macroeconomic variables. They discover that there is a positive short-run and long-run relationship between stock prices with CPI while; stock prices have negative association with money supply and the exchange rate.

Islam (2003) replicates the above study to examine the short-run dynamic adjustment and the long-run equilibrium relationships between four macroeconomic variables (interest rate, inflation rate, exchange rate, and the industrial productivity) and the Kuala Lumpur Stock Exchange (KLSE) Composite Index. The results from his study also supported Hendry's approach, that there existed statistically significant short-run and long-run relationship among the macroeconomic variables and the KLCI stock return. He finds inflation rate, to have a positive relationship with stock prices. Another study conducted by Yusoff (2003) on the effects of monetary policy on the Malaysian stock market, shows that there is cointegration between the monetary policy variables and stock prices, with a negative relation between inflation and stock prices and money supply.

From the above discussions, it seems that there are long lists of literature on the macroeconomic variables and its effects on stock prices. Therefore, we find that it is interesting to investigate these effects and their relationship in the pre and post-crisis for Malaysian case to examine whether they are consistent with the priori studies.

3. RESEARCH METHODS

For this study, as mentioned before we analyze the interaction of stock price and selected macroeconomic variables which are inflation, money supply and exchange rates. Our empirical analysis in this paper covers an 8-years period for pre-crisis (January 1987-january 1995) as well as for post- crisis (January 1999 -January 2007) using monthly time series data. The selection of these periods is intended to study the effect of pre and post crisis, from which the Malaysian market is estimated to have recovered from by the end of 1998. For stock prices (KLCI) we use end of the month values of KLCI price index. For the inflation, we use CPI (consumer price index) as a proxy to inflation. The M2 money supply is used as the money supply variable and is expressed in the domestic currency, i.e. Ringgit. The exchange rate represented by employing nominal effective exchange rate, the bilateral exchange rate with reference to US dollar. The data are obtained from the IMF's International Financial Statistics Database (IFS) and complemented by data from www.econstats.com for various years. The KLCI is used as it encompasses the largest amount of stocks traded in Malaysia.

To examine the effect of these variables on stock prices, the generic model applied takes the form as below:

$$LnKLCI = \beta_0 + \beta_1 LnCPI + \beta_2 LnM2 + \beta_3 LnNEER + \varepsilon_t$$

3.1. Unit Root Tests

We test for the stationarity of the variables to avoid the spurious results. Time series is considered as stationary if a series is mean-reverting, that is, the series repeatedly returns back to its mean and does not have a tendency to drift. Therefore, if the mean and variance of the series are constant overtime, while the value of the covariance between the two periods depends only on the gap between the periods and not on the actual time at which the covariance is considered, then the series is stationary. But, if one or more of the above mentioned conditions are not fulfilled, then the series is non-stationary (Paramaia; Akway, 2008).

There are several methods for testing the presence of unit roots. The most widely used methods are Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP), which we have both applied in this paper.

ADF is applied when the error terms (u_t) are correlated. Otherwise we can only use Dickey-Fuller test. ADF performed by adding the lagged values of the dependent variable ΔY_t. The null hypothesis for ADF test for unit root test is $\alpha_1 = 0$. We can use the example of Gujarati (1995) for estimating ADF. The following regression is for ADF test purpose:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t$$

Where εt is a white noise error term and $\Delta Y_{t-1} = (Y_{t-1} - \Delta Y_{t-2})$ and so on are the number of lagged difference term which is empirically determined (Gujarati, 1995). ADF also has its own critics. Paramaia and Akway (2008) claimed that the ADF test has good size but poor power properties.

Meanwhile another test is PP test. This test controls the higher-order serial correlation. PP test use non parametric statistical methods and avoid the use of adding lagged difference terms as in ADF test. The null hypothesis for PP test is $\beta_1 = 0$. The PP test is relatively better (still generally poor), but has a very poor size in the presence of MA processes. The following equation represent for PP test (Jeong; Fanara; Mahone, 2002):

$$Y_t = \beta 0 + \beta_1 Y_{t-1} + e_t$$

3.2. Cointegration Tests

After the order of integration of each variable has been determined, we perform the cointegration analysis. This analysis is to determine whether the time series of these variables display a stationary process in a linear combination. Cointegration means that data from a linear combination of two variables can be stationary despite those variables being individually non-stationary (Gujarati 1995). For this purpose, the Johansen (1991) method of multivariate cointegration is employed. A finding of cointegration implies the existence of a long-term relationship between the dependent and the independent variables. If there is at least one cointegrating relationship among the variables, then the causal relationship among these variables can be determined by estimating the VECM (will be discussed later).

The Johansen and Juselius method uses two tests to determine the number of cointegrating vectors (Adebiyi, 2007), namely the "Likelihood Ratio Trace test-LRT" and the "Maximum Eigenvalue test- ME".

The likelihood trace statistics expressed as:

$$LRT = -T \sum_{i-i+1}^{n} \ln(1 - \mu i)$$

For this null hypothesis, it is said that the number of cointegrating vectors is less than or equal to r, in which r is 0, 1, 2, 3…so on. The alternative hypothesis against this is that r = n.

Meanwhile the Maximum Eigenvalue test is formulated as:

$$ME = -T \ln (1-\mu_r)$$

The null hypothesis is that the existence of r cointegrating vector. And the alternative hypothesis is r + 1 cointegrating vectors.

3.3. Granger Causality Tests

The short-run causal relationships between the dependent variable and each of the variables can be tested by using Granger Causality tests (Paramaia; Akway, 2008). A test of causality is to know whether the lags of one variable enter into the equation for another variable (Enders 1995). There are two important steps involved with Granger's Causality test. First, stationary data is needed rather then non stationary data. Second, in addition to the need to test the stationary property of the data, the Granger methodology is somewhat sensitive to the lag length used. So for selecting the appropriate lag length for our paper purposes, there are various lag length criteria available. For our purpose we use Akaike's information criteria (Granger, 1969,), final prediction error, Likelihood ratio test, etc

3.4. Variance Decomposition and Impulse Response Function

Once the VECM model is estimated, then we employ two short-run dynamic analyses called Impulse Response Functions (IRFs) and Variance Decompositions (VDCs) for our paper. Both analyses allow us to investigate the behavior of an error shock to each variable on its own future dynamics as well as on the future dynamics of the other variables in the VECM system (Gunasekarage; Pisedtasalasai; Power, 2004). Impulse Meanwhile, VDCs is used to detect the causal relations among the variables. It explains the degree at which a variable is explained by the shocks in all the variables in the system (Mishra, 2004).

Response Function is used to detect the dynamic interaction among variables. For computing the IRFs, it is necessary that the variables in the system are in ordered and that a moving average process represents the system.

4. EMPIRICAL RESULTS

4.1. Unit Root Tests

Table 3 reports the results of the ADF and PP Unit root test, the individual lag is chosen based on the Akaike Information Criterion (AIC). Both tests are conducted with trend and intercept. Except for CPI in the post crisis period, both ADF and PP tests agree that KLCI, M2, and NEER contain one unit root, in other words they are I(1) variables at 1% confidence interval in the pre and post crisis periods. However, for CPI data after crisis, the two tests yield slightly different results. The ADF test suggests that it is not stationary at first difference. Nevertheless, PP test provides evidence more towards stationarity of all variables in their first difference. Since the level of confidence is high (1%), then for the purpose of this paper, we accept the result of the PP test for LnCPI and conclude that it is stationary at first difference in both periods.

Table 3
Unit Root Test

Variable	Level		First Difference	
	ADF	PP	ADF	PP
		Pre-Crisis		
LnKLCI	0.0281 (-3.687261)	0.1683 (-2.896772)	0.0001* (-5.536771)	0.0000* (-9.222315)
LnCPI	0.1500 (-2.956698)	0.1500 (-2.956475)	0.0000* (-9.019117)	0.0000* (-8.992148)
LnM2	0.3466 (-2.460990)	0.3793 (-2.396077)	0.0000* (-8.648151)	0.0000* (-8.668226)
LnNEER	0.1411 (-2.988075)	0.5234 (-2.128291)	0.0000* (-6.443258)	0.0000* (-5.664637)
		Post- Crisis		
LnKLCI	0.3018 (-2.554958)	0.4338 (-2.292187)	0.0000* (-8.746806)	0.0000* (-8.716823)
LnCPI	0.9672 (-0.734449)	0.9737 (-0.646139)	0.2276 (-2.729898)	0.0000* (-10.57360)
LnM2	0.9939 (-0.120770)	0.9915 (-0.231166)	0.0000* (-8.860174)	0.0000* (-8.860609)
LnNEER	0.8100 (-1.536681)	0.7562 (-1.671935)	0.0000* (-6.784862)	0.0000* (-6.784862)

Values based on MacKinnon (1996) one-sided p-values. The value in parenthesis refers to t-statistics.
* indicates significance at 1%.

4.2. Cointegration Test

Having concluded that each of the series is stationary, we proceed to examine whether there exists a long-run equilibrium between stock prices and the macroeconomic variables selected.

Table 4 provides the Johansen-Juselius Cointegration test results. We set the lag order of first differenced right-hand-side variables to 4 in the pre crisis and 2 for the post crisis data, using the Akaike Information Criterion (AIC), which we find sufficient to render the error term serially uncorrelated in conducting the test. Furthermore, following Reinsel and Ahn (1992), we adjust the trace and maximal eigenvalue statistics by a factor (T-np)/T, where T is the effective number of observations, n is the number of variables, and p is the lag order. This is to correct bias towards finding evidence for cointegration in finite or small samples. As may be noted from the table, both the maximum eigenvalue and the trace statistics suggests the presence of a unique cointegrating vector at 5% significant level for the period before crisis. On the other hand, in the period after crisis the maximal eigenvalue statistics did not indicate the presence of cointegration, however the trace statistics showed a unique cointegration between the variables. In this case, we accept the result of the trace statistics as the sample used is quite large.

Table 4
Johansen-Juselius Cointegration Test

Null Hypothesis	System with CR				Critical Values (5%)	
	Trace	Max. Eig	Trace	Max. Eig	Trace	Max. Eig
	Pre-Crisis		Post Crisis			
r = 0	61.18585	39.99855	50.75945	24.64908	47.85613	27.58434
r ≤ 1	21.18730	16.11387	26.11037	13.79054	29.79707	21.13162
r ≤ 2	5.073426	4.646491	12.31983	11.19910	15.49471	14.26460
r ≤ 3	0.426936	0.426936	1.120725	1.120725	3.841466	3.841466

Note: The lag order specified for the pre and post crisis test is 4 and 2 respectively, which we find sufficient to render the error term serially uncorrelated. The 5% critical values are based on Osterwald-Lenum (1992).

Accordingly, these variables are tied together in the long-run in the period before and after the crisis and their deviations from the long-run equilibrium path will be corrected. The presence of cointegration also rules out non-causality among the variables. In other words, there must be at least a unidirectional causality from one variable to the other.

We also report the cointegrating coefficients in long-run equation form normalized on stock prices (LnKLCI):

Pre Crisis:

$$LnKLCI_0 = -13.38685 + 8.793096\ LnCPI_0 - 3.443952\ LnM2_0 + 1.789090\ LnNEER_0 + \varepsilon_{t0}$$

Post Crisis:

$$LnKLCI_1 = 7.092459 + 4.072937\ LnCPI_1 - 0.583043\ LnM2_1 - 2.565241\ LnNEER_1 + \varepsilon_{t1}$$

From the long-run equation of both the period before and after crisis, there seems to be a positive relationship between inflation rate and the price of stocks. This result seems to be consistent with Ibrahim and Yusoff (2001), Ibrahim and Aziz (2003) and Islam (2003) for the case of Malaysia and Abd. Majid et al. (2001) for the case of Malaysia and Indonesia. This finding supports the view that stock prices in Malaysia are a good hedge against inflation (Ibrahim and Yusoff, 2001).

Regarding money supply (M2), the negative coefficient gives also a negative association between M2 and stock prices, for both post and pre crisis periods. According to the Stock Valuation Model and Monetary Portfolio Hypothesis, the increase in money supply leads to a reduction in interest rate, which in turn will increase the price of stocks. Nevertheless, based on several studies, money supply has an immediate positive response on stock prices but that effect is dissolved and the long-run association becomes negative. This can be caused by the inflationary expectations that future real dividends will be lower, hence decreases the attractiveness of stocks and stock prices in turn will fall (Mukhrejeee and Naka, 1995 and Dasgupta and Sensarma, 2002). Nevertheless, the positive coefficient for CPI annuls this justification. Therefore, the negative relationship between M2 and stock prices must be explained using a different framework, that probably an increase in money supply result in inflation uncertainty, leading to depreciation expectation and anticipation of future contractions (Ibrahim and Yusoff, 2001).

As for exchange rate, the pre-crisis long-run equation shows that currency depreciation seems to be associated with an increase in stock prices. While the post-crisis long-run equation indicates the opposite, meaning that currency appreciation leads to a decrease in stock prices. In fact, currency effect may have a positive or negative association with stock prices depending on the nature of the economy. For net-exporting economies, currency depreciation leads to an increase in net exports as domestic products become cheaper in the world market. Hence the increase in firms' profitability will be reflected in the value of the stocks. However, for economies that depend heavily on imports, currency depreciation may lead to higher import prices causing a fall in firms' profit and in turn the price of stocks. The net effect of currency depreciation will depend on which of these factors is more dominant. In addition, currency depreciation may also create expectations in future increase in the exchange rate which consequently leads to a fall in the investment flows to the country (Ibrahim and Yusoff 2001). Our result shows that negative net effects are more dominant, hence creating downward pressure on stock prices. This result is consistent with Ibrahim and Yusoff (2001) and Ibrahim and Aziz (2003) for the Malaysian equity market, and Kwon and Shin (1999), for the Korean case. While a study by Yusoff (2003) on Malaysian stock market finds that positive net effects are more dominant.

4.3. Error Correction Model

The presence of cointegration indicates that at least one of the variables tests react to deviations from the long-run relationship. Here we investigate whether stock prices corrects for disequilibrium.

Our dynamic causal link between macroeconomic variables and stock prices can be modeled as:

$$\Delta(LnKLCI)_t = h_0 + h_{1i}\sum_{i=0}^{1}\Delta LnCPI_{t-i} + h_{2i}\sum_{i=0}^{1}\Delta LnM2_{t-i} + h_{3i}\sum_{i=0}^{1}\Delta LnNEER_{t-i} + h_{4i}EC_{t-1} + E_t$$

Where EC_{t-1} here is the stock prices error correction term (lagged residual of statistic regression) and "Δ" stands for first difference.

If the error term is significant, the lagged dependent variables are important in predicting current movement if the stock prices and also means that stock prices adjust to the previous equilibrium error and that past macroeconomic variables have significant explanatory power for current stock prices.

Based on table 5, the estimated coefficient for ECT_0 is 30.28% and ECT_1 is 27.6% and are found significant at 1% significant level, suggesting that the last period (month) disequilibrium in stock prices before crisis is corrected in the next month by 30.28% while after crisis the disequilibrium is corrected by only 27.6% in the next month. There seems to be a decline in the

Table 5
Error Correction Model of Stock Prices

Error Correction	Parameter Estimate	Standard Error	t-statistics
ECT0	-0.302813	-3.61830	0.08369*
ECT1	-0.275707	-4.78059	0.05767*

*,**,*** indicates significance at 1%, 5% and 10% respectively

speed of adjustment after the crisis, however both values seems to adjust slowly towards the long-run equilibrium. This implies that any shock that forces stock prices from their long-run value will take a long time for prices to return to its equilibrium unless there are other shocks that counter the initial one.

4.4. Granger Causality

After estimating the long-run equilibrium for stock prices and macroeconomic variables, we intend to investigate the dynamic interactions between these variables. In this section we present the result of the pair wise Granger Causality with a uniform lag 4 for the period before crisis and 2 for the period after crisis which is sufficient to whiten the noise process.

From table 6, some general findings can be concluded. For the period before crisis we can see that only exchange rate affects stock prices with bidirectional causality between both variables. However, inflation rate and money supply may have an indirect affect on stock prices through their affect on exchange rate.

While for the period after crisis:

(a) Only money supply and exchange rate affect stock prices

(b) There seems to be no causality between stock prices and inflation

(c) There exists a unidirectional causality from money supply and exchange rate to inflation

Based on these findings we can conclude that for the period before crisis, exchange rate lead stock prices and vise versa, while after the crisis money supply and exchange rate lead stock prices but not the other way around. The finding that money supply leads stock prices is in line with earlier studies conducted on the Malaysian equity market Ibrahim and Yusoff (2001) and Yusoff (2003).

Table 6
Short-run Granger Causality

Null Hypothesis	Pre-Crisis		Post-Crisis	
	Chi-sq	Prob.	Chi-sq	Prob.
LnCPI does not Granger Cause LnKLCI	4.824558	0.3058	3.855577	0.1455
LnM2 does not Granger Cause LnKLCI	6.644070	0.1559	5.619017	0.0602***
LnNEER does not Granger Cause LnKLCI	8.162423	0.0858***	5.405330	0.0670***
LnKLCI does not Granger Cause LnCPI	5.686069	0.2239	0.713226	0.7000
LnM2 does not Granger Cause LnCPI	5.795021	0.2150	6.548214	0.0379**
LnNEER does not Granger Cause LnCPI	11.94921	0.0177*	6.379311	0.0412**
LnKLCI does not Granger Cause LnM2	2.173075	0.7040	1.618386	0.4452
LnCPI does not Granger Cause LnM2	8.330643	0.0802***	2.313394	0.3145
LnNEER does not Granger Cause LnM2	1.875571	0.7586	1.700582	0.4273
LnKLCI does not Granger Cause LnNEER	10.52584	0.0324**	0.576943	0.7494
LnCPI does not Granger Cause LnNEER	0.627260	0.9600	0.074652	0.9634
LnM2 does not Granger Cause LnNEER	17.54078	0.0015*	0.007170	0.9964

*, **, *** indicates significance at 1%, 5%, and 10% respectively.

4.5. Variance Decomposition

Variance decomposition measures the percentage of forecast error of variation that is explained by another variable within the short-run dynamics and interactions. Since the results maybe sensitive to ordering of the variables, the most widely used orthogonalisation procedure is the Choleski Decomposition which eliminates any contemporaneous correlation between a given innovation series and all those series which precede it in the chosen ordering. The ordering chosen is CPI, M2, NEER which is based on the degree of exogeneity of the variables and is also consistent with the work of Ibrahim (2001).

The results are presented in tables 7.1 and 7.2 with variance decomposition at 3, 6, 9, and 12 month horizon. The findings suggest the presence of interaction among the variables. We observe that variations in stock prices are predominantly attributed to its own variations, accounting for 99.20% in the period before the crisis and 85.47% for the period after the crisis of the KLCI forecast error variance after 3 months. Compared to other variables in the first two quarters of the period before crisis, money supply explains most of the variation in stock prices counting for 11.59%, followed by inflation rate by 5.64%. However exchange rate does not have a short-run impact in the variation of stock prices, it only shows significant effect in the end of the year, counting for 2% of the variation. However, the results after the crisis show different dynamics of interaction between these variables. In the first quarter inflation explains relatively higher fraction of the KLCI forecast error variance by 12.97%, followed by money supply with 8.74%. Exchange rate has a tendency to not capture the variation in the first semester of the year, but at the end of the year exchange rate forecast error variance is around 28.52%, accounting for the highest percentage among the other variables, followed by inflation (11.5%) and money supply (6.64%). This can be due to the reason that Malaysia followed the pegged exchange rate regime from 1998 until mid 2005, which indicate that there have not been significant shocks/innovations in the value of exchange rate.

On the other hand, KLCI capture captures most variations on money supply accounting for 24.69% at the end of the year, which is considered high, followed by the exchange rate (3.28%) which is not that significant. In the period after crisis, however, it seem that KLCI does not capture much variations on the macroeconomic variables discussed, except for CPI (3.36%) which is also not considered high. While inflation responds to both shocks in exchange rate and money supply, each explaining 15.89% and 11.41% of the forecast error variation of CPI at the end of the year, respectively. These results are consistent with the Granger-Causality test that has been conducted earlier. In the same time, forecast error variation in M2 is attributable in a substantial portion to inflation with 7.76% after 12 months.

From these results we can say that dynamics of interaction between macroeconomic variables and stock prices seems to be different from the period before and after the crisis. This could be due to changes in policy taken by the government to reform policy target effectiveness and curb volatility in stock prices. Nevertheless, we can conclude from our results that exchange rate, money supply and inflation rate can all be regarded as good candidates to be observed and controlled by the government in order to stabilize stock prices.

Table 7.1
Variance Decomposition (Pre-Crisis)

Variable Explained	Period	By innovation in (%)			
		LnKLCI	LnCPI	LnM2	LnNEER
LnKLCI	3	99.20257	3.231635	0.495370	0.297236
	6	82.29356	5.640274	11.58915	0.477015
	9	73.50910	4.593857	20.67950	1.217543
	12	70.45798	4.039567	23.46959	2.032860
LnCPI	3	0.735043	87.81286	11.31188	0.140218
	6	0.559425	67.12024	30.10561	2.214720
	9	1.452107	64.02092	33.16075	1.366226
	12	1.585387	64.68697	32.51228	1.215367
LnM2	3	13.11796	16.59164	69.99904	0.291354
	6	17.70095	15.04679	65.94664	1.305627
	9	22.52203	12.85111	62.16501	2.461853
	12	24.69744	11.58301	60.68824	3.031314
LnNEER	3	1.985894	1.401347	5.303894	91.30886
	6	2.496015	1.036437	7.751059	88.71649
	9	2.456489	1.294547	12.51168	83.73728
	12	3.277097	2.153943	13.46013	81.10883

Table 7.2
Variance Decomposition (Post-Crisis)

Variable Explained	Period	By innovation in (%)			
		LnKLCI	LnCPI	LnM2	LnNEER
LnKLCI	3	85.47097	8.607071	4.179621	1.742341
	6	75.92323	8.607071	4.179621	1.742341
	9	65.84774	12.96895	8.738528	2.369300
	12	53.34811	13.22600	8.191379	12.73488
LnCPI	3	0.683714	11.49512	6.637695	28.51907
	6	2.011325	87.20893	5.165051	6.942310
	9	2.896248	75.89726	9.580613	12.51080
	12	3.364860	69.80094	11.41147	15.89134
LnM2	3	1.484233	66.53542	12.34322	17.75650
	6	0.900565	9.519536	87.86611	1.130119
	9	0.590792	8.512842	88.49663	2.089966
	12	0.478730	8.043176	89.47420	1.891829
LnNEER	3	0.063678	7.762513	90.17684	1.581918
	6	0.954868	0.010290	2.330225	97.59581
	9	1.964940	0.054435	1.507212	97.48349
	12	2.598178	0.144420	0.933748	96.95689

Note: Cholesky Ordering: LNKLCI LNCPI LNM2 LNNEER

4.6. Impulse Response Function

Impulse response function can give an indication of the causal properties of the system. From Figures 1.1 and 1.2, we can see that the results are in line with the variance decomposition, where stock prices respond positively for shocks in inflation and money supply, with residing respond overtime for the latter indicating that the relation between M2 and stock prices is positive in the short-run but becomes negative in the long-run. The respond of stock prices to exchange rate is negative for the period before crisis but in the period after crisis the relationship

Figure 1.1: Impulse Response Function (Before Crisis)

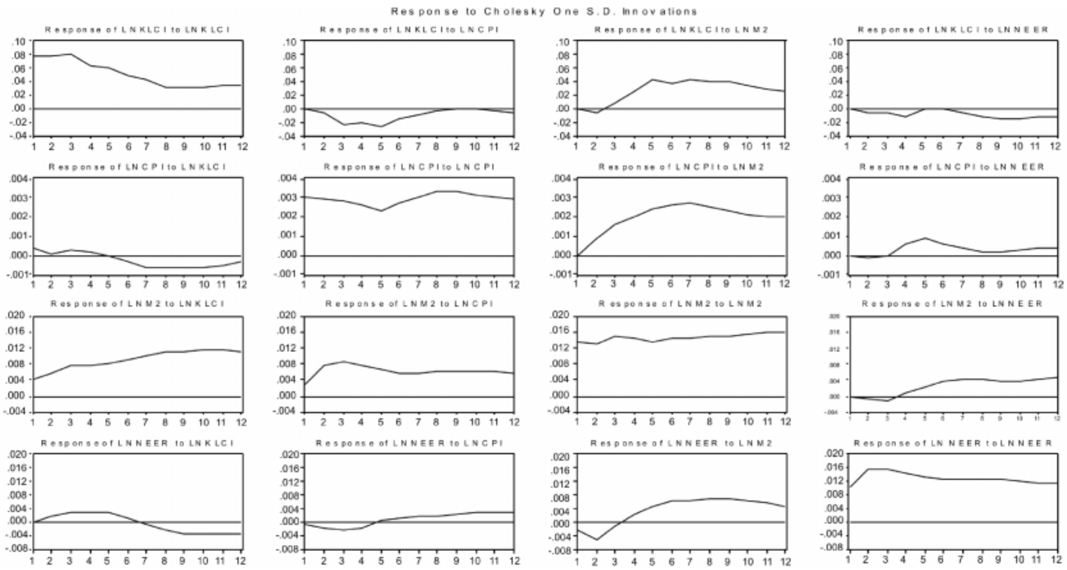
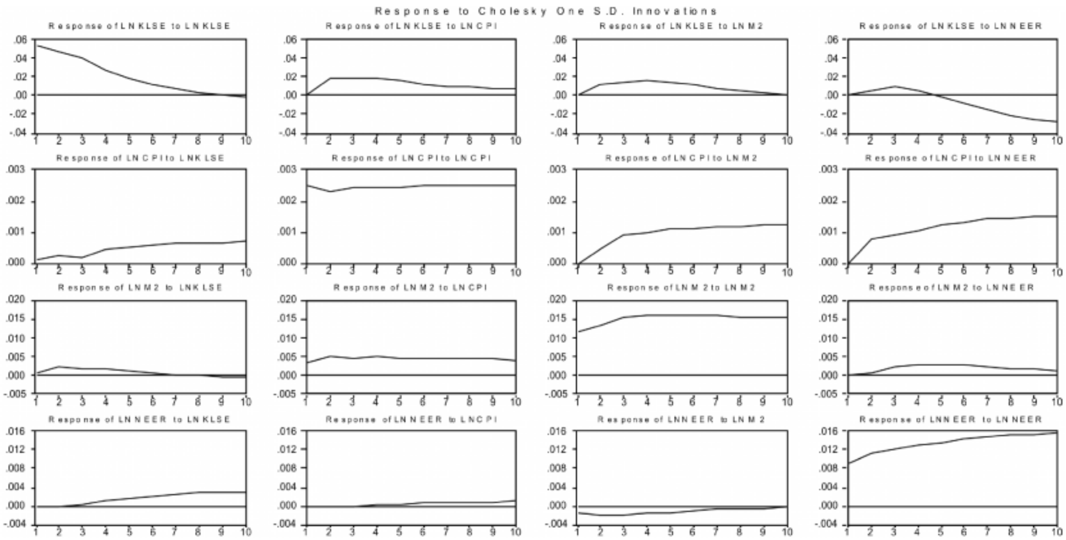


Figure 1.2: Impulse Response Function (After Crisis)



is positive up till the fourth month, but falls to negative values afterwards. This is also in line with the result of the NEER negative coefficient in the long-run equation, shocks in the exchange rates affect stock prices negatively in the long-run but positively in the short-run. Overall results correspond well to other researches (Ibrahim and Yusoff, 2001).

5. CONCLUSION AND POLICY IMPLICATION

This paper studies the effects of macroeconomic variables namely: inflation rate, money supply, and exchange rate on stock prices for Malaysia in the pre-crisis (1987-1995) and post-crisis periods (1999-2007). The findings indicate that these variables share a long-run relationship in both periods, indicating that deviations in the short-run stock prices will be adjusted towards the long-run value. However, from the value of the error correction model 30.28% before crisis and 27.6% after crisis, we can say that this adjustment is slow unless there are other shocks that occur at the same time and counter the initial shock. This result signals the importance of these variables as government targets to emphasize policy effects on stock market. Furthermore, the long-run equilibrium indicates that there is a positive relationship between inflation rate (CPI) and stock prices. This is in line with other studies conducted on the Malaysian equity market for the period before the economic crisis (Ibrahim and Yusoff (2001), Sabri et al (2001), Ibrahim and Aziz (2003) and Islam (2003)). This indicates that the feature of Malaysian stock prices as being good hedges against inflation stands even after the crisis. As for money supply (M2) is negative, which is also in line with Ibrahim and Yusoff (2001) and Ibrahim and Aziz (2003). The negative relation between money supply and stock market can be due to increase in inflation uncertainty that may lead to decrease in stock prices. As for exchange rate, there is different pattern of interaction in the period before and after crisis. Before crisis the long-run relationship was positive, while in the period after crisis there is negative association indicating that negative currency effect net effects are more dominant, hence creating downward pressure on stock prices. This also shows that the Malaysian economy is open for international trade. The results of the variance decomposition and impulse response function indicate that stock prices respond to innovations in exchange rate and money supply positively in the short-run, but the effect becomes negative in the long-run. This finding helps in giving input to the government in employing exchange rate policies as in the case of emerging markets adverse repercussions on equity markets may occur (Abdullah and Murinde (1997), Ibrahim and Yusoff (2001). Therefore, the decision of adopting exchange control measures introduced on September 1998 can be considered as part of pre-emptive measures implemented by the central bank to reduce several areas of vulnerabilities in the economy, including the stock market. The findings show that inflation, money supply and exchange rate are still good variables to be emphasized on by the government as financial policy instruments in order to stabilize stock prices.

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