INFLUENCES OF MACROECONOMIC VARIABLES ON STOCK PRICES IN MALAYSIA

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ABSTRACT

The purpose of this paper is to investigate the relationship between the Malaysia stock market and a set of macroeconomic variables, i.e. money supply, industrial production, exchange rate, interest rates and reserves using monthly data covering the period M1:1980 to M11:2007. This study employed a methodology of Johansen co-integration test and a Granger causality test from a vector error correction model (VECM). The co-integration test and the VECM illustrate that stock prices are co-integrated with a set of macroeconomic variables — money supply (M2), industrial production, exchange rate, interest rates and reserves. In addition, this study adopts an innovation accounting by simulating impulse response function (IRF) and variance decomposition (VD) for further inferences. The findings show that industrial production contributed the highest percentage in the forecasting of variance error of stock prices.

Keywords: *Co-integration; Macroeconomic variables; Stock market return.*

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1. Introduction

The changes in macroeconomic variables contain important information for stock market participants is now well established. The stock market plays an important role in the economic development of a country. It is regarded as a mechanism for the effective mobilization of domestic funds to assist economic development and also for the efficient allocation of resources. The speed and accuracy with which this information is incorporated into stock prices is crucial to the efficient functioning of the stock market and economic growth.

The relationship between macroeconomic variables and the movement of stock prices for the developed countries have well been documented in the literature over the last several years (Fama, 1981; Lee, 1992; Kaneko & Lee, 1995; Mukherjee & Naka, 1995; Booth & Booth, 1997; Mavrides, 2000; Maysami & Koh, 2000; Sadorsky, 2003; Chen, 2003). For studies in the developing countries, Chen & Kim (2005) examine the impact of macro and non-macro economic variables on the Chinese stock market with a special reference on the hotel stock return. Chen, Roll & Ross (1986) employed a multivariate arbitrage pricing theory (APT) to analyze the relationship between the market returns and macroeconomic factors, including measures of industrial production, the money supply, inflation, and interest rate and exchange rate variables. They confirmed a strong relationship between the market returns and these variables. Hamao (1988) found that inflationary expectations cause a change in the risk premium and in the term structure of interest rate. In turn, these variables have a significant impact upon stock returns in the Japanese market.

In addition, the long-run relationships between the stock market index and various macroeconomic variables are commonly observed. Mookerjee & Naka (1995) showed that short-run relationships among these variables existed in the Japanese stock market. However, this might not be the case for a small open economy. Mookerjee & Yu (1997) further found that not all macroeconomic variables were cointegrated with stock prices in Singapore. Cheung & Ng (1998) obtained evidence of cointegration between stock market indices and various macroeconomic variables, including oil prices. Cointegration between stock market returns and several macroeconomic variables also existed in South Korea (Kwon & Shin, 1999). However, the stock market indices were found not to be leading indicators of macroeconomic variables, such as the production index, money supply, exchange rate, and the trade balance.

In the case of Malaysia, Ibrahim (1999) indicated that stock prices had a long-run relationship with consumer prices, credit aggregates, and official reserves. In 2003, Ibrahim found cointegration between returns and the money supply in the Malaysian equity market to be a major influence on equity prices. Groenewold (2004) analyzed the relationship between share prices and real output using structural VAR models without considering other macroeconomic variables. One of the major results showed that a macroeconomic boom caused an overvaluation in stock prices.

As we can see, most of the previous studies gave more attention to well-developed countries but less attention to small and developing country like Malaysia. Even though there are quite many of studies rely on stock behavior done by using Malaysian data, but almost of them focus on the unidirectional effect of changes in the stock price to the limited macroeconomics variables. In this regards, we conducted this study as a motivation to provide the major macroeconomic determinants to the stock prices using monthly data for Malaysia which comprises the pre and post of Asian financial crisis period (M1:1980 to M11:2007).

In the view of the importance of identifying factors affecting the changes in stock prices particularly for a small open economy such as Malaysia, this study examines the causality relationship of between five macroeconomic variables, such as reserve, money supply, treasury bills, real exchange rate and industrial production is a proxy for output to the Malaysian's stock prices. We adopt the Vector Autoregressive (VAR) framework by initially looking at the existence of long run and short run relationship between stock market and the macroeconomic variables via the cointegration technique, followed by the Variance Decomposition analysis and Impulse Response Function. The establishment of co-integration analysis has offered an empirical approach in analyzing the relationship between macroeconomic variables and the stock market. For instance, Granger (1986) has verified a long-term equilibrium existed between stock prices and macroeconomic variables via the co-integration approach. Then, we proceed with the Johansen's vector error-correction model (VECM) to further explore the dynamic movement among the variables and the adjustment process towards the long run equilibrium. Finally, we conduct the Variance Decomposition analysis as well as impulse response function in order to gauge the importance of each macroeconomic variable to the stock market movement when a shock is imposed to the system.

The rest of the paper is organized as follows: the next section elaborates the literature review about the relationship between macroeconomic variables to the stock prices. Section 3 highlights the hypothesis, methodology and data employed in this study while section 4 discusses the empirical result. Finally, section 5 summarizes and concludes the paper.

2. Literature Review

It has been generally accepted that macroeconomic variables drive the movement of stock prices. Early studies done to capture the effect of economic forces uses theoretical framework based on the Arbitrage Pricing Theory (APT) model developed primarily by Ross (1976). A number of evidences exist as to the relationship between the stock market index and various macroeconomic variables.

Rahman *et al*. (2009) pointed out three conclusions regarding relationship between macroeconomic variables and stock market. First, changes in the share prices are affected by the changes in macroeconomic performance in the well-developed markets, but results are inconclusive for the emerging markets. Secondly, the predictive role of stock market on macroeconomic activities is inconclusive for both the developed and emerging markets. Thirdly, there is still a dispute whether there is a unidirectional or bidirectional relationship between macroeconomic performance and stock market returns for both developed and developing economies.

Studies on non-US markets have mostly been based on the Chen *et al*. (1986) approach. Hamao (1988) tested the Japanese market and found strong pricing evidence, except for the case of Japanese monthly production. Martinez & Rubio (1989) used Spanish data and found no significant pricing relationship between stock returns and macroeconomic variables. Poon & Taylor (1991) are also unable to explain stock returns in the UK by the factors used by Chen *et al*. (1986). Kaneko & Lee (1995) have re-examined the US and the Japanese markets. They employed the Chen *et al*. (1986) factors to evaluate the effects of systematic economic news on stock market returns. Using an eight variable VAR system, they found that both the term and risk premiums, as well as the growth rate of industrial production, are significantly priced in the US.

In Japan, however, international factors had become increasingly more important. As opposed to the findings of Hamao (1988), changes in oil prices, terms of trade and exchange rates were significant in Japanese stock returns. Jones & Kaul (1996) investigated the response in the stock market of oil price changes in the US, Canada, the UK, and Japan. They concluded that the US and Canadian stock markets are rational, in the sense that the response to oil shocks could be completely accounted for by their impact on current and future cash flows. In the UK and Japan, however, stock markets have overreacted to new information about oil prices. The results from the studies above suggest that significant macroeconomic factors for stock returns exist in the well-developed US and Japanese markets, while such factors are not easily revealed in European markets. Schwert (1989), Koutoulas & Kryzanowski (1996), and Maysami & Koh (2000) show that changes in the macroeconomic variables can predict the stock market.

Granger (1986) and Johansen & Juselius (1990) proposed to determine the existence of long-term equilibrium between economic variables and stock prices. Chen *et al*. (1986) provided the basis for the belief that there exists long term equilibrium between stock prices and macroeconomic variables. Granger (1986) proposed to verify this through cointegration analysis. Employing this methodology, there has been a growing literature showing strong influence of macroeconomic variables and stock markets, mostly for industrialized countries (see, for example, Hondroyiannis & Papapetrou, 2001; Muradoglu *et al*. 2001; Fifield *et al*. 2000; Lovatt & Ashok 2000; and Nasseh & Strauss 2000). Additionally, researchers have begun to turn their attention to examining similar relationships in developing countries, particularly those in the growth engines of Asia (for example, Maysami & Sims 2002, Maysami & Koh 2000).

Among the studies for the Malaysian market is that of Habibullah & Baharumshah (1996a). Applying residual-based co-integration tests, they find no evidence for co-integration between various stock indices, money supply and output using monthly data that span from January 1978 to September 1992, thus provide the basis to conclude that the Malaysian stock market is informationally efficient with respect to output and money supply. Using a restricted error-correction model Habibullah & Baharumshah (1996b) find evidence for informational inefficiency in the Property index with respect to money supply when an alternative test. Another study for Malaysian market is carried out by Cornelius (1993) to examine the relationship between money supply changes and stock prices using bivariate Granger causality tests and find evidence against the informational-efficiency hypothesis for the Malaysian market. In line with this work, Ibrahim (1999) extends the above study by investigating the dynamic interactions between seven macroeconomic variables and the stock prices for Malaysia and found that stock market is not informationally efficient with respect to consumer prices, credit aggregates and official reserves. From bivariate error-correction models, the study revealed two things: reactions of the stock prices to deviations from the long run equilibrium and that the stock prices are Granger-caused by changes in the official reserves and exchange rates in the short run.

Rahman *et al*. (2009) examine the factors that affect the Malaysian stock market using VAR framework. The study found that money supply, exchange rate, reserves, interest rate and industrial production have significant long run effects on Malaysia's stock market in a VECM framework. Besides, the study also revealed that the Malaysian stock market is sensitive to changes in macroeconomic variables and has stronger dynamic interaction with reserves and industrial production index as compared to money supply, interest rate and exchange rate.

Maysami & Koh (1998) extend Mukherjee & Naka's (1995) study of the impact of economic forces on the Japanese stock market to the Singapore context. The study applied Johansen's vector error-correction model (VECM) for multivariate co-integration analysis and monthly time-series data and identified several economic factors that have a long run equilibrium effect on the Singapore stock market. They found that the Singapore market is sensitive to interest and exchange rate. The study also found that the Singapore stock market is significantly and positively co-integrated with stock markets of Japan and the United States.

In another study, Maysami *et al*. (2004) extends the study of Maysami & Koh's (2000) enquiry of the co-integrating relationship between macroeconomic variables and the SES All-S Equities Index, by incorporating the effects of market volatility during the seven-year period between February 1995 and December 2001. The study examine the long-term equilibrium relationships between selected macroeconomic variables and the Singapore stock market index, as well as with various Singapore Exchange Sector indices—the finance index, the property index, and the hotel index. The study concludes that the Singapore's stock market and the property index form co-integrating relationship with changes in the short and long-term interest rates, industrial production, price levels, exchange rate and money supply.

3. HYPOTHESIS, DATA AND METHODOLOGY

The data used are monthly data for the period from January 1980 to November 2007 (335 observations) sourced from International Financial Statistics (IFS), March 2008, published by the International Monetary Fund (IMF). Two periods are used to better analyze the relations between macroeconomic variables and stock prices before and after Asian Financial Crisis. We called Period 1 which covered from 1980M01 to 1997M06 as pre-crisis and Period 2 which covered from 1997M07 to 2007M11 as post-crisis. The macroeconomic variables selected for this study are presented in Table 1. We used share prices to proxy for stock prices of Bursa Malaysia. All the data are seasonally adjusted.

Table 3.1: Definitions of Variables

Variables	Definitions
STOCK	Logarithm of the Stock Prices of Bursa Malaysia
RES	Logarithm of the month-end Reserves
M2	Logarithm of the month-end M2 Money Supply of Malaysia
IP	Logarithm of the month-end Industrial Production Index
RER	Logarithm of the Real Exchange Rate based on relative Consumer Price Index
TB	The month-end rate of Treasury Bill 3 months

To arrive at the stationary variables needed in the ECM, all variables are converted into logarithms. Table 2 provides the summary statistics for the variables in levels and in first differences.

Table 3.2: Descriptive Statistics

	STOCK	RES	RER	M2	TB	IP
Mean	4.223069	10.68889	4.881696	11.83578	4.526979	3.973030
Maximum	5.112894	12.74066	5.197120	13.56066	10.15311	4.937618
Minimum	3.016566	8.920811	4.483586	9.993540	1.788834	2.756979
Std. Dev.	0.499698	1.178259	0.172636	1.016803	1.641772	0.676695

	ΔSTOCK	ΔRES	ΔRER	ΔM2	ΔTB	ΔIP
Mean	0.005470	0.010997	-0.001381	0.010680	-0.000494	0.006332
Maximum	0.198841	0.330674	0.126387	0.054647	1.627042	0.398217
Minimum	-0.320646	-0.207682	-0.124192	-0.020557	-2.046111	-0.230964
Std. Dev.	0.062067	0.051392	0.018809	0.011705	0.322632	0.046776

In estimating the VECM, we first check for stationarity and unit roots through performing the augmented Dickey-Fuller (ADF). Since the ADF test is often criticized for low power, we complement this test with the Phillips-Perron (PP) test and Kwiatkowski-Phillips-Schmidt-

Shin (KPSS) test on the variables in levels and first differences. Only variables integrated of the same order may be co-integrated, and the unit root tests will help us determine which variables are integrated of order one, or *I*(1). If the variables are not co-integrated, they do not exhibit a long term equilibrium relationship. For the last two decades, emphasis was given for unit root testing to time series data such that the empirical relationship of the variables satisfies the classical stationary assumptions and to avoid spurious regressions if the variables in ordinary regressions are non-stationary.

A set of time-series variables are said to be co-integrated if they are integrated of the same order and a linear combination of them is stationary. Such linear combinations would then point to the existence of a long-term relationship among the variables (Johansen & Juselius, 1990). If the time series variables contain unit roots or are co-integrated of the same order, namely *I*(1), then the long run combination amongst the non-stationary variables can be established although in the short run, the variables may drift apart. Deviations in the short run will force back to its long run equilibrium via the feedback process. Co-integration test involves two steps which include testing for unit root and the likelihood ratio test.

Since the time series variables are co-integrated of the same order, then the long run combination amongst the non-stationary variables can be established although in the short run, the variables may drift apart (Engle & Granger, 1987). The Engle & Granger (1987) approach, however, can only deal with one linear combination of variables that is stationary whereas in a multivariate practice, more than one stable linear combination may exist. To avoid this problem, we draw on Johansen & Juselius (1990) maximum likelihood (ML) procedure to test for the number of co-integrating vectors which also allows inferences on parameter restrictions. ML procedure operates under a vector autoregressive (VAR) model.

$$\Delta x_t = \sum_{i=1}^{q-1} \prod_i \Delta x_{t-i} + \prod_q \Delta x_{t-q} + \mu + v_t \qquad (1)$$

where x_t is an *n x 1* vector of variables, $\prod_q$ is an *n x n* matrix of rank r ≤ n, μ is an *n x 1* vector of constant term and v is an $n\,x\,1$ vector of residuals. The hypothesis is

H$_o$ = $\prod_q = \alpha\beta'$ where α and β are *n x r* loading matrices and eigenvectors. The aim of this procedure is to test the number of *r* co-integrating vectors $\beta_{1,}\beta_{2,}...,\beta_r$ which provide *r* stationary linear combinations of $\beta' X_{t-q}$. The likelihood ratio (LR) statistics for testing hypothesis H$_o$ = $\prod_q = \alpha\beta'$, is a test that there are at most *r* co-integrating vectors, $\lambda_{Max} = -T\ln(1-\lambda_{r+t})$ versus an alternative, $\lambda_{Trace} = -T\sum_{i=r+1}^{k}\ln(1-\lambda_i)$. The linear restriction (LR) statistics for testing *r* against *r+1* co-integrating vectors is given by $-2\ln(Q) = T\sum_{i=1}^{r}\ln\left(\frac{1-\lambda_i^*}{1-\lambda_i}\right)$ which determines the significant eigenvalues and the corresponding number of eigenvectors. The statistic is embodied as a chi-squared distribution with *r* degrees of freedom.

We employ a recent comprehensive test of Granger causality as developed by Granger (1986) and Engle & Granger (1987). This approach allows for a causal link between two variables stemming from a potential long run equilibrium relationship between the variables. This

Granger causality test is based on error correction models, resulting from the co-integrated properties of time series variables. The error correction model can be expressed as:

$$\Delta X_t = \alpha_0 + \sum_{i=1}^{n} \beta_{xi} \Delta X_{t-1} + \sum_{i=1}^{m} \beta_{yi} \Delta Y_{t-i} + Z_1 \eta_{t-1} + \varepsilon_t \qquad (2)$$

where η_t is the lagged value of the error term from the co-integration equation:

$$X_t = \phi Y_t + \eta_t \qquad (3)$$

The inclusion of η_t provides for an additional channel through which potential causality between *X* and *Y* can be conducted.

Once co-integrating relationship has been established, the next step is to estimate the error correction model (ECM). An advantage of co-integration analysis is that through building an error-correction model, the dynamic co-movement among variables and the adjustment process toward long-term equilibrium may be examined. Although Engle & Granger (1987) two-step error correction model can be applied in a multivariate context, we choose VECM, a full information maximum likelihood estimation model, since it yields more efficient estimators of the co-integrating vectors. VECM permits testing for co-integration in a whole system of equation in one step without requiring a specific variable to be normalized. Another advantage of VECM is the non-requirement for a prior assumption of endogenity or exogenity of the variables. In addition, VECM allows us to examine the causality in Granger-sense. The error correction term is evaluated using *t*-test whilst the lagged first-differenced term of each variable uses the *F*-test. Patterns of causal relationship can be established amongst the different pairs of variables. The relationship could be unidirectional from *x* to *y* or *y* to *x*, bidirectional or the variables can be independent of one another.

As identified by Masih & Masih (1996), VECM alone does not provide indications of the dynamic properties of the system nor the relative strength of the Granger causality test beyond the sample period. As such, we draw on the variance decomposition (VDC) technique to examine a breakdown of the change in value of the variable in a given period arising from its own shocks in addition to shocks in other variables in previous periods. In addition, we also include the Impulse Response Function (IRF) based on the unrestricted VAR to map the time profile of the effects of innovations (shocks) in the residuals on the behavior of the series. IRF traces the response of current and future values of endogenous variables to a one standard deviation shock through the dynamic structure of VAR. The IRF is estimated as $X_t = \mu + \sum_{i=0}^{\infty} \phi_{jk}(i)\varepsilon_{t-i}$ where μ is a 6 x 1 vector of constant, ε_{t-i} is a 6 x 1 error vector, $\phi_{jk}(i)$ is a 6 x 6 matrix with $\phi_{jk}(0) = I$ and elements of $\phi_{jk}(i)$ are the impact multipliers which examine the interactions amongst all variables over the entire path.

4. EMPIRICAL RESULTS

4.1. *Unit Root Tests*

Co-integration requires the variables to be integrated of the same order. So, we test the variables for unit roots to verify their stationarity. In this study, Augmented-Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests are employed to investigate the nature of the series. The specifications of the test is tested with both an intercept and a trend. A variable is said to be integrated of order d, written as *I*(d) if it requires differencing d times to achieve stationary. The results of ADF, PP and KPSS unit root tests are presented in Table 1. The ADF and PP tests reveals that hypothesis of a unit root cannot be rejected in all variables in levels. However, the hypothesis of a unit root is rejected in first differences, which indicates that all variables are non-stationary in level but are stationary at first differences. In other words, the results of the tests suggest that all variables are integrated of order one *I*(1).

Table 4.1: ADF, PP and KPSS Test for Unit Root (with trend and intercept)

	Level			**First Difference**		
	ADF	**PP**	**KPSS**	**ADF**	**PP**	**KPSS**
STOCK	-2.850591 (0.1803)	-2.513870 (0.3212)	0.192219**	-12.08240** (0.0000)	-11.86170** (0.0000)	0.048488
RES	-2.661270 (0.2536)	-2.991258 (0.1362)	0.104817**	-17.69369** (0.0000)	-17.83238** (0.0000)	0.048880
M2	-1.341901 (0.8755)	-1.763417 (0.7204)	0.180363**	-8.140503** (0.0000)	-19.12805** (0.0000)	0.111525
IP	-1.905689 (0.6493)	-2.855634 (0.1786)	0.328695**	-28.67087** (0.0000)	-28.42738** (0.0000)	0.038030
RER	-1.926615 (0.6383)	-2.187822 (0.4944)	0.184080**	-16.04104** (0.0000)	-16.32691** (0.0000)	0.053238
TB	-2.731211 (0.2247)	-2.353690 0.4033	0.273836**	-13.53493** (0.0000)	-13.16628** (0.0000)	0.045077

Note: *, and ** indicate significance at 5% and 1% respectively. For ADF and PP, H_o = Variable has a unit root and H_o = Variable is stationary for KPSS test.

4.2. *Cointegration Test*

Table 4.2: Johansen-Juselius Cointegration Tests

Null Hypothesis	Test Statistics		Critical Values (5%)	
	Trace	Max. Eigen.	Trace	Max. Eigen.
None	144.1124	61.15588	95.75366	40.07757
At Most 1	82.95652	30.58187	69.81889	33.87687
At Most 2	52.37464	22.53383	47.85613	27.58434
At Most 3	29.84082	21.24421	29.79707	21.13162
At Most 4	8.596609	7.178802	15.49471	14.26460
At Most 5	1.417807	1.417807	3.841466	3.841466

Note: The lag order of the test is 11, which we find sufficient to render the error terms serially uncorrelated.

Before proceeding to Johansen-Juselius (JJ) test for co-integration, we performed lag length selection exercise to choose the optimum lag. The results are however not consistent. For example, the recommended lag length based on AIC, LR, FPE, SC, HQ are 3, 7, 3, 1 and 2, respectively. Due to inconsistency in terms of the optimum lag length, we adopted another method based on residuals of VAR. The selection of lag length is obtained at which based on the one that has the absence of serial correlations in the residuals. Based on this method, the optimal lag length is 11. Table 2 below reports the results for the co-integration test. For the cointegration test, we have relied on both maximum eigenvalue and trace tests to compare results. Both trace and eigenvalue tests indicate that at least four and one cointegrating equations at 5%, respectively. This test suggests two major contentions. First, the selected variables move along together in the long run and short terms deviations will be corrected towards equilibrium. Secondly, co-integration literally indicates causality in at least one direction.

4.3 *Granger Causality Test*

The Granger causality test in vector error correction form allows the examination of the dynamic causal interaction amongst the intended variables. Granger causality is conducted on the variables using the optimum lag 11. The results indicate the existence of two-way causality between stock and two variables; namely reserves and interest rate. One-way causality is evident to be running from stock to IP.

Table 4.3: Granger Causality Tests

	χ^2-statistics of lagged first-differenced terms						ECT
DEP VAR	**ΔSTOCK**	**ΔRES**	**ΔRER**	**ΔM2**	**ΔIP**	**ΔTB**	**(T-ratio)**
ΔSTOCK	--	27.98687 [0.0033]	9.648926 [0.5622]	15.82503 [0.1478]	15.91542 [0.1443]	29.80814 [0.0017]	-0.142207 (5.88156)**
Δ RES	23.94451 [0.0130]	--	16.72129 [0.1164]	14.92652 [0.1859]	13.33762 [0.2718]	7.204983 [0.7822]	-0.082915 (3.67363)**
Δ RER	8.976166 [0.6241]	12.03812 [0.3608]	--	12.51499 [0.3262]	6.898041 [0.8073]	7.928353 [0.7197]	-0.013522 (1.56190)
Δ M2	13.29247 [0.2746]	11.19190 [0.4273]	4.003110 [0.9698]	--	2.472000 [0.9960]	12.23575 [0.3462]	-0.012623 (2.40039)*
Δ IP	44.15522 [0.0000]	14.08552 [0.2283]	5.764178 [0.8886]	10.35794 [0.4985]	--	12.18178 [0.3501]	0.003893 (0.20987)
Δ TB	32.91934 [0.0005]	24.89452 [0.0094]	6.451195 [0.8416]	12.72281 [0.3118]	12.53706 [0.3247]	--	0.056953 (0.43628)

Note: numbers in squared brackets are *p*-values
numbers in brackets are *t*-ratios
* and ** indicate significance 5% and 1% respectively

4.4 *Impulse-Response Functions*

The IRF displayed in Figure 1 shows that shocks in reserves is significant and negatively related with stock prices until the 15th month and increases quickly before it moves towards long run equilibrium. Stock prices response to shocks in real exchange rate is significant at the 10th month. Shocks in industrial production on stock prices is significant and positively related while interest rate is marginally significant and negatively related initially but positively related between the 15th to the 24th month. However, on the response to money supply shock, the result did not show significant responses.

Figure 2 indicates that reserves response to stock prices is significant and positively related for the first 8th month before quickly decrease and moves towards zero in the long run. On the other hand, real exchange rate and money supply responses to shock in stock price is found to be marginally significant. On the response of shock in stock price on industrial production is highly significant at 6th to 20th month but tend to be negatively related after 25th month. The figure also reveals that interest rate response to stock prices is highly significant within 20th to 30th month.

Figure 1

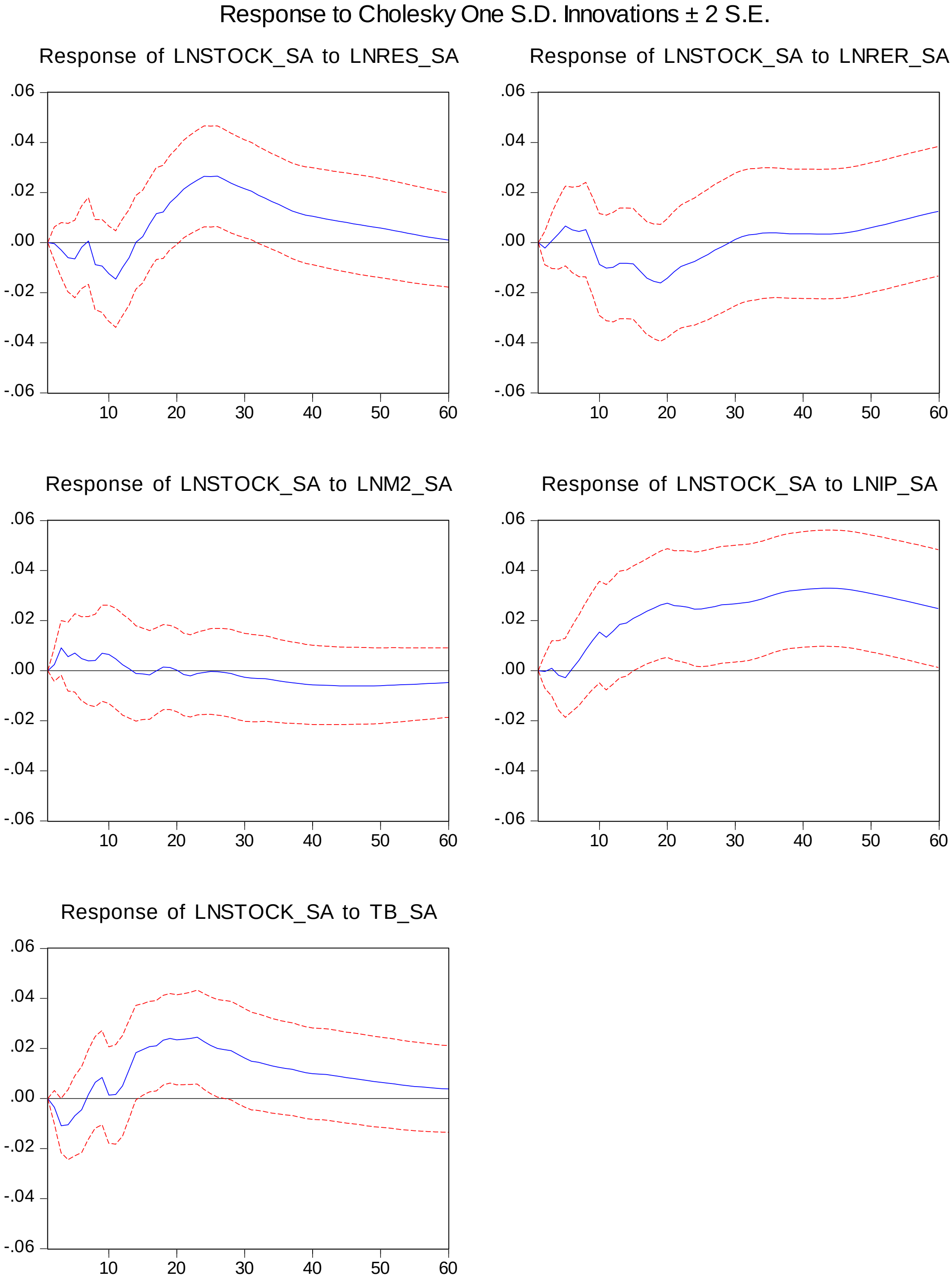
Response to Cholesky One S.D. Innovations ± 2 S.E.
Response of LNSTOCK_SA to LNRES_SA
Response of LNSTOCK_SA to LNRER_SA
Response of LNSTOCK_SA to LNM2_SA
Response of LNSTOCK_SA to LNIP_SA
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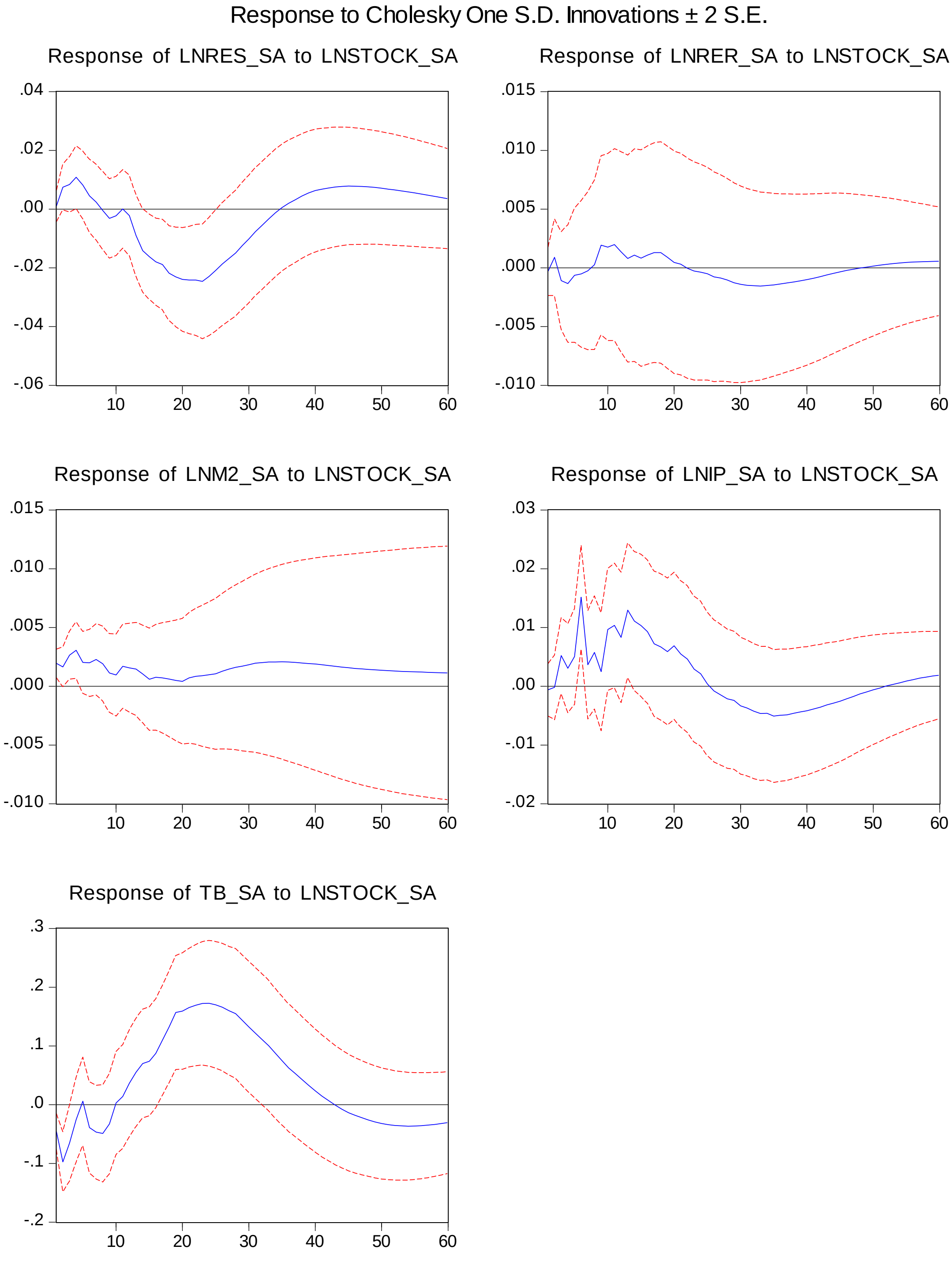
Figure 2


Response to Cholesky One S.D. Innovations ± 2 S.E.
Response of LNRES_SA to LNSTOCK_SA
Response of LNRER_SA to LNSTOCK_SA
Response of LNM2_SA to LNSTOCK_SA
Response of LNIP_SA to LNSTOCK_SA
Response of TB_SA to LNSTOCK_SA
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4.5 *Variance Decompositions*

Variance decompositions show the percentage of forecast error variance in one variable of the autoregression explained by innovations to all variables within the vector autoregression. The variance decomposition is an alternative method to IRF for examining the effects of shocks to the dependent variables. It determines how much of the forecast error variance for any variable in a system is explained by innovations to each explanatory variable, over a series of time horizons. Usually own series shocks explain most of the error variance, although the shock will also affect other variables in the system. Taking the variables at level, we simulate how they react to their own shocks and shocks in other variables. The variables follow the Cholesky factorization (Luthepohl, 1991). Thus, we specified the ordering as follows– (i) TB, RER, M2, IP, RES, STOCK based on pair-wise correlation test. From table 4, stock price responds pertinently to its own innovations but the effect fades off over time. At one year horizon, the fraction of Malaysia stock prices forecast error variance attributable to variation in industrial production is 0.06 percent. But then it further increases to almost 25 percent in 5 years (60 months). On the other hand, the percentage of industrial production forecast variance is explained by innovation in stock prices is very small which less than 6 percent though at longer time horizon.

Table 4.5: Variance Decompositions

Horizon	Explained by Innovations in					
	STOCK	RES	RER	M2	IP	TB
(a) *Variance Decompositions of Stock Prices (STOCK)*						
1	94.91375	0.176629	0.094071	1.743124	0.060128	3.012299
12	79.9482	5.743794	2.309965	3.8816	0.757070	7.359374
24	58.67614	11.3427	7.081035	4.645399	4.990898	13.26384
36	48.61874	16.59182	6.058183	4.810961	10.38435	13.53595
48	42.5589	15.51923	5.724333	4.278104	18.98111	12.93833
60	39.29966	14.65037	5.390778	4.019532	24.32481	12.31485
(b) *Variance Decompositions of Reserves (RES)*						
1	0.000000	94.17401	0.101253	3.230217	0.010361	2.484163
12	1.494070	80.82652	2.577476	12.85619	0.669086	1.576659
24	11.12776	49.32992	11.80391	6.536657	13.17996	8.021797
36	9.557703	39.31646	13.92792	5.218620	24.74354	7.235759
48	8.441945	33.71461	13.57068	4.782396	33.14124	6.349133
60	7.785469	31.23080	12.67475	5.008522	37.27267	6.027792
(c) *Variance Decompositions of Real Exchange Rate (RER)*						
1	0.000000	0.000000	99.94458	0.000000	0.000000	0.055420
12	0.158718	5.628539	92.17057	1.201596	0.407807	0.432765
24	0.132410	6.808578	90.05788	1.859571	0.432352	0.709207
36	0.250434	7.884919	87.09113	2.100460	1.738685	0.934370
48	0.248708	9.154051	83.06113	2.029083	4.126401	1.380627

60	0.298985	9.899417	79.50442	1.946916	6.588196	1.762068
(d) *Variance Decompositions of Money Supply (M2)*						
1	0.000000	0.000000	0.169980	95.47940	0.000000	4.350618
12	0.418514	1.089113	2.216473	84.16791	7.996351	4.111639
24	0.760729	1.661177	17.36236	53.65125	24.42442	2.140065
36	0.420934	3.473682	26.22469	37.20221	31.03364	1.644840
48	0.287911	4.955146	27.75638	28.66358	36.37462	1.962361
60	0.270785	6.097734	25.96918	23.94096	41.35515	2.366195
(e) *Variance Decompositions of Industrial Production (IP)*						
1	0.000000	0.000000	2.972920	2.029765	92.88077	2.116548
12	3.293061	0.751607	7.351189	1.119357	86.61371	0.871073
24	3.747292	0.799087	7.836184	0.874178	85.77329	0.969972
36	5.104632	1.331874	9.739652	1.149301	81.52195	1.152591
48	5.501727	1.298685	10.35687	2.034563	79.69642	1.111736
60	5.189449	1.430688	9.842116	3.291973	79.19573	1.050042
(f) *Variance Decompositions of Treasury Bill (TB)*						
1	0.000000	0.000000	0.000000	0.000000	0.000000	100.0000
12	0.953770	7.151110	0.192732	4.271303	2.352353	85.07873
24	12.23341	13.56840	4.899323	5.178658	5.988740	58.13147
36	16.92316	14.11522	6.399720	4.596743	7.745371	50.21978
48	16.37313	14.21156	7.861521	4.446408	8.211576	48.89580
60	16.22292	14.05331	8.798495	4.278898	9.068066	47.57832

Note: Variables' ordering: *TB, RER, M2, IP, RES, STOCK*

5. Summary and Conclusion

According to the Johansen-Juselius (JJ) cointegration test result, this study found that all the selected macroeconomic variables, which are reserve, money supply, real exchange rate, interest rate and industrial production are cointegrated. In other word the variables move along together in the long run and short terms deviations will be corrected towards equilibrium. The results of Granger causality test indicated the existence of two-way causality between stock and two variables; namely reserves and interest rate, while there is one-way causality evidence from stock to industrial production index.

The IRF indicates two important inferences. First, response of stock prices due to the impulse or shocks in the five macroeconomic variables; money supply, reserves, real exchange rates, interest rates and industrial production index. According to the IRF figure, the shock in reserves, real exchange rate and industrial production exhibited the significant response to the changes in stock prices in the short run. However, shock of money supply and interest rates did not indicate the significant responses to stock prices.

Second, response of the five macroeconomic variables; money supply, reserves, real exchange rates, interest rates and industrial production index due to the shock in stock prices.

The empirical result shows that the interest rates, industrial production and reserves are significantly response to the shock in stock prices. Instead, the real exchange rate and money supply is found to be marginally significant responses to the shock in stock prices.

Based on the result on variance decomposition, we can conclude that innovation industrial production contributed the highest percentage in forecasting the error in the variance of the stock prices, reserves, and money supply within five years. While the forecast error variance in real exchange rate, interest rate and industrial production were most explain by the innovation in reserves, real exchange rate and stock prices.

In general, the IRF and VDC further support the contention that the stock prices is sensitive towards changes in the stipulated variables. In particular, reserves and industrial production show stronger dynamic interaction between the other macroeconomic variables. Although the linkages in the macroeconomic variables and the movement of the stock prices have been well researched in the developed countries, there are still avenues for research in this area for emerging economies. As in the case of Malaysia, further research could be conducted to examine the relationship between the macroeconomic variables and the various sectors in the stock market.

Finally, several suggestions for future research may be offered. The empirical model may be estimated with additional and/or alternative economic and financial factors. Studies encompassing various regions should be conducted when more data are available. Such research will contribute toward improving our understanding of the emerging financial markets responses to the frequently occurring phenomena of economic crisis induced by globalization.

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