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MACROECONOMIC VARIABLES, EXCHANGE RATE AND STOCK PRICE: A MALAYSIAN PERSPECTIVE

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ABSTRACT

The paper analyzes dynamic interactions among three macroeconomic variables (real output, price level, and money supply), exchange rate, and equity prices for the Malaysian case using time series techniques of cointegration and vector autoregression. In the analysis, we rely on variance decompositions and impulse-response functions to gauge the strength of the interactions among the variables. The Malaysian stock prices seem to be driven more by changes in domestic factors, particularly money supply. Specifically, we note that money supply exerts a positive effect on the stock prices in the short run. However, money supply and stock prices are negatively associated in the long run. We also observe the negative effects of depreciation shocks on stock prices. Other selected notable results are: the stock prices contain valuable information for future variations in macroeconomic variables especially the price level; currency depreciation is both contractionary and inflationary; the Malaysian monetary authorities seem to focus mainly on stabilizing the exchange rate; and the money supply seems to be pro-cyclical and inflationary. One important policy implication is that the monetary authorities should be very cautious in implementing exchange rate and monetary policies as they may have adverse repercussions on the Malaysian financial market.

JEL Classification: E44, G15

Key words: Stock price behavior, Macroeconomic variables, Vector autoregression

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1. INTRODUCTION

Financial economists, policy makers and investors have long attempted to understand dynamic interactions among macroeconomic variables, exchange rates and stock prices. Theoretically, their causal interactions may be motivated using such models as the standard stock valuation model, monetary and portfolio allocation models of exchange rate determination, and standard Aggregate Demand – Aggregate Supply (AD-AS) textbook models. According to the stock valuation model, stock price represents the discounted present value of the firm's future cash flows. This means that any change in such economic variables as real output, money supply, exchange rates and others may affect stock prices through their influences on firms' cash flows and discount factors.[1]

At the same time, changes in stock prices may also influence variations in economic activities and act as a channel of monetary transmission mechanisms. In particular, reflecting real economic activities, changes in stock prices lead to an increase in the demand for real money and the interest rate and, subsequently, the value of domestic currency (Solnik, 1984; and Ajayi et al., 1998). Moreover, the increase in domestic stock prices means that domestic financial assets have become more attractive. As a result, individual investors or firms will adjust their domestic and foreign portfolios by demanding more domestic assets. The portfolio adjustments of individuals and firms will, subsequently, lead to an appreciation of the domestic currency. Other macroeconomic variables may also be affected due to these adjustments. Furthermore, under the standard open-economy AD-AS model, changes in money supply affect real activity through various channels. These include the traditional liquidity channel, exchange rate channel and stock price channel via Tobin's-*q* theory, wealth effects and household liquidity effects (Mishkin, 1998, 646). The AD-AS model also allows for interactions among macroeconomic variables representing such markets as goods and services, money, and international markets.

From these standard models, we may discern that the interactions among these variables are interwoven in a dynamic way. Economic variables affect and are affected by stock prices. Concurrently, they (i.e., macroeconomic variables) interact with each other. Unfortunately, the exact patterns of the interactions and which variable is dominant in the interactions remain unclear. Yet, the nature and strength of the dynamic interactions among them is of high interest and needs to be evaluated empirically. For instance, Abdalla and Murinde (1997) noted the importance for understanding the interactions between equity and currency prices especially for emerging markets that need to develop their financial markets and, at the same time, move toward increasing international liberalization. The latter further attests to the importance of identifying relative strength of international disturbances (such as exchange rate disturbance) and domestic shocks on domestic aggregate fluctuations, especially for designing credible and consistent policy responses by monetary authorities. Uncovering these dynamic interactions may also reveal various operative monetary transmission mechanisms, which again serve as an essential input to policy makers. It also helps in gauging the predictability and efficiency of equity markets, a valuable information for investors as well as policy makers.

In the present paper, we attempt to evaluate the dynamic interactions among various macroeconomic variables and the stock price for the case of Malaysia. The macroeconomic variables considered include real economic activity, money supply, aggregate price level, and the exchange rate. The first three variables are common variables representing domestic real and money markets. The inclusion of the exchange rate in the analysis is motivated by the fact that Malaysia is highly dependent on international trade.[2] As we have highlighted, proper understanding of the relative importance of shocks originating from various markets – real, money, financial, and international markets – is highly crucial for economists, policy-makers and investors. Accordingly, the present analysis has a main focus on identifying dominant macroeconomic factors for stock price fluctuations. It also aims at evaluating dynamic behavior of other variables emphasizing particularly the monetary transmission mechanisms and the roles of exchange rates in domestic economic performance.

While empirical studies investigating the issue on developed markets are expanding, empirical analyses for emerging markets such as Malaysia are rather limited. The few empirical studies that focused specifically on Malaysia that may be cited include Habibullah and Baharumshah (1996) and Ibrahim (1999; and 2000). These analyses, however, are incomplete in at least two respects. First, they only considered a subset of the markets we consider in the present paper. Habibullah and Baharumshah (1996) only looked at the long-run relationships among the stock price, money supply and real output, ignoring the role of the exchange rate. Ibrahim (2000) focused on the interactions among the stock price, exchange rate, money supply and official reserves. Variables from the goods market, however, were not included. Although Ibrahim (1999) covered a wider range of macroeconomic variables, he mainly concentrated on bivariate interactions between the stock price, on the one hand, and a macroeconomic variable of interest, on the other. Secondly, the existing studies normally end at reporting cointegration and Granger causality test results as a way of describing the strength of the interactions. However, better measures for the strength of dynamic interactions are variance decomposition and impulse-response functions (Lastrapes and Koray, 1990). In particular, unlike Granger causality tests, these measures capture both the direct and indirect effects of innovations in one variable, on other variables in the model. Accordingly, the dynamic interactions among these variables can be fully addressed. Our study is, thus, not only to fill the gap in the literature on developing economies but also to complement existing studies on the two respects raised above.

The rest of the paper is structured as follows. In the next section, we outline the empirical approach used in the analysis, which is based on cointegration tests and vector autoregression (VAR) analysis. While the cointegration tests capture the presence of a long-run relationship among the variables, the VAR analysis documents the short-run dynamics of the variables. From the VAR, we generate variance decomposition and impulse-response functions to gauge the strength of these dynamics. Section 3 describes the data and presents the results from the cointegration tests. The variance decomposition and impulse-response functions generated from the VAR are discussed in section 4. Lastly, section 5 concludes with the main findings.

2. EMPIRICAL APPROACH

Our empirical approach is based on recent standard methods of cointegration and vector autoregressions (VAR). The approach is chosen for several reasons. First, the VAR modeling places no *a priori* structural restrictions and provides good approximation to the data generation process of a vector of time-series variables when sufficient lags are included. Moreover, the model captures empirical regularities in the data in an unrestricted fashion, which accordingly makes it well suited for evaluating interdependencies among variables. Lastly, from variance decomposition and impulse response functions generated from the VAR, we may gain insight on the strength and direction of transmission of shocks in the system.[3]

As we have noted, we consider three macroeconomic variables – real output, money supply and price level – for evaluation of their dynamic interactions with equity and currency prices. In order to understand fully the dynamic interactions between macroeconomic variables and asset prices, we acknowledge the need to incorporate a larger number of variables. Indeed, modeling the whole economy and how various markets interact will be the ideal case. This is undoubtedly a difficult task. Empirically, the incorporation of every variable deemed important may quickly result in loss of degrees of freedom and efficiency, given the finite number of observations. Accordingly, we limit ourselves only to the aforementioned macroeconomic variables. The real output, money supply and price level, which aptly represent variables from real and money markets, are generally included in existing studies that evaluate the dynamic interactions between stock prices and macroeconomic variables. Then, due to the open nature of the Malaysian economy, we also incorporate the exchange rate in the analysis.[4]

In the analysis, we first evaluate cointegration properties of the five variables using the VAR-based approach of Johansen (1988) and Johansen and Juselius (1990), henceforth the JJ test.[5] The test is noted to have more power than alternative tests of cointegration including the two-step Engle-Granger (1987) cointegration tests (Cheung and Lai, 1993; and Gonzalo, 1994). Moreover, treating all variables as potentially endogenous, the test is capable of identifying the number of cointegrating vectors governing the long-run relationships among the variables. Johansen (1988) and Johansen and Juselius (1990) developed two test statistics to identify the number of cointegrating vectors. These are the trace and the maximal eigenvalue test statistics. The trace statistic tests the null hypothesis that there are at most r cointegrating vectors against the alternative of more than r cointegrating vectors. Meanwhile, the maximal eigenvalue statistic tests for the null hypothesis of exactly *r* cointegrating vectors. From the estimated cointegrating vectors, we may discern the long-run association among the variables concerned.

In implementing the JJ test, several notes need to be mentioned. First, since cointegration suggests co-movements of the integrated series, we need to establish first the stochastic properties of each variable. Accordingly, prior to the test, we conduct standard augmented Dickey-Fuller (ADF) unit root tests to determine the variables' orders of integration. And second, we need to determine the lag lengths for the VAR. Arbitrary lag lengths may result in bias or inefficiency in parameter estimates due to the possibility of selecting the lag lengths that are too short or too long. Moreover, Hall (1991) cautions that the JJ test results may be sensitive to the orders of vector autoregressions. In the paper, we place emphasis on the requirement that the error terms from the model need to be serially uncorrelated. Namely, we increase the lag length successively until the error terms of the VAR model are white noise. Lastly, the JJ test also provides estimates of a cointegrating vector governing the long-run co-movements of the variables. Subsequently, from the cointegrating vector, we may make inferences on the long-run associations between the variables of interest.

Once we uncover the cointegration properties of the variables, we then work with an unrestricted vector autoregression (VAR) model. The model is well suited for the purposes of evaluating the strength and the direction of the transmission of shocks across markets. The results from cointegration tests are important for modeling short-run dynamic interactions among the variables based on the VAR. Namely, if the variables are non-stationary and are not cointegrated, the dynamic interactions among them need to be evaluated based on standard VAR model with variables expressed in first difference. By contrast, if they are cointegrated, an error correction model should be used. Equivalently, cointegration among the variables justifies the use of the VAR model in levels.

The VAR model may be written as:

$$(1) \qquad A(L)X_t = U_t$$

where *A(L)* is a matrix of polynomials in the lag operators, *X* is a vector consisting of appropriately transformed variables, and *U* is a vector of innovations to these variables. In accordance with the cointegration test, we set the lag lengths in (1) such that the error terms for each equation forming the VAR are serially uncorrelated.

It needs to be noted that estimated results of the VAR model such as (1) are more easily interpreted in its moving average representation, from which we may generate variance decomposition and impulse-response functions. Accordingly, we invert the estimated model based on (1) to derive its moving average representation using Sims' (1980) empirical strategy. The strategy involves orthogonalizing innovations in each of the variables using Choleski decomposition of the residual covariance matrix, imposing a recursive structure on the contemporaneous relationship among the variables. The variance decomposition and impulse-response functions generated from such a strategy, however, may be sensitive to the ordering of the variables. In the analysis, we order the goods market variables (real output and price) first, followed by the money market variable (money supply) and lastly by the asset prices (exchange rate and stock prices). This ordering is consistent with various works (Koray and McMillin, 1999; and Park and Ratti, 2000), which presume sluggish responses of the goods market to disturbances in other markets and contemporaneous responses of asset markets to innovations in other markets. Alternatively, to serve as a robustness check on the results obtained, we reverse the order of the variables by placing the asset market variables first followed by the goods market and money market variables. This ordering preserves the sluggish responses of the good markets to monetary shocks. Note that placing the asset market variables first may be rationalized on the observation that information on financial data is available contemporaneously while macroeconomic data are available with lags.

3. DATA AND COINTEGRATION

As we have mentioned, the analysis considers the interactions among the stock price, the exchange rate and three macroeconomic variables, namely, real output, money supply and price level. To measure the stock price, we use end-of-the-month values of the Kuala Lumpur Composite Index (*KLCI*). The exchange rate (*EXC*) is represented by the bilateral Ringgit exchange rate *vis-à-vis* the US dollar. Since monthly data on real GDP are not available, we use real industrial production (*IP*) to capture real economic activity. The money supply is represented by the M2 monetary aggregate. Meanwhile, we employ the consumer price index as a measure of the aggregate price level (*CPI*).[6] These data, which are retrieved from the IFS CD-ROM and taken from Lian (1993) and *Investors Digest* (various issues), are monthly data covering the period January 1977 to August 1998. All data are expressed in natural logarithms.

As a pre-requisite for establishing the presence of a long-run relationship among the variables, we first implement the widely used ADF tests to evaluate the integration properties of the variables under consideration.[7] Table 1 reports the results of the ADF tests for all the

TABLE 1
ADF Unit Root Tests

	Levels		First Difference	
Variables	No Trend	With Trend	No Trend	With Trend
KLCI	-2.1246	-2.3359	-4.1392*	-4.2467*
EXC	0.6455	-0.8774	-1.7098	-2.0731
IP	-0.2165	-2.4023	-3.2605**	-3.1487***
CPI	-0.7824	-2.4388	-2.2907	-2.2113
M2	-0.8819	-2.1968	-2.7967*	-2.7986

Note: *, ** and *** denote significance at 1%, 5% and 10%, respectively.

TABLE 2
Johansen-Juselius Cointegration Tests

Null Hypothesis	Trace	Maximal Eigenvalue	Variables	Long-run Coefficients
$r = 0$	81.861**	31.296***	*KLCI*	-1.0000
$r \leq 1$	50.564**	23.759	*EXC*	-1.5787
$r \leq 2$	26.805	17.637	*IP*	0.2476
r ≤ 3	9.168	8.420	*CPI*	4.5197
$r \leq 4$	0.748	0.748	*M2*	-0.3957

Note: ** and *** denote significance at 5% and 10% levels, respectively.

series, where the tests are implemented without and with a time trend. For the variables in levels, the ADF tests without and with the time trend cannot reject the null hypothesis of non-stationarity. However, we find evidence that *KLCI*, *IP* and *M2* are stationary when expressed in first differences. Accordingly, these variables seem to be integrated of order 1, or I(1). For *CPI* and *EXC*, the tests suggest the possibility of two unit roots in the series. Accordingly, we complement the tests for the two series (i.e., *CPI* and *EXC*) using the Phillips-Perron (PP) tests. The tests indicate that the variables are integrated of order 1.[8] Accordingly, we also treat these two variables as an I(1) process.

Since the results from the integration tests suggest the possibility of a long-run relationship among the variables, we proceed to cointegration tests applying the JJ procedure. We choose the lag length for the VAR such that the error terms are serially uncorrelated. Using the Ljung-Box-Pierce *Q*-statistics to test the null hypothesis of serially uncorrelated errors up to lag orders of 24, we find that setting the lag length to 12 is sufficient to whiten the noise process. The results of cointegration are reported in Table 2.

As may be observed from the table, the trace statistic indicates the presence of two cointegrating vectors. Meanwhile, the maximal eigenvalue statistic indicates a unique cointegrating vector. From these results, we conclude that there is a unique cointegrating vector governing the long-run relationship among the variables.[9]

We also report in Table 2 the implied long-run coefficients from the estimated cointegrating vector by normalizing on the stock price index. In specific, the long-run cointegrating regression can be written as:

$$KLCI = -1.5787EXC + 0.2476IP + 4.5197CPI - 0.3957M2 - 9.0716 \quad (2)$$

Several interesting results are notable. In the long-run, currency depreciation seems to be associated with the stock market decline, as evidenced by the negative exchange rate coefficient. Theoretically, the effects of currency depreciation on stock prices can be either negative or positive. For an economy that is highly dependent on imports, currency depreciation raises input prices and reduces firms' profit margin. Moreover, currency depreciation may generate expectations of future depreciation and, subsequently, drive portfolio investments out of the country. By contrast, it may be argued that currency depreciation encourages exports and, thus, firms' profits. The net effects, accordingly, will depend on which force is more dominant. In our context, it appears that the two negative effects of currency depreciation dominate.

The long-run association between the stock price and the industrial production is positive. This should be expected as the changes in the stock price reflect expectations of future economic conditions. Likewise, current changes in the industrial production may influence the firms' expected future cash flows. Interestingly, *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. This finding is consistent with the works of Shabri et al. (2001), and Khil and Lee (2000). Examining the relationship between stock returns and inflation for Malaysia and Indonesia, Shabri et al. (2001) found a positive association between Malaysian stock prices and inflation. Examining whether the common stocks can be a good hedge against inflation for 10 Pacific-rim countries, Khil and Lee (2000) documented a negative link between stock returns and inflation for all countries except Malaysia. That is, Malaysia is the only country that exhibits a positive association. Given this result on *KLCI-CPI* long-run relationship, the negative link between *KLCI* and *M2* needs to be explained by factors other than inflationary pressures generated by monetary expansion. Perhaps, the increase in money supply results not only in inflation but also inflation uncertainty, generates depreciation expectations and leads to anticipation of future contractions.

4. VAR RESULTS

While the cointegration analysis captures the long-run relationship among the variables, it does not address the short-run dynamics and interactions among them. That is, it does not provide information on how a variable of interest responds to shocks or innovations in other variables, which is highly important for understanding the transmission of shocks across markets. Accordingly, we proceed to evaluate the variance decomposition and impulse response functions based on a VAR specification for the purpose. In line with the JJ test, we set the

TABLE 3
Variance Decompositions

Variable	Periods	Innovations in *KLCI*	*EXC*	*IP*	*CPI*	*M2*
(A) Ordering: *IP*, *CPI*, *M2*, *EXC*, *KLCI*						
KLCI	12	58.85	6.69	3.89	8.23	22.33
	24	48.48	8.85	6.64	9.47	26.57
EXC	12	4.58	84.21	2.65	0.34	8.23
	24	9.53	72.79	3.24	1.57	12.88
IP	12	5.24	16.91	66.62	3.74	7.48
	24	8.26	14.97	64.41	3.19	9.16
CPI	12	6.47	16.51	2.06	61.36	13.60
	24	13.13	17.37	2.28	45.67	21.55
M2	12	1.15	18.00	7.45	5.87	67.52
	24	6.25	38.74	14.63	6.69	33.69
(B) Ordering: *KLCI*, *EXC*, *IP*, CPI, *M2*						
KLCI	12	74.38	4.34	5.68	1.69	13.91
	24	63.92	5.72	9.25	2.77	18.34
EXC	12	7.65	78.78	4.64	0.30	8.63
	24	15.32	66.26	5.81	0.48	12.13
IP	12	7.12	15.11	68.06	3.18	6.54
	24	9.28	12.62	67.85	2.74	7.51
CPI	12	19.49	18.95	1.67	51.36	8.52
	24	28.54	20.82	2.09	35.11	13.44
M2	12	6.69	13.53	9.51	3.83	66.44
	24	12.91	31.39	19.15	3.56	32.97

lag length of the VAR in levels to 13, which is sufficient to render the error terms serially uncorrelated. Since the results may be sensitive to the ordering of the variables, we experiment with two alternative orderings that have plausible identifying restrictions. These are (i) *IP*, *CPI*, *M2*, *EXC*, and *KLCI*, and (ii) *KLCI*, *EXC*, *IP*, *CPI*, and *M2*.

4.1 VARIANCE DECOMPOSITIONS

Table 3 reports the results for variance decompositions at 12- and 24-month horizons. Panel A of the table corresponds to the first ordering while panel B is for the second ordering. The results suggest the presence of interactions among the stock market, exchange rate and macroeconomic variables. Focusing on Panel A of the table, we may observe that variations in *KLCI* are predominantly attributed to its own variations and *M2* variations. They respectively account for about 48 percent and 26.6 percent of the *KLCI* forecast error variance after 24 months. Innovations in *IP*, *CPI* and *EXC* also explain quite sizable fractions of the *KLCI* forecast error variance. Namely, 6.6 percent, 9.5 percent and 8.8 percent of the *KLCI* variations may respectively be attributed to these variables. Note that the results from the alternative ordering (Panel B) further substantiate the significance of *IP* and *M2* in accounting for movements in *KLCI*. However, the fraction that is accounted by *CPI* reduces substantially to only 2.8 percent. Note that the contribution of *EXC* is still above 5 percent at 24-month horizon. From these variance decompositions for *KLCI*, we may conclude that movements in Malaysian equity market are domestically driven. It responds more to monetary shocks than to real shocks.

KLCI shocks also contribute significantly to variations in the macroeconomic variables and the exchange rate under both orderings but especially under the alternative ordering. Namely, for the first ordering (second ordering), innovations in *KLCI* explain about 13.1 percent (28.5 percent) of the *CPI* forecast error variance. *KLCI* innovations also explain 9.5 percent (15.3 percent) and 8.3 percent (9.3 percent) of respectively *EXC* and *IP* variations. Lastly, about 6.3 percent (12.9 percent) of *M2* variance is attributed to *KLCI* shocks. These results suggest that the stock market tends to incorporate information on future macroeconomic variables such as inflation, real output and money supply. The significant effect of *KLCI* on *M2* may also suggest that

Malaysian monetary authorities react to changes in the stock market. The response of the exchange rate to *KLCI* shocks may reflect inflows or outflows of portfolio investments.

Looking at the interactions among the exchange rate and the three macroeconomic variables, we note the importance of the Malaysian exchange rate to variations in Malaysian macroeconomic performance. While *M2* explains only 7.5 percent to 9.2 percent of the variations in *IP*, the exchange rate innovations account for about 12.6 percent to 15.0 percent. The results seem consistent with Malaysia being highly dependent on international trade. Note that the forecast error variance of *M2* is attributable in a substantial portion to innovations in *EXC*. Namely, about 31.4 percent to 38.7 percent of its variance is accounted by *EXC* shocks after 24 months. This result tends to indicate that the Malaysian monetary authorities have a focus on stabilizing the exchange rate movements, which again emphasizes the importance of international trade to the Malaysian economy. The *EXC* shocks also explain about 17.4 percent to 20.8 percent of the *CPI* variance. Other results that may be noted from the table are the importance of *M2* variations to real economic activity and inflation variance. These results conform well to existing studies on the Malaysian case (Ibrahim, 1995; Tan and Cheng, 1995; and Masih and Masih, 1998).

4.2 IMPULSE-RESPONSE FUNCTIONS

To examine further the dynamic interactions among these variables, we generate impulse-response functions from the estimated VAR. Since the results for the two orderings are qualitatively similar, we present the plots of the functions only for the first ordering. Keeping in line with the discussion on variance decompositions, we first look at the interactions between the stock market index and other variables. The plots are given in Figure 1. Then, we shift to the interactions between macroeconomic variables and the exchange rate. Selected notable results from interactions among macroeconomic variables are also given. These are presented in Figure 2. These impulse-response plots are presented together with two standard error bands.

From these figures, we may highlight several notable points. From Figure 1, we note a positive lagged response of stock prices to *IP* shocks. However, it is not significant. Gjerde and Sættem (1999) also

FIGURE 1
Impulse-Response Functions—*KLCI* versus Other Variables

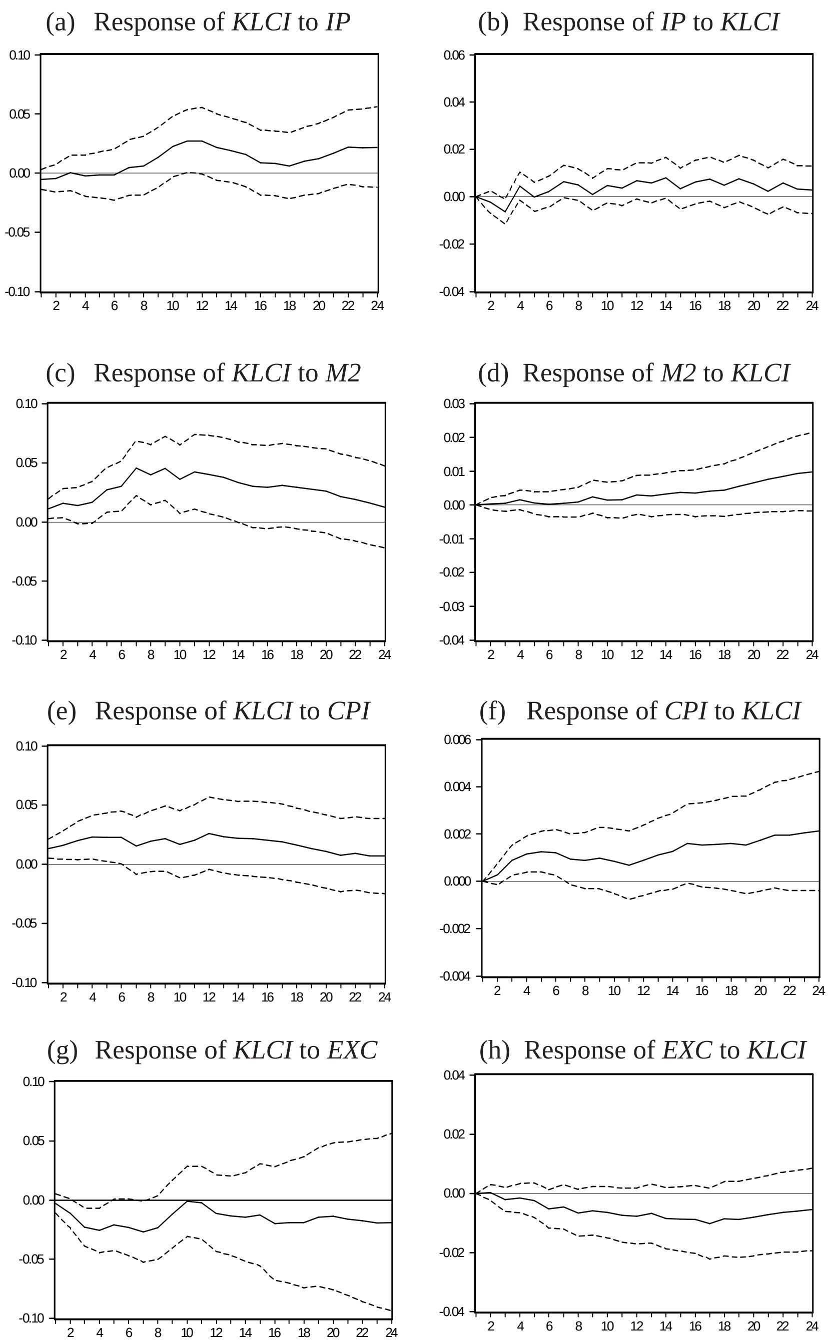
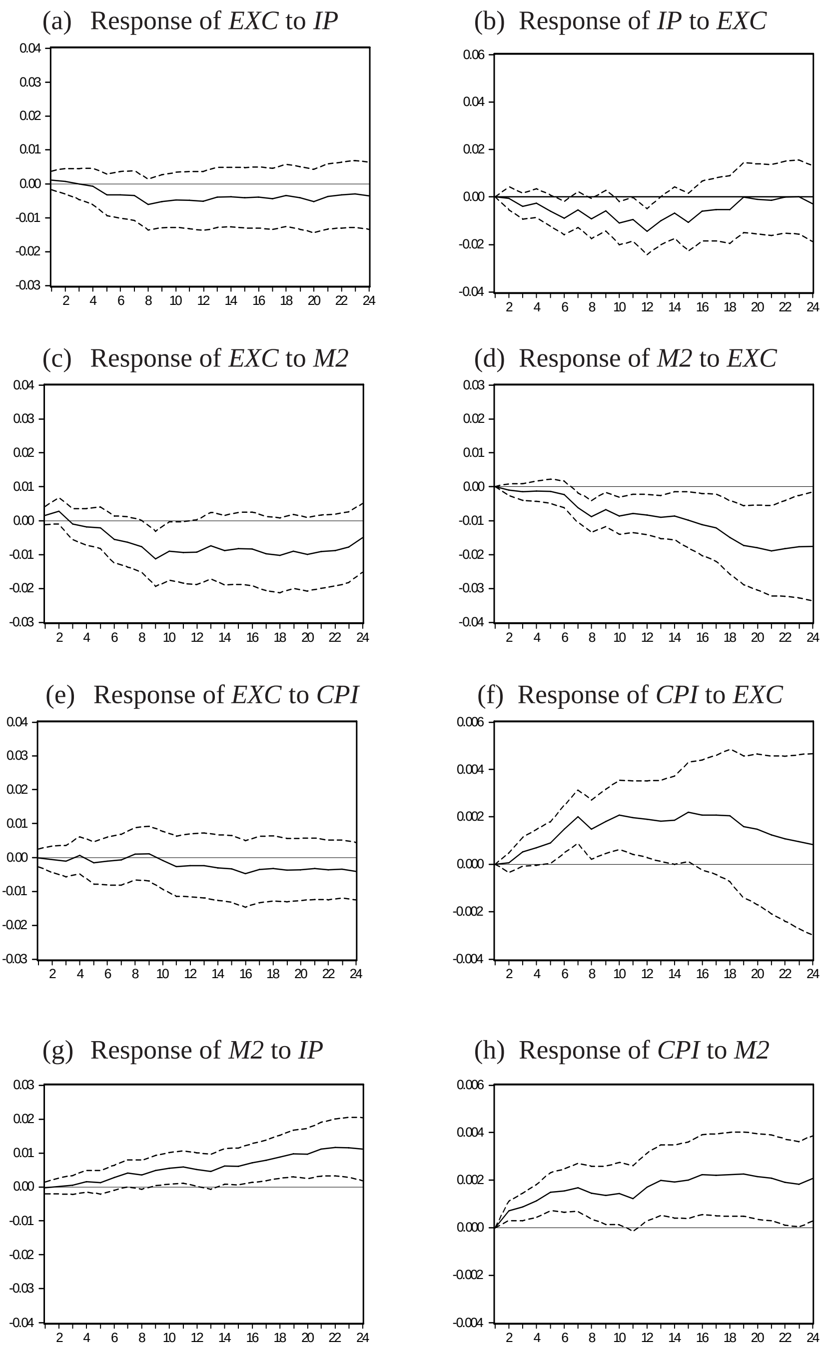


FIGURE 2
Impulse-Response Functions—Other Variables



documented a similar finding for a small open, but developed, market of Norway. Interestingly, a one standard deviation innovation in *M2* results in positive equity price responses, which peak around 7-8 months after the shocks and then subside gradually afterward. Thus, together with the long-run results, the stock prices seem to have immediate positive responses to, but negative long-run association with, *M2* innovations. Since Mukherjee and Naka (1995) advanced a view that the relationship between the two is ambiguous and may be positive or negative, an explanation for the observed findings need to be made. Indeed, based on a diagrammatic model, Bulmash and Trivoli (1991) argued that the increase in money supply has immediate positive liquidity effects and long-run negative effects on the stock market. Provided that rational expectations on consequences of monetary expansion are formed with delay, monetary expansion generates first the wealth effect, which leads to an increase in aggregate spending on both real goods and services and on financial assets such as stocks and bonds. In the long-run, various factors such as inflation uncertainty and anticipation of depreciation and monetary contractions may set in and result in negative responses by the stock market.

Note also that *KLCI* innovations lead to positive responses by *CPI*, which reaffirms the view that the Malaysian equity market provides a good hedge against inflation. We may observe from Figure 1 the positive and significant response of *CPI* to *KLCI* shocks. This result reiterates the information content of the stock prices for especially the *CPI*. Consistent with the long-run result, stock prices respond negatively and significantly to Ringgit depreciation shocks at 2-7 month horizons. Likewise, innovations in the stock prices lead to negative responses (appreciation) by the exchange rate. However, they are not significant. The finding that depreciation shock decreases the stock prices echoes the view of Abdalla and Murinde (1997) for the importance of exercising caution in the implementation of exchange rate policies.

Figure 2 further reveals the important role of the exchange rate to Malaysian macroeconomic performance. Depreciation shocks lead to reductions in *IP* and *M2* and an increase in *CPI*. The negative response of *IP* to exchange rate innovations reflects contractionary devaluation in the Malaysian case. At the same time, depreciation shocks are also inflationary. More importantly, we confirm our early observation that monetary authorities attempt to stabilize changes in the currency value.

Namely, the money supply becomes contractionary to contain the decreasing value of the Ringgit and expansionary in the face of currency depreciation. Conversely, Malaysian variables do not seem to exert significant influences on the exchange rate.

Other notable results given in the last two plots of Figure 2 suggest the pro-cyclical pattern in the money supply, where it reacts positively to real economic activity shocks. This may stem from the focus of the monetary authority on the exchange rate stabilization.[10] The increase in real economic activity leads to currency appreciation. This results in positive responses by money supply and, thus, accounting for a positive response of the money supply to initial output shocks. Again, our results document the inflationary effects of monetary expansion. This finding further strengthens existing evidence that is highly supportive of the Monetarist proposition for the Malaysian case. However, it needs to be reiterated that, the inflation rate in Malaysia is not solely domestically driven as it also responds positively to currency depreciation.

5. CONCLUSION

The study analyzes the dynamic interactions among financial variables, the stock price and exchange rate, and three basic macroeconomic variables-real output, price level and money supply-using time-series techniques of cointegration and vector autoregression. Some important results are detailed as follows. The inclusion of the macroeconomic variables and the exchange rate improve the predictability of the Malaysian equity prices. Conversely, the movements of the stock market also contain information on future variations of these variables particularly the consumer prices. We note specifically that movements in the Malaysian stock market are driven more by domestic factors, particularly the money supply, than by the external factor (i.e., the exchange rate).[11]

Particularly, the stock prices have immediate positive responses to monetary expansion. However, they are negatively related in the long-run. These results seem to be in line with the views advanced by Bulmash and Trivoli (1991). Namely, the increase in money supply results first in wealth effects, leading to an increase in the stock prices. However, as expectations on inflation and associated inflation uncertainty and anticipations of currency depreciation or future contractions set in, the stock prices tend to decline. From a policy point of view, this channel of monetary transmission mechanism requires monetary authorities to take caution in implementing monetary policies especially if they are used to affect movements in the stock market. The reason is, although monetary policies can move the stock market as desired (e.g., implementing expansionary monetary policy to support stock prices) in the short-run, they tend to lead to adverse results in the long-run.

We also note from the analysis a negative long-run association between the stock prices and the Ringgit bilateral exchange rate *vis-à-vis* the US dollar. In other words, currency depreciation is associated with the decline in the stock market. Our dynamic analysis further indicates that currency depreciation tends to result in a reduction in stock prices. This finding, thus, echoes an argument made by Abdulla and Murinde (1997) that governments of emerging markets need to be cautious in implementing exchange rate policies since they may have adverse repercussions on domestic equity markets. The results also indicate significant influences of the exchange rate changes on the Malaysian economy. A notable result is that the Malaysian monetary authorities seem to concentrate mainly on stabilizing the exchange rate. That is, the money supply responds positively to currency appreciation and *vice versa*. The pre-dominant focus on exchange rate stabilization has made the movements in money supply to be pro-cyclical. The increase in real activity tends to increase the value of the Ringgit. However, the monetary authorities react positively to keep the Ringgit at a competitive level, resulting in money supply being pro-cyclical. Recall that, if the money supply increases continuously due to continuous positive growth of the economy, an adverse effect of the increase will be felt by the stock market in the long-run. Accordingly, a predominant focus by the monetary authorities to stabilize the exchange rate may prove to be destabilizing.

ENDNOTES

1. Mukherjee and Naka (1995) discussed the effects of a broad range of macroeconomic variables on firms' cash flows and discounted factors. Aggarwal (1981) and Bodnar and Gentry (1993) further emphasized the importance of exchange rates to stock price fluctuations.

2. There has been a shift in emphasis towards industrialization and export

promotion strategies since the 1980s. This emphasis has, in turn, resulted in increasing dependence over imported intermediate goods and capitals. Prior to 1980, the ratios of exports and imports to GDP were below 50 percent. Then, these ratios surpassed 50 percent during the 1980s. From 1990 to 1997, the export ratio was 88.4 percent and the import ratio was 90.6 percent, making Malaysia one of the highly open economies (Ibrahim, 2002).

3. A problem with the VAR technique is that structural interpretation of the VAR coefficients may not be made. According to Genberg et al. (1987), this will not pose a serious problem if the focus is not on structural interpretation.

4. A large and expanding number of studies consider and incorporate these macroeconomic variables. Examples of recent studies include Mukherjee and Naka (1995), Gjerde and Saettem (1999), Kwon and Shin (1999), Park and Ratti (2000), Canova and De Nicolo (2000), and Maysami and Koh (2000).

5. Since the tests are now well known, we do not describe them here. Interested readers may refer to Johansen and Juselius (1990) for details. See also Hall (1989) and Dickey et al. (1991).

6. The choices of specific monetary aggregates (M1, M2 or M3) or price aggregates (CPI, GDP deflator or others) are always a matter of debate. To reflect and capture both liquidity and wealth effects, we believe that a broader monetary aggregate should be used. This means that M3 is the most appropriate. However, since data on M3 are not available for the whole sample, we settle with M2 monetary aggregate. With respect to the measure of the price level, we employ the CPI. Most existing studies use CPI as a measure of inflation (see endnote 4). Moreover, the use of CPI is justified on the basis that it is an oft-quoted measure of inflation by the government and accordingly receives great attention from investors and economic agents.

7. The ADF test is widely used for testing the integration order of time-series data. However, it lacks power in that it fails to reject the null hypothesis of a unit root too often. Accordingly, some evidence of rejection from the test is weighted highly. Moreover, it becomes standard to complement the ADF test with another test for integration. In our case, we employ the PP test. We conclude in favor of the null only if these tests taken together fail to reject the null hypothesis.

8. The PP test statistics with the trend term included for CPI and EXC in levels are respectively -1.6485 and -0.5743. Meanwhile, the corresponding

statistics for the first differences of the variables are -13.641 and -15.227.

9. Johansen and Juselius (1990) seemed to favor the maximal eigenvalue test over the trace test. Moreover, Haug (1996) noted that the JJ maximal eigenvalue test has less size distortions compared to the JJ trace test.

10. The Malaysian monetary authority has broad macroeconomic objectives including stable price level, stable exchange rate, sustainable output growth and low unemployment rate. The impulse-response function that we plot suggests that the money supply reacts to stabilize the exchange rate. By contrast, the money supply is pro-cyclical, responding positively to output, which may not be taken as the central bank's reaction function. Taken these results together, we conclude that exchange rate stabilization is a major focus of Malaysia's central bank.

11. There is parallel literature on financial integration that documents the significant influence of major equity markets (such the U.S. and Japanese markets) on equity markets of developing economies. In our work, we do not include this important variable. Accordingly, our interpretation on the predominant influences of domestic variables on Malaysian equity prices should be taken with caution. Combining macroeconomic forces and financial integration in modeling equity price behavior is a subject of ongoing research.

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