The Interrelatedness of Malaysian Equity Markets, Money Markets and Foreign Exchange Market

Wan Mansor Wan Mahmood*

The a er examines the relationshi among equity markets, money markets and the foreign exchange market in the Malaysian context. These three markets are roxies y the 3 month treasury ills of the money market, the uala um ur com osite index for stock market, and the ringgit against inga ore dollar for the foreign exchange market. The time eriod for the study co ers from January 1998 through ecem er 2002. The results sho that these markets are integrated o er time in the long run. s for the short run, the results re ort the existence of significant idirectional short run causal interaction only et een exchange rates and money market rates. The issues are im ortant to look into y in estors, multinational com anies and go ernment alike, as disru tion of any one market ill ha e an effect on their strategies in the other markets.

Introduction

Interest in integration among economics variable continue to increase and the need to better understand these interaction particularly with the 1997 Asian financial markets crises has risen. Shocks, such as equity market interruptions, attacks on currency values and the frequent changes in interest rates to balance the inflation rate have received mixed reactions among financial analyst, traders and regulators. Moreover, the movements in interest rates, foreign exchange rates and equity prices also have important managerial implications particularly for Multinational Corporation (MNC). It is important to note that this present scenario happen due to the change in the market structure for financial services such as improved in communication, information and production technology, which have all fostered a competitive environment among international traders and investors.

Following this development, numerous market linkages studies have been carried out to explore on these relationships. For examples, research on the relationship between interest rates and exchange rates variables can be dated back to the research by Aliber, 1973; Mishkin, 1984; Ngama, 1994 and So, 2001. However, their study mainly focuses only on the long run equilibrium relationships or short run bivariate relationship between these variables. In explaining long run relationship between and among variables, it is also important to understand reasons behind their economic theoretical linkages. For example, strong economic conditions normally resulted in lower interest rates and follows by increase activity in equity market that led to increase in stock prices.

* Associate Professor, Universiti Teknologi MARA Terengganu, Dungun, Terengganu, Malaysia. E-mail: dwanmans@tganu.uitm.edu.my

The short run relationship, which is very important in today's environment, is often ignored. The analysis of short run relationship is very important particularly for the finance manager of MNC in managing their current assets and current liabilities, since these components are subject to the changes and short-term movements of interest and exchange rates. Therefore, the analysis on the transmission of information between interest rates and exchange rates is of immerse significance to the management of MNC.

Apart from examining the movement of these variables, researchers also studied cause/effect relationships. For examples, Joehnk and Petty (1980) find that equity prices are generally inversely responsive to interest rates. A similar result also obtained by Hafer (1986) who finds that increase in interest rates generally reduces equity prices. His empirical results confirmed that discount rate changes have significant negative effect on stock prices.

In recent years, the topic on interrelatedness between and among equity markets, money market and foreign exchange market around the world becomes the subject of research and discussion among academician. Extensive study has been carried out in examining the international correlation as well as cause and effect of at least between two of these three variables. However, within the national boundaries and domestic environment, less attention has been given in exploring these interactions.

No study has so far been carried out in Malaysia to test the relationship among equity markets, money markets and foreign exchange markets. This is somewhat surprising given the increasingly important role played by exchange rates and interest rates in the equity market relationship particularly an emerging market such as Malaysia. Vast quantity of capital flows through Foreign Direct Investment (FDI) into the country affect equity market values and interest rates. What impact the FDI has on equity market, foreign exchange market and money market relationships following the Asian financial and currency crises. Are there any reasons why most of the equity markets still not fully recovered? Therefore, an understanding of the relationship between and among these financial market variables is important, since it affects the country's economy (including the capital flows into the country) especially in the light of current world events, which is full of uncertainty.

In the light of the above discussion, this paper provides additional insights into the relationship between and among three sets of the Malaysian financial markets: equity markets, money markets and foreign exchange markets, and the impact of each variable on the other variables within the context of three markets. This study contributes to the present literature in three distinct areas:

1. It is the first such study on the relationships of money markets, exchange markets and equity markets using Malaysia data set. This will shed some light on the interaction, particularly in the emerging market like Malaysia.
2. The study explores the relationship between and among variables not only through their long run equilibrium but also the dynamics of their short term interactions. Both, the Engle-Grangle (EG) and Johansen maximum likelihood co-integration tests are employed together with the Vector Equilibrium Correction Model (VECM). This examinations help finance managers, traders, investors and policymakers to have a better understanding of the behavior, particularly of the short run movements of money market

rates, exchange rates and equity prices. This enables participants in these three markets to make more informed investment and financing decisions.

3. This study employs both bivariate and multivariate Granger causality in capturing the directions of short run movement between and among variables. The multivariate Granger causality is considered to be more efficient compare to bivariate, since it regress all variables in one single equation.

Review of Selected Literature

The study reviews the literature on the following procedures: the study looks into the domestic setting of interaction of equity markets, money market and exchange rates and analyzes the international interaction within each variable, and between and among the three sets of financial markets. Relationships on the first categories focus on the relationships between any two variables. For example, studies of relationship between exchange rates and stock markets include Bhandari and Genberg (1990), who find unstable long run relationship between nominal prices and nominal exchange rate. Aggarwal (1981) discovered a positive significant effect of the value of the dollar on the US stock prices, while Soenen and Hennigar (1988) detected a significant negative impact of the value of dollar on the stock prices. Researchers also studied the cause/effect relation between equity market and money market.

Several early studies find that the interest rates and equity share prices are generally negatively related. The empirical results of Joehnk and Petty (1980) suggest that stock prices are inversely responsive to interest rates. Hafer (1986) found the similar results. Hafer pointed out an increase in interest rates generally reduces equity prices, because the increase presages a tightening monetary policy. The empirical results of the study find that discount rate changes have significant negative effect on stock prices. Thorbecke and Alami (1992) demonstrated that the funds rate is a priced factor in the arbitrage pricing model and that anticipated increases (decrease) in the funds rate lower (raise) share prices. Cheung (1997) examines the impact of US stock returns on the Asian-Pacific stock return due to changes in the US monetary policy in 1994. His findings suggest that monetary developments in the US can have a significant impact on the Asian-Pacific stock returns, especially for those Asian-Pacific countries, which have strong economic links with the US.

As for the second set of market analysis in relation with international interaction, (different geographic market) equity market, are among the most popular topic to be investigated. The majority of the findings report that the US market causes other market and not the reverse. For example, Becker *et al.* (1990) study on cause/effect of stock market between the US and Japan find that the US market significantly affects Japanese market. Similar results are also reported by Eun and Shim (1989) and Knif and Pynnonen (1999), who find innovation in the US stock market spillover to other markets with insignificant feedback effects. Within the regional stock market, Baig and Goldfajn (1998) do not find any interaction among the five Asian stock markets investigated.

Recent research in the foreign exchange markets is mostly concern with interaction and spillover effect among countries. For example, Moosa and Bhatti (1997) based on an interest rate parity framework, showed evidence of integration between Japan and six other Asian countries. Except for the study by Swanson (2003), no other studies are found that relate three financial economics variable: equity market, money markets and foreign exchange markets.

The author investigates different aspects of global financial markets, specifically relationships among equity markets, money markets and foreign exchange markets across the countries. Their results show that international money markets and international equity markets are becoming increasingly integrated over time. They also found strongest relationships among the equity markets, with a causality emanating from the US and the German markets, which significantly affected the other markets.

Data and Methodology

Monthly data of the Malaysian ringgit, 3-month Interbank Money Market (MMI) rate is obtained from the Bank Negara Malaysia (BNM) quarterly report and are used to proxy for short-term interest rates. The Malaysian ringgit value against one unit of Singapore dollar (direct quotations) is used to proxy for Foreign Exchange Rate (FOREX) and is also obtained from BNM quarter report. The equity market is proxied by closing quotes of stock composite index of Kuala Lumpur Stock Exchange (KLSE) obtained from Investors' Digests. The analysis covers the time period from January 1998 through December 2002, with a total of 60 observations. The study uses monthly data, since these data are available and complete for all the three variables. It should be noted that the sample period employed covers the period of capital control policy introduce by the government. One of the items in this policy is that Malaysian ringgit is pegged at the US$1 to RM3.80. However, the exchange rates with other currencies including Singapore dollar are allowed to fluctuate within certain range. The raw data for all the variables are reported in Table 1.

Table 1: Raw Data of Interest Rate, Stock Index and Foreign Exchange Rate

Variables	MMI	FOREX	KLCI
N	60	60	60
Mean	4.549	2.2072	679.3
Median	3.175	2.1982	702.5
Std. Dev	2.696	0.0946	137.7
Minimum	2.840	2.0529	302.9
Maximum	11.070	2.5076	982.2

The standard deviation of equity market is larger than the interest rate and foreign exchange rate. This shows that the raw data of equity market has very large range and thus, are more volatile than the other two variables. Following Swanson (2003), the variables are structures using the following forms:

- The equity market variable is continuously compounded computed as $R_{i,t} = \ln(P_{i,t}/P_{i,t-1})$ where $P_{i,t}$ is the price level of market i at time t;
- The interest rates are in its original form; and
- The exchange rates are transformed to logarithmic form.

The descriptive statistics of the stock returns, interest rates and foreign exchange rates are given in Table 2.

Table 2: Descriptive Statistics of Interest Rate, Logarithmic of Foreign Exchange and Monthly Changes of Stock Index			
Variables	MMI	FOREX	KLCI
No. of Observations	60	60	59
Mean	0.04549	0.79083	0.0021
Median	0.03175	0.78764	-0.0080
Std. Dev	0.02696	0.04234	0.1071
Minimum	0.02840	0.71925	-0.2846
Maximum	0.11070	0.91933	0.2944
Skewness	1.5588	0.56033	0.36246
Kurtosis-3	0.86489	0.27332	0.67836
Notes: MMI, FOREX and KLCI are, respectively, the interest rate, logarithmic foreign exchange and changes in stock index.			

From the Table 2, it can be observed that the standard deviation of stock index returns (KLCI) contain similar results with that of raw data i.e. very volatile as compared with those of money market rate (MMI) and logarithmic Foreign Exchange Rate (FOREX). In addition, the three variables have excessive kurtosis and are positively skewed.

To model the long-run relationships between the variables, the study applies the unit root test, the Engle Granger co-integration test and the Johansen (1988) co-integration tests. As shown by many previous researchers, all these tests provide a more comprehensive investigation of economics variables linkages and are able to assist in tackling the long-term aspects of the issue.

The first step in modeling time series is to test for the stationarity of the data. A financial time series is said to be integrated of one order i.e., I (1), if it becomes stationary after differencing once. If two series are integrated of order one, there may have a linear combination that is stationary without requiring differencing and, if they do, they considered being co-integrated.

The concept of co-integration, introduced by Granger (1981,1986) and further developed by Engle and Granger (1987), incorporates the presence of non-stationarity, long-term relationship and short-run dynamics in the modeling process. Since a lengthy, detailed description of co-integration can be found in many textbooks (see Engle et al. 1991; Davidson and Mac Kinnon, 1993; Benerjee et al. 1993; Hamilton, 1994), a brief overview is sufficient here.

Assuming that each series has the same number of unit roots, the co-integration regression using Ordinary Least Squares (OLS) method can be applied by using the equation:

$$Y_t \quad c \quad . X_t \quad t \qquad \text{...(1)}$$

where Dis the estimator for independent variable X and c is the intercept. The P_t is white noise error term and suggests temporary deviations from long-run equilibrium. The residual terms, P_t , from the co-integration regression in equation 1 is tested for unit roots employing Dickey-Fuller and Augmented Dickey-Fuller (ADF) procedure. The ADF estimation is as follows:

$$\hat{u}_t \quad \cdot_0 \quad /_1 \; t \; 1 \quad \sum_{i=1}^{n} /_i \; \hat{u}_{t \; i} \quad P_t \qquad \text{...(2)}$$

where, α_0, δ_0 and β are coefficients to be estimated, n is the number of lagged terms and ε_t is a white noise disturbance. The significance of the estimated δ_0 will be estimated. If the t-statistic on the δ_0 coefficient exceeds the critical value, (i.e., $\delta \neq 0$) then the ε_t errors from the co-integration regression are stationary, and the variables X and Y are co-integrated. The tabulated distribution in Fuller (1976, p.373) is applied to interpret the t-ratio. In applying regression of equation 2, it should be noted that the number of lags n chosen must be sufficient enough to ensure that the error term, H_t, is strictly white noise. The study estimated with a variety of lags and the optimal result is reported.

As mentioned earlier, co-integration (Engle and Granger, 1987 and Johansen, 1988) analysis is used to examine long-term aspects. Engle and Granger (1987) typically preferred for bivariate analysis, while Johansen (1988), and Johansen and Juselius (1990), preferred for multivariate analyzes. Co-integration among a set of variable implies that even if they are non-stationarity, they never drift apart. In contrast, lack of co-integration suggests that such variables have no long run link (Arshanapalli and Doukas, 1993, p.195). Co-integration analysis captures relationship among the levels of price which are lost when other techniques are used because of the differences which has to be done in order to achieve stationarity of variables.

The Johansen (1988) co-integration tests rely primarily on two test statistics. They are trace test statistic and maximum eigenvalue test statistic. Both methods test for the nonzero characteristic roots. The trace test formulation is as follows:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{k}\ln(1-\hat{\lambda}_i)$$

where T is the number of observations and $\hat{\lambda}_t$ is the eigenvalues. The second test, the maximum eigenvalue formulation, is represented by:

$$\lambda_{max}(r, r+1) = -T\ln(1-\hat{\lambda}_t)$$

The trace formulation tests the null hypothesis that the number of r-cointegrating vectors of r = 0, that is, there are no co-integrating vectors in the system. If it is rejected, then sequential testing of $r \leq 1$, $r \leq 2$…is used. The maximum formulation tests the null that the number of co-integrating vectors is r against the alternatives hypothesis of r + 1 co-integrating vectors. Johansen and Juselius (1990) provide critical value for the two statistics. If the series are co-integrated, then the study will use the ECM since it is appropriate formulation to be employed.

Error Correction Model (ECM)

Granger's theorem argues that when co-integration exists between two variables, it provides the basis for construction of Error Correction Model (ECM). In ECM, it allows the introduction of past disequilibrium as explanatory variables in the dynamic behavior of current variables in order to capture both the short-run dynamics and long-run relationships between the currencies. Thus, the validity of an error correction model with the described properties can be used as an alternative test for co-integration. The bivariate ECM auto-regression can be expressed as follows:

$$\hat{u}_t < \cdot_0 \; /_0 \; _{t\;1} \sum_{i\;1}^{m} {}_i \, \hat{u}_{t<i} \sum_{j\;1}^{n} /_j \, \hat{u}_{t\;j} \; \#_t \qquad ...(3)$$

where, $R_{t\;1}$ is the lagged value of the error correction term derived from the long run co-integration regression equation 1, m and n are the optimal number of lags for the lagged dependent and lagged independent variables, respectively, and X_t is the residual. The results of equation 3 provide a test of the relationship between changes dependent variables Y_t and lagged change in the independent variable X_t. Similarly, by replacing variable Y with variable X, it is possible to test the impact of lagged Y on changing X using the same equation. For an issue concerning selection of an appropriate for lag length for the lag variables of Y_{t-i} and X_{t-j}, the study follows the criteria of minimizing the mean square of error of prediction (Akaike, 1974). Akaike's Final Prediction Error (FPE) test.

In case of multivariate, the ECM formulation is:

$$'Y_t \; D_0 \; /_0 P_{t\;1} \sum_{i\;1}^{m} E_i 'Y_{t\;i} \sum_{j\;1}^{n} G_j 'X_{t\;j} \sum_{k\;1}^{p} Q_k 'Z_{t\;k} \; X_t \qquad ...(4)$$

where, an additional variable, i.e the explanatory variable Z is include in equation beside changing variables Y and X to explain the changing variable Y as shown in equation 4. One important implication of the above model described in literature (Engle and Granger 1987), is that prices in an efficient speculative market cannot be co-integrated. If it they are co-integrated, then it implies that the market is inefficient since there must be 'Granger causality' running in at least one direction. In other words, return of one variable can be used to forecast the other return, even after taking into consideration the lagged values of the forecast price.

Empirical Result

The study tests for stationarity of the series using DF and ADF procedures. From the results in Table 3, the level series of the data is not stationary. When the first differences of the series are applied, the test statistics of DF and ADF become significant at 5% level. The series are equation 1 processes and therefore, they are integrated of the same order. As mentioned earlier, when integration occurs, Johansen testing procedures are used to investigate whether the two variables are co-integrated.

Table 3: Unit Root Tests on Level and First Differences

Variables	Dickey-Fuller Test		Augmented Dickey-Fuller Test (AR1)	
	Raw Data	First Differences	Raw Data	First Differences
MMI	-2.0612	-9.1755	-2.0612	-9.8012
FOREX	-1.9760	-25.4800	-1.9760	-25.4850
KLCI	-1.6730	-33.9010	-1.6730	-34.1080

Note: 95% critical value for the augmented Dickey-Fuller statistic = -2.9127.

Table 4 and Table 5 present the Engle-Granger co-integration results and the t-test for the DF and ADF unit root tests on residuals from the co-integrating regression equation. The tests statistics results are then compared with the critical value from Davidson and MacKinnon (1993).[1] The t-statistics results reported evidence of co-integration in two of the six cases of bivariate models and in two of the three cases for multivariate models. In the bivariate model, the dependent variable of interest rates is co-integrated with the value of explanatory variables of exchange rate and equity market. In other words, today's KLCI return and today's FOREX return significantly affected today's MMI return. Similar results are also obtained for the KLCI return, which is co-integrated with values of explanatory variables of interest rates and foreign exchange rates. As for multivariate model, out of three dependent variables, two dependent variables, MMI and KLCI return are affected by the explanatory variables.

Table 4: Engle-granger Cointegration Tests for Models with I (1) Variables—Bivariate Model

Dependent	Independent	Residual t-test for DF	Residual t-test for ADF
MMI	FOREX	-2.4565	-2.5826
	KLCI	-3.7420*	-4.5561*
FOREX	MMI	2.4701	-2.3860
	KLCI	-2.1195	-2.0879
KLCI	MMI	-2.7416	-3.6948*
	FOREX	-1.9429	-2.6567

* Significant at 5%.

Table 5: Engle-granger Cointegration Tests for Models with I (1) Variables—Multivariate Model

Dependent	Independent	Residual t-test for DF	Residual t-test for ADF
MMI	FOREX		
	KLCI	-3.6700*	-4.0100*
FOREX	MMI		
	KLCI	-2.7486	-2.6444
KLCI	MMI		
	FOREX	-3.0455*	-3.9483*

The Johansen co-integration test results are exhibited in Table 6. The results of bivariate model presented indicate that there exist at most r = 2 co-integrating vectors for dependent variable MMI and independent variable KLCI and vice versa since the null of r <= 2 cannot be rejected at either the 90% or 95% critical level. For other variables, there exist at most r = 1 co-integrating vectors. As for multivariate model, these exist at most r = 2 co-integrating vectors. Thus, there is evidence of co-integration vectors in all cases either using Johansen bivariate or multivariate models. Since the evidence suggests co-integration in the long run, the study further applies error correction model to test for the short run relationship between and among these variables using both bivariate and multivariate procedures.

Results for Error Correction Model

The results for bivariate and multivariate error correction model are reported in Tables 7 and 8 respectively. For the bivariate model, both coefficients in innovations between money market and foreign exchange market are statistically significant at 5% level. In other words, the innovations in the foreign exchange are transmitted to the money market and vice versa. The results suggest that money market and foreign exchange market are bound together in a long

[1] The test statistics do not follow the normalt-distribution.

Table 6: Johansen Cointegration Tests for Models with I (1) Variables

H_o	λ_{max}	Trace
Variables: MMI_t and $FOREX_t$		
r = 0	29.7406*	34.3774*
r<= 1	4.6368	4.6368
Variables: MMI_t and $KLCI_t$		
r = 0	50.6818*	67.0653*
r<= 1	16.3835*	16.3835*
Variables: $FOREX_t$ and MMI_t		
r = 0	29.7406*	34.3774*
r<= 1	4.6368	4.6368
Variables: $FOREX_t$ and $KLCI_t$		
r = 0	38.2204*	42.4406*
r<= 1	4.2202	4.2202
Variables: $KLCI_t$ and MMI_t		
r = 0	50.6818*	67.0653*
r<= 1	16.3835*	16.3835*
Variables: $KLCI_t$ and $FOREX_t$		
r = 0	38.2204*	42.4406*
r<= 1	4.2202	4.2202
Variables: MMI_t, $FOREX_t$ and $KLCI_t$		
r =0	24.2576	43.0724
	(22.0400)*	(34.8700)*
r<=1	12.0945	18.8148
	(15.8700)	(20.1800)
r<=2	6.7202	6.7202
	(9.1600)	(9.1600)

Note:	95% Critical Value	90% Critical Value
r = 0	15.8700	13.8100
r<= 1	9.1600	7.5300
r = 0	22.0400	19.8600
r<= 1	15.8700	13.8100
r<= 2	9.1600	7.5300

* Statistically significant at 5% level.

run equilibrium relationship. The money market follows and adjusts to innovations in the foreign exchange market and vice versa. Long run relationships are also detected between foreign exchange market and money market.

However, only innovations in money market are transmitted to the foreign exchange market. This suggests that money market follows and adjusts to innovations in the foreign exchange market. Finally, the long-run co-integration is also detected between money market and equity market. However, innovation transmissions are only one way (unidirectional) i.e., from money market to the equity market. The results imply that any deviation in long run for a certain period of time will be corrected in the following period. In this study, the deviation in long run will be corrected in the following month. The correction process will take place in the money markets.

To examine the short run relationship between variables in the bivariate model, the present study test the hypothesis H_0: $\beta = 0$ (j = 1,....n). The findings in Table 8 reject the existent of significant short-run interaction for all cases except one i.e., between exchange rate and money market but only for unidirectional. The β coefficient on ΔX_{t-j}. is positive and statistically significant only from exchange to money market, suggesting that an increase in exchange rate (a fall in value of ringgit) has positive effects on the money market. This implies that an immediate past decrease in value of ringgit has positive short run effect on the money market.

To examine the long-run effects using the multivariate setting, the study test the vector of error correction terms, P_{t-1}, equation 4. This term represents the deviation from the long run co-integrations at time t and) represents the response of the dependent variable to departures from equilibrium. According to Granger (1986), one of the two channels of causality can be detected through the error correction term, P_{t-1} and its coefficient,), can

Table 7: Error Correction Test Results—Bivariate

$$\Delta Y_t = \alpha_0 + \lambda_0 \varepsilon_{t-1} + \sum_{i=1}^{m} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{n} \gamma_j \Delta X_{t-j} + \varepsilon_t$$

Dependent ΔY_t	Independent ΔX_{t-j}	ε_{t-1}	ΔY_{t-i}	ΔX_{t-j}
MMI	FOREX	0.14819*** [3.0555]	0.42533*** [14.75] (-5)	0.023085*** [12.04] (-1)
FOREX	MMI	0.14848* [1.8303]	0.87751*** [3.51] (-7)	0.008663 [0.458] (-2)
MMI	KLCI	-0.34217** [-2.6932]	0.71758*** [16.89] (-11)	0.0044093 [0.220] (-5)
KLCI	MMI	-0.14337* [-1.7816]	-0.035909 [-0.222] (-4)	-0.039127 [-0.115] (-4)
FOREX	KLCI	0.075114 [1.2499]	0.99384*** [155.27] (-7)	0.00023 [0.003] (-5)
KLCI	FOREX	-0.096608 [-1.4559]	0.0099023 [0.0612] (-3)	0.0024046 [0.163] (-3)

Note: Lags order are in parentheses. The t-statistics are in bracket * Significant at 10%** Significant at 5% *** Significant at 1%.

Table 8: Error Correction Test Results—Multivariate

$$\Delta Y_t = \alpha_0 + \lambda_0 \varepsilon_{t-1} + \sum_{i=1}^{m} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{n} \gamma_j \Delta X_{t-j} + \sum_{k=1}^{p} \theta_k \Delta Z_{t-k} + \varepsilon_t$$

Dependent DY_t	Independent DX_{t-j}	Independent DZ_{t-k}	ε_{t-1}	Y_{t-i}	DX_{t-j}	Z_{t-k}
MMI	FOREX	KLCI	0.12508 [1.6077]	0.43999*** [16.32] (-6)	0.021220*** [11.95] (-2)	-0.011553 [-1.76] (-3)
FOREX	MMI	KLCI	0.10203 [1.3014]	1.0190*** [45.35] (-11)	-1.0873* [-2.15] (-2)	-0.0018747 [-0.035] (-2)
KLCI	MMI	FOREX	-0.26254** [-2.4010]	0.0004 (-1) [0.00275]	0.52685 [0.695] (-6)	0.014855 [-0.363] (-5)

Note: Lags order are in parentheses. The t-statistics are in bracket * Significant at 10%** Significant at 5% *** Significant at 1%.

tested using the t-statistics. The causality test statistics for long-run are reported in Table 8. The results show insignificant relationship for all cases except between exchange rate and interest rates on equity market. This suggests that in long-run exchange rates and interest rates follows and adjusts to innovations in the equity market. The results imply that deviation in long-run will be corrected in the following month and the correction process will take place in the exchange rates and interest rates.

Finally, the study examines the short-term causal relations among these variables within the framework of the multivariate error correction model by using equation 4. For example, equity market (KLCI) and interest rates (MMI), Granger causes exchange rate (FOREX), if either coefficients, G_j or θ_k are individually significant. The significance of the lags of each independent variable is tested individually using the t-statistics. The multivariate causality test results are reported in Table 8. The findings show the existence of significant bidirectional short run causal interaction between exchange rates and interest rates. An increase in exchange rate (fall in ringgit) (t-test =11.9) significantly causes interest rate to increase and a fall in interest rate (t-test = -2.15) causes exchange rate to increase (weaker ringgit).

The finding that domestic currency depreciates (weaker ringgit against Singapore dollar) tends to have a positive short-run effect on domestic interest rates and vice versa has some theoretical argument. Low domestic money market rate, for example, will create more demand for domestic currency since the cost of capital is reduced. This view suggests that low in interest rate induce domestic currency appreciation. More local investors expand their businesses to take advantage of the cheap cost of capital. This demand pressure causes the domestic currency to appreciate. The feedback interaction, on the other hand suggests that weaker exchange rates cause money market to strengthen. The reason is that, an increase in inflation expectation due to high economic expansion will cause regulator to increase interest rates in order to reduce expected excess money circulation in the market, thus exerting downward pressure on the value of domestic currency in the short-run.

The results of the present study should be view with cautious, and thus, broad generalizations about the relationship between and among variables should not be made. Based on the results using bivariate analysis of interactions of the market, the present study finds numerous significant causality between the markets, but when all three markets are combined through multivariate analysis, some of the significant relationships disappear. The use of multivariate approach in testing these three markets to allows for simultaneous determination of coefficients are most relevant and should be used in producing an efficient results.

Summary and Conclusion

This paper provides an investigation of long-run and short-run causality relationships between and among equity market, foreign exchange rates and interest rates in Malaysia for the period 1998 through 2002. Using Johansen co-integration procedure, the results report long run equilibrium interaction among these three financial markets. In examining the long run relationship using the multivariate ECM, the results show insignificant relationship for all cases except between interest rate and exchange rates on equity market.

Finally, the study examines the short term causal relations among these variables within the framework of the bivariate and multivariate ECM. The findings report the existence of significant bidirectional short run causal interaction only between exchange rates and money market rates for both models. Specifically, an increase in exchange rate (fall in ringgit) significantly causes interest rate to increase and a fall in interest rate causes exchange rate to decrease (a stronger ringgit against Singapore dollar).

A fall in interest rates usually is good news for the foreign exchange market as it reduces the cost of capital for the firms and increases the demand for ringgit, thus increase its value. During the study, the Bank Negara Malaysia decreases interest rates twice as the Malaysian economy begin to recover from the financial crisis and the slowdown of the late 1990s. As for interaction between equity market and interest rates, the results show lower interest rates does not help to drive Malaysian equity price as such. In this situation, it is suggested that other economic factors rather than interest rates are helping to push equity prices.

The study reveals that exchange rate does not play an important role in determining the equity market and vice versa. No significant relationship is found between these variables either in the bivariate model or multivariate model. This result contradicts most of the previous findings that find weaker ringgit is associated with a strengthening equity market or a strong ringgit cause stronger equity market. In the literature, the currency values and equity markets moving together in a similar direction is the more usual discovering. In conclusion, the issues of interaction among equity market, interest rates and foreign exchange rates are important to look into by investors, multinational companies and government as disruption of any one market will have an effect on their strategies on the other markets. Y

Reference # 42J-2006-12-02-01

References

1. Aggarwal R (1981), "Exchange Rates and Stock Prices: A Study of US Capital Markets under Floating Exchange Rates", *Akron Business and Economic Review*, pp. 7-12.
2. Aliber R Z (1973), "The Interest Rate Parity Theory: A Reinterpretation", *Journal of Political Economy*, Vol. 81, pp. 1451-1459.
3. Arshanapalli B and Doukas J (1993), "International Stock Market Linkages: Evidence From the Pre- and Post-October 1987 Period", *Journal of Banking and Finance*, Vol. 17, pp. 193-208.
4. Bahmani-Oskooee M and Sohrabian A (1992), "Stock Prices and the Effective Exchange Rate of the Dollar", *Applied Economics*, Vol. 24, pp. 459-464.
5. Baig T and Goldfajn I (1998), "Financial Market Contagion in the Asian Crisis", *International Monetary Fund Working Paper*, pp. 98-155.
6. Becker K G, Finnerty J E, Gupta M (1990), "The Intertemporal Relation between the US and Japanese Stock Markets", *Journal of Finance*, Vol. 45, pp. 1297-1306.
7. Benerjee A, Dolado J J, Galbraith J W and Hendry D F (1993), *Cointegration, Error Correction and the Econometric Analysis of Non-stationary Data*, Oxford University Press, Oxford.
8. Bhandari J S and Genberg H (1990), "Exchange Rate Movements and International Interdependence of Stock Markets", *Journal of Finance*, Vol. 45, pp. 1297-1306.
9. Cheung D W W (1997), "Pacific Rim Stock Market Integration under Different Federal Funds Rate Regimes", *Journal of Business Finance and Accounting*, Vol. 24, pp. 1343-1351.
10. Davidson R and MacKinnon J G (1993), *Estimation and Inference in Econometrics*, Oxford University Press, Oxford.
11. Engle R F and Granger C W J (1987). "Cointegration and Error Correction: Representation Estimation and Testing", *Econometrica*, Vol. 55, pp. 251-276.

12. Engle R, Granger C and Yoo B (1991), "Cointegrated EconomicTime Series: An Overview with New Results", *Long-run Economic Relationships Readings in Cointegration*, Engle R and Granger C (Eds.). New York, Oxford University Press, pp. 237-266.

13. Eun C S and Shim S (1989), "International Transmission of Stock Market Movements", *Journal of Financial and Quantitative Analysis*, Vol. 24, pp. 241-256.

14. Fuller W A (1976), *Introduction to Statistical Time Series*, New York, John Wiley & Sons.

15. Granger C W J (1981), "Some Properties of Time Series Data and their Use in Econometric Model Specification", *Journal of Econometrics*, Vol. 16, pp. 121-130.

16. Granger C W J (1986), "Developments in the Study of Cointegrated Economic Variables", *Oxford Bulletin of Economics and Statistics*, Vol. 48, pp. 213-228.

17. Hafer R W (1986), "The Response of Stock Prices to Changes in Weekly Money and Discount Rates", *The Federal Reserve Bank of St. Louis Review*, pp. 5-14.

18. Hamilton J D (1994), *Time Series Analysis*, Princeton University Press, Princeton, NJ.

19. Joehnk M D and Petty J W (1980), "The Interest Sensitivity of Common Stock Prices", *Journal of Portfolio Management*, Vol. 6, pp. 18-25.

20. Johansen S (1988), "Statistical Analysis of Cointegration Vectors", *Journal of Economic Dynamics and Control*, Vol. 12, pp. 231-254.

21. Johansen S and Juselius K (1990), "Maximum Likelihood Estimation and Inference on Cointegration—with Applications to the Demand for Money", *Oxford Bulletin of Economics and Statistics*, Vol. 52, pp. 169-210.

22. Knif J and Pynnonen S (1990), "Local and Global Price Memory of International Stock Markets", *Journal of International Financial Markets, Institutions and Money*, Vol. 9, pp. 129-147.

23. Mishkin F S (1984), "Are Real Interest Rates Equal Across Countries? An Empirical Investigation of International Parity Conditions", *Journal of Finance*, Vol. 39, pp. 1345-1357.

24. Moosa I A and Bhatti R H (1997), "Are Asian Markets Integrated? Evidence for Six Countries vis-à-vis Japan", *International Economic Journal*, Vol. 11, pp. 51-67.

25. Ngama Y L (1994), "Testing for the Presence of Time-varying Risk Premium Using a Mean-conditional Variance Optimization Model", *Oxford Bulletin of Economics and Statistics*, Vol. 56, pp. 189-208.

26. So R W (2001), "Price and Volatility Spillovers between Interest Rate and Exchange Value of the US Dollar", *Global Finance Journal*, Vol. 12, pp. 95-107.

27. Soenen L A and Hennigar E S (1988), An Analysis of Exchange Rate and Stock Prices—The US Experience between 1980 and 1986", *Akron Business and Economic Review*, pp. 7-16.

28. Swanson P E (2003), "The Interrelatedness of Global Equity Markets, Money Markets and Foreign Exchange Markets", *International Review of Financial Analysis*, Vol. 12, pp. 135-155.

29. Thorbecke W nd Alami T (1992), "The Federal Funds Rate and the Arbitrage Pricing Theory: Evidence that Monetary Policy Matters" *Journal of Macroeconomics*, Vol. 4, pp. 731–744.