

## BIVARIATE CAUSALITY BETWEEN EXCHANGE RATES AND STOCK PRICES IN MALAYSIA

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### ABSTRACT

*The main purpose of this paper is to examine the relationship between stock prices and exchange rates in Malaysia. This research considers high-frequency data of USD-MYR exchange rates and Kuala Lumpur Composite Index (KLSE) from July 22, 2005 to March 23, 2007, which is the period when the MYR was unpegged. The Johansen cointegration method suggests that there is no long-run equilibrium relationship between these two financial variables. Both Engle Granger and Toda-Yamamoto causality tests find that there is uni-directional causality running from stock prices to exchange rates.*

JEL: D4, D46 G14, G15

### INTRODUCTION

The interaction between exchange rates and stock prices has several important implications. First, the relationship between exchange rates and stock prices has a crucial role in the capital market development of emerging markets, particularly in those countries which have expanding corporate sectors with listed firms and growing tradable sectors that are sensitive to exchange rate policies (Abdalla and Murinde, 1997). Second, the interaction between exchange rates and stock prices is often used to predict future trends by fundamental investors (Nieh and Lee, 2001). Third, economic and financial policymakers and regulators need to know the relationship between asset prices, such as those between exchange rates and stock markets, if they are to formulate the appropriate policies (Hatemi-J and Roca, 2005).

The direction of causality between exchange rates and stock prices has been highly debated. There are two competing perspectives on whether exchange rates Granger cause stock prices or vice versa. The first is the traditional approach, which concludes that exchange rates cause stock prices. The transmission channel would be exchange rate fluctuations which affect firm's values through changes in competitiveness and changes in the value of firm's assets and liabilities, denominated in foreign currency, ultimately affecting firms' profits and therefore the value of equity. On the other hand, changes in stock prices may influence movements in exchange rates via portfolio adjustments (inflows/outflows of foreign capital). If there is a persistent upward trend in stock prices, inflows of foreign capital would rise. However, a decrease in stock prices would induce a reduction in domestic investor's wealth, leading to a fall in the demand for money and lower interest rates, causing capital outflows that would result in currency depreciation. Therefore, under the portfolio approach, stock prices would affect exchange rates with a negative correlation (Tabak, 2006).

The Malaysian economy witnessed a major financial crisis in 1997. The crisis was first felt in the foreign exchange and stock markets. Between June 1997 and December 1998, the ringgit depreciated by 33 percent against the US dollar. The immediate impact of the ringgit depreciation was on the stock market, with the Kuala Lumpur Composite Index (KLSE), the market's main indicator, declining by about 44.8 percent in the second half of 1997. As part of the policy redressal, the ringgit was fixed at RM3.80 to the US dollar in September 1998 to bring speculative currency flows against the ringgit under control. On

July 22, 2005, Malaysia abandoned the fixed exchange rate regime introduced during the Asian financial crisis and adopted a managed float exchange rate. Malaysia abandoned the ringgit peg just hours after China dropped its fixed exchange rate for the yuan. From July 22, 2005 to March 23, 2007, ringgit appreciated smoothly, from 3.7799 to 3.4565 against the US dollar, an appreciation of 8.56 percent. The KLSE, on the other hand, increased drastically from 939.69, rose two percent or 17.75 points, its highest close since May 2000 to 1235.65 on March 23, 2007. The effect on the domestic stock index is very different with exchange rates. Therefore, the Malaysian case provides an interesting arena to study the relationships between stock prices and exchange rates.

Furthermore, the KLSE is one of the fastest growing emerging stock markets. Market capitalisation and number of listed companies have increased in recent years. At the end of 1997, the market capitalisation was RM376.16 billion and the number of listed companies was 708. At the end of 2006, on the other hand, the market capitalisation had increased to RM848.7 billion and the number of companies had increased to 1027.

The rest of the paper is organized as follows. In the next section, we review some empirical studies and the main findings in emerging countries. Section three presents the data, methodology employed and the empirical results, while section four we provide concluding remarks.

## LITERATURE REVIEW

A number of empirical studies have been conducted in emerging market economies. Results of these studies have been mixed. For example, Abdalla and Murinde (1997) examined the relationship between exchange rates and stock prices in Korea, Philippines, India and Pakistan over the period January 1985 to July 1994. They found that there was a long-run equilibrium relationship between exchange rates and stock prices in India and the Philippines only and that exchange rates Granger cause stock prices in Korea, India and Pakistan while stock prices Granger cause exchange rates in the Philippines.

Granger *et al.* (2000) examined the causality issue using Granger causality tests for the emerging markets for the period January 3, 1986 to June 16, 1998. He found that exchange rates lead stock prices in South Korea which are in agreement with the traditional approach. On the other hand, data of the Philippines and Hong Kong suggest the result expected under the portfolio approach, which is stock prices lead exchange rates. Data from Malaysia, Singapore, Thailand and Taiwan indicate strong feedback relations, whereas that of Indonesia and Japan fail to reveal any recognizable pattern.

Hatemi-J and Roca (2005) used bootstrap causality tests with leveraged adjustments to examine the links between exchange rates and stock prices in Malaysia, Indonesia, Philippines and the Thailand in the periods immediately before and during the Asian Financial crisis. They found that prior to the crisis, exchange rates Granger cause stock prices in Indonesia and Thailand, while the reverse was true in Malaysia, however during the crisis there was no significant link between the variables.

Azman-Saini *et al.* (2003) found that there is a feedback interaction in Thailand for the pre-crisis period. However, the exchange rates lead stock prices during the crisis period. Recent study by Azman-Saini *et al.* (2006) in Malaysia found that there is a bi-directional causality for the pre-crisis period (January 1993 to December 1996). The results for the crisis period (January 1997 to August 1998) suggest that there is uni-directional causality running from exchange rates to stock prices. During the crisis, stock market decline was led by the ringgit depreciation.

Overall there is no consensus on the relationship between exchange rates and stock prices in emerging countries, suggesting further studies are needed to shed light on the issue. Furthermore, It would be

important and interesting to consider situations where asset market such as the foreign exchange in the period immediately during the currency unpegged.

## DATA, METHODOLOGY AND RESULTS

### Data

In order to perform the causality analysis, we use daily closing prices in Kuala Lumpur Composite Index (KLSE) and nominal exchange rates in terms of Malaysia ringgit relative to US dollar. The financial data set was drawn for the period from July 22, 2005 to March 23, 2007, which comprises 430 observations in total. The variables are obtained from *DataStream* and transformed into natural logarithm scale prior to analysis. Log transformation can reduce the problem of heteroskedasticity because it compresses the scale in which the variables are measured, thereby reducing a tenfold difference between two values to a twofold difference (Gujarati, 1995).

There is a problem that arises in examining integration of stock prices and exchange rates. The problem lies in the missing observations due to different stock markets and exchange rates holidays. Since the study extensively incorporates lags in the regressions, missing data is particularly troublesome. Thus, it is desirable to fill in estimate-based information from an adjacent day. This study follows the studies of Jeon and Von Furstenberg (1990) and Hirayama and Tsutsui (1998) by adopting the method of Occam's razor (just by filling in the previous day's price).

### Unit Root and Cointegration Tests

The first stage involves establishing the order of integration using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP), with and without a deterministic trend. Table 1 presents the results of the unit root tests for the two variables exchange rate (*exr*) and stock price (*sp*). The results indicate that exchange rates and stock prices are not stationary in their levels. On the other hand, all data are stationary at first difference and therefore indicating that all variables are I(1).

Table 1: Results of the Unit Root Tests

Panel A: ADF and PP Unit Root Tests at Level				
Variables	ADF		PP	
	$\tau_{\mu}$	$\tau_{\tau}$	$\tau_{\mu}$	$\tau_{\tau}$
<i>exr</i>	0.5178(0)	-1.3623(0)	0.5028(2)	-1.3839(3)
<i>sp</i>	0.8921(1)	-1.2236(1)	1.1104(2)	-1.1537(3)
Panel B : ADF and PP Unit Root Tests at First Difference				
Variables	ADF		PP	
	$\tau_{\mu}$	$\tau_{\tau}$	$\tau_{\mu}$	$\tau_{\tau}$
<i>exr</i>	-20.2263(0)***	-20.3221(0)***	-20.2257(2)***	-20.3221(0)***
<i>sp</i>	-16.0808(0)***	-16.2850(0)***	-16.1563(5)***	-16.1640(7)***

Notes: The null hypothesis is that the series is non-stationary, or contains a unit root. The rejection of the null hypothesis for both ADF and PP tests is based on the MacKinnon critical values. Values in parentheses are optimal lag lengths according to the Schwarz Information Criteria and Newey-West Bandwidth.  $\tau_{\mu}$  and  $\tau_{\tau}$  are constant and trend and constant, respectively. Asterisk (\*\*\*) denotes that a test statistic is significant at the 1% significance level.

Given the variables are I(1), the cointegration hypothesis between the variables is examined using the methodology developed in Johansen (1991) and Johansen (1995) in order to specify the long run relationship between the variables. According to Johansen (1988), a *p*-dimensional vector autoregression (VAR) of order *k*[VAR(*k*)] can be specified as follows:

$$Z_t = d + \prod_1 Z_{t-1} + \dots + \prod_k Z_{t-k} + \omega_t (t = 1 \dots T) \tag{1}$$

We can rewrite this expression as,

$$\Delta Z_t = d + \prod_k Z_{t-k} + \sum_{i=1}^{k-1} \theta_i \Delta Z_{t-i} + \omega_t \tag{2}$$

Here  $\Delta$  is the first difference operator,  $\prod$  and  $\theta$  are  $p$ -by- $p$  matrices of unknown parameters and  $\omega_t$  is a Gaussian error term. Long-run information about the relationship between exchange rates and stock prices in Malaysia is contained in the impact matrix  $\prod$ . When the matrix  $\prod$  has full column rank, it implies that all variables in  $Z_t$  are stationary. When the matrix  $\prod$  has zero column rank, the expression is a first differenced VAR involving no long-run elements. If, however, the rank of  $\prod$  is intermediate meaning that  $0 < rank(\prod) = r < p$ , there will be  $r$  cointegrating vectors that make the linear combinations of  $Z_t$  become stationary or integrated.

There are two Johansen cointegration tests. First, the maximum likelihood estimation procedure provides a likelihood ratio test, called a trace test, which evaluates the null hypothesis of, at most,  $r$  cointegrating vectors versus the general null of  $p$  cointegrating vectors. A second, likelihood ratio test is the maximum eigenvalue test, which evaluates the null hypothesis of  $r$  cointegrating vectors against the alternative of  $(r + 1)$  cointegrating vectors. The results of the cointegration tests are reported in Table 2. The null hypothesis of no cointegrating vector ( $r = 0$ ) cannot be rejected. Thus, although the variables were found to be  $I(1)$ , they are not cointegrated.

Table 2 : Johansen’s Cointegration Tests Between Exchange Rates and Stock Prices

$H_0$	$H_1$	Eigenvalue	Trace Statistics	5% Critical Value	Max-Eigen Statistics	5% Critical Value	VAR
$r = 0$	$r = 1$	0.0162	10.9547	19.96	6.9926	15.67	2
$r \leq 2$	$r = 2$	0.0092	3.9621	9.24	3.9621	9.24	

Notes: VAR is order of the variance.  $H_0$  and  $H_1$  denotes the null and alternative hypothesis respectively and  $r$  denotes the number of cointegrating vectors.

### Testing for Causality

To examine the issue of causations, we employ Granger causality tests. Because all the variables were  $I(1)$  but not cointegrated, we transform the variables by taking their difference to induce stationary and test for standard Granger causality without adding an error correction term as follows:

$$\Delta exr_t = \alpha + \sum_{i=1}^k \zeta_i \Delta exr_{t-i} + \sum_{j=1}^l \varphi_j \Delta sp_{t-j} + \varepsilon_t \tag{3}$$

$$\Delta sp_t = \psi + \sum_{i=1}^r \chi_i \Delta sp_{t-i} + \sum_{j=1}^s \gamma_j \Delta exr_{t-j} + \eta_t \tag{4}$$

The lag lengths  $k$ ,  $l$ ,  $r$  and  $s$  are chosen using the Schwarz Information Criteria. Table 3 shows that there is statistical uni-directional Granger causality runs from stock prices to exchange rates but there is no feedback causality from exchange rates to stock prices.

Table 3: Causality Tests Between Exchange Rate and Stock Prices: Engle Granger Approach

Dependent Variables	Independent Variables	Order of Lag	Joint Test of Zero Restrictions of Variables Added in Column 2	
			F-Statistics	p-values
$\Delta exr$	$\Delta sp$	2	2.5219*	0.0815
$\Delta sp$	$\Delta exr$	2	0.0863	0.9174

Notes:  $\Delta$  denotes a first difference. \* denotes statistically significant at the 10% level.

In addition to the Engle-Granger approach (1987), we also used the Toda-Yamamoto (1995) method to consider the robustness of the results based upon knowledge of the order of integration. The Toda-Yamamoto approach involves using the levels of the variables as in Equations (5) and (6) even if the variables may be individually non-stationary:

$$exr_t = \alpha + \sum_{i=1}^m \beta_i exr_{t-i} + \sum_{j=1}^n \gamma_j sp_{t-j} + u_t \tag{5}$$

$$sp_t = a + \sum_{i=1}^q b_i sp_{t-i} + \sum_{j=1}^r c_j exr_{t-j} + v_t \tag{6}$$

The initial lag lengths  $m$ ,  $n$ ,  $q$  and  $r$  are chosen using the Schwarz Information Criteria. However, for Toda-Yamamoto the initial lag lengths are augmented with extra lag. Because  $exr_t$  and  $sp_t$  are  $I(1)$ , then one extra lag is added to each variable. Wald tests are then used to test the direction of causality. For example, in Equation (5), the lags of  $sp_t$ , excluding the extra lag added to capture maximum order of integration, are tested for their significance. If the null hypothesis that the lags are jointly equal to zero is accepted, then  $sp_t$  does not cause  $exr_t$ . Testing for the joint significance of  $exr_t$ , excluding the extra lag added, in Equation (6) allows tests for uni-directional or bi-directional causality.

The results using this approach are presented in Table 4. The causality results are qualitatively the same as the results presented in Table 3. The null hypothesis that stock prices do not Granger cause exchange rate can be rejected at the 10 percent significance level. On the other hand, the hypothesis that exchange rate do not Granger causes stock prices cannot be rejected. Therefore, we find evidence that there is uni-directional causality from stock prices to exchange rates in the case of the Malaysia. This could mean that the transmission of information between foreign exchange and stock was inefficient.

Table 4: Causality Tests between Exchange Rate and Stock Prices: Toda-Yamamoto Approach

Dependent Variables	Independent Variables	Lag Structure	VAR Order	Joint Test of Zero Restrictions of Variables Added in Column 2	
				MWALD statistics	p-values
$\Delta exr$	$\Delta sp$	2	(3)	2.6526*	0.0716
$\Delta sp$	$\Delta exr$	2	(3)	0.1326	0.8759

Notes: The  $[k+d(max)]$ th order level VAR was estimated with  $d(max)=1$  since the order of integration is 1. Reported estimates are asymptotic Wald statistics. \* denotes statistically significant at the 10% level.

## CONCLUSIONS

This paper examined the interaction between stock prices and exchange rates focusing on the period when Malaysia dropped its currency peg against the US dollar. We employed daily data and applied cointegration using the Johansen approach, application of standard Granger causality tests and the Toda-Yamamoto approach to study the exchange rates and stock prices interaction. Using Johansen cointegration approach, our results show no long-run association between stock prices and exchange

rates, in line with previous research in other countries (see for example Granger *et al.* (2000)). This means that stock prices and exchange rates do not move together in the long run. However, using standard Granger causality test and Toda-Yamamoto approach, we found evidence of a uni-directional link from stock prices to exchange rates. Therefore, investors can use information obtained from stock market to predict the behaviour of currency market. Moreover, authorities in Malaysia can use the stock prices as a policy tool to attract the foreign portfolio investment by taking stabilizing measures for stock market.

The above results provide evidence support the portfolio balance models of exchange rate determination that postulate a uni-directional causation that runs from stock prices to exchange rates, but these results oppose the traditional models that hypothesized causation from exchange rates to stock prices. We, however, suggest that the significance of our results could possibly be improved upon by applying more observations. The use of more observations may better capture the dynamics of stock and currency market interrelationships.

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