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Dynamic Links between Exchange Rates and Stock Prices in Malaysia: An Asymmetric Cointegration Analysis

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Abstract. The present article used a monthly data and applied Enders and Siklos (2001) asymmetric cointegration analysis to examine the impact of exchange rates on stock prices in Malaysia for the period of 1999-2014. The result suggests that variables were cointegrated based on Engle-granger two step technique. Moving to threshold auto regressive (TAR) and momentumthreshold auto regressive (M-TAR) the finding reveals that based on the latter variables were asymmetrically cointegrated as null hypothesis of no cointegration was rejected at 1% significance level based on Enders and Siklos (2001), while the former shows that variables do not have long-run relationship and the speed of adjustment is symmetric. This signifies that increase in the prices of shares in Malaysian stock market could lead to Malaysian Ringgit appreciation over other major global currencies. The stocks will become more expensive and discourage foreign investors' participation in the market which inhibits the influx of stable foreign capital into Malaysian financial system. The implication is that regulators should ensure that adequate and efficient policies are put in place in order to keep the Ringgit exchange rates at optimal level so as to enhance the participation of foreign investors and improve market competitiveness.
Keywords. Stock prices, Exchange rates, Asymmetric, Cointegration, Malaysia.
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1. Introduction

Development of the capital market and its stability is one of the important policy objectives of the monetary regulatory authority in each economy, this is because of financial sector's contribution on attaining long-run growth. Malaysia will not be in exception as the country pass through several financial markets reforms from government controlled fixed regime to open market economy that existed presently in order to allow market forces to determine the performance of the financial system as well as overall economic growth. Since

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early 1990s studies on the relationship between stock prices and exchange rates become more interested among academicians, regulators and policy makers in the globe. Emergence of new markets, financial market globalization and implementation of flexible exchanger rates regimes brought about dramatic changes in both transition and emerging markets and these are among the reasons why researchers developed keen interest is observing such relationship. This is because the dynamics increased in investment opportunities as well as increase the exchange rates instabilities poses serious threat to the entire investment decision and require investors to diversify their portfolios. The aim of the present paper is to investigate the impact of exchange rates on stock prices in Malaysia using monthly data for the period of 1999-2014, the study applied asymmetric cointegration technique developed by Enders & Siklos (2001). The originality as well the gap filled based on this article is that although several studies are conducted about this issue in Malaysia, but very few if any applied same method across long time series to address this important relationship.

2. Literature review

There are two models that explain theoretically the links between stock prices and exchange rates; the first is flow oriented models which presume that the key factor that determine exchange rate is the performance of country's current account as well as its trade balance. The model also highlight that exchange rate differences affects international competitiveness and balance of trade which have a significant impact on real economic variables of output and real income (Dornbusch & Fisher, 1980). The central argument of the model is that the nexus between stock prices and exchange rates is positive. The second model conversely argues that exchange rate determination depend on the role financial accounts in an economy. These two models are also classified into portfolio balance model and monetary model, the latter proposed that there is negative relationship between stock prices and exchange rates and concluded that stock prices affect exchange rates. This means when domestic stock prices increase, the local currency appreciate through direct and indirect networks. This will motivate investors to buy more local stocks as prices increases and sale their foreign assets so as to get more local currency buy the domestic stocks. The dynamics therefore positively affect local currency, when the prices of domestic assets upsurge it leads to more wealth creation and as such more money is needed which lead to increase in the interest rate. Because of high rate of interest foreign investors will increase their investment and the more domestic currency will be required and as such its value appreciate. Monetary approach however claimed that potential value of exchange rate is determined by its real value and other prices since exchange rates are also a price of an asset. This model concludes that there is no relationship between exchange rates and stock prices. A lot of empirical studies also documented several evidences on this issue for different countries, but to our search very few studies are conducted on Malaysia and no study applied same methodology to address this important issue in Malaysia.

Earlier studies that investigated the links between these variables include among others Aggarwal (1981), Donnelly & Sheehy (1996) and their results exhibited present of linear relationship between stock prices and real exchange rate among U.S. stock U.K financial markets. In their study Soenen & Hennigar (1988) claimed that the relationship between U.S. stock market prices and exchange rates of 15 countries in negative but statistically significant. Other studies that applied cointegration and causality tests include Ajayi et al., (1998) that investigated the causal nexus between stock prices and exchange rates across seven developed and eight Asian developing economies. The Granger causality result shows unidirectional causality running from stock market prices to exchange rates for all developed financial markets. Whereas, no causal relationship exist in developing markets. Neih & Lee (2001) used both Engle-Granger and Johansen maximum likelihood cointegration tests to study whether there is long-run relationship between stock prices and exchange rates for G7 countries. The outcome shows that no element of cointegration exist between the variables for all sample countries. The relationship between exchange rates and stock prices is found to be positive among nine Asian countries (Chiang & Yang, 2003). Smyth & Nandha (2003) investigated the relationship between stock prices and exchange rates for Bangladesh, India, Pakistan, and Sri Lanka using both Engle–Granger and the Johansen cointegration techniques and the cointegration result shows no element of long-run relationship among the variables under investigation. The Granger causality result shows unidirectional causal relationship running from exchange rates to stock prices for India and Sri Lanka, while no causal relationship found for Bangladesh and Pakistan. Plylaktis & Ravazzolo (2005) studied the short-run and long-run relationship between stock prices and exchange rates using multivariate VAR and Granger causalitytechniques across five Asia pacific nations; Malaysia, Hong Kong, Philippines, Singapore, and Thailand. The main finding shows that there is positive relationship between stock market and foreign exchange across the countries investigated.

Pan et al., (2007) also assess the relationship between stock prices and exchange rates across seven East Asian countries using both Granger causality tests and multivariate cointegration approaches and the result shows that there is unidirectional causality among the variables running from exchange rates to stock prices for all the countries except Malaysia. In his study for the analysis between real effective exchange rates and stock prices in China Zhao (2010) applied both vector Autoregression (VAR) and the multivariate GARCH (MGARCH). The outcome shows that variables were not cointegrated, the variables however shows time varying featured when multivariate GARCH is used. The causality between stock and foreign exchange markets is investigated by Paul, et al., (2011) across Australia, Canada, Japan, Switzerland, and UK using Granger causality approach. The outcome shows that variables were not cointegrated, but the causality test shows the presence of causal relationship among the variables in all countries except Switzerland where the causality is weak. The Hiemstra–Jones test which shows the possible non-linear causality shows that there is causality between stock prices and exchange rates in Japan and weak causality also exist in Switzerland. in his study on the links between stock prices and exchange rates across five Sub-Saharan African markets based onVector Autoregression and the dynamic conditional Correlation models. The result based on Vector Autoregression model shows no element of cointegration among the variables, and the other model shows that coefficients do not persist and the estimate indicated a negative time-varying correlation for all the sample countries except Ghana which shows positive correlation.

3. Overview of Malaysian stock market

The Malaysian stock market is previously known as Kuala Lumpur stock exchange (KLSE) which is renamed to BURSA Malaysia in April, 2004. It is among the biggest markets in Southeast-Asian region, despite it is small but its openness nature make it integrated to the rest of the world markets that attracted huge foreign direct investment. The 1980s industrial revolution in the country promoted the market due to the overall economic expansion in 1990s it experience higher growth in terms of market capitalization as well as number of listed companies. In 1990 only 271 companies were listed with USD 47.87 billion market capitalization as well as USD 10.70 overall traded stock value. But just after six years (1990-1996) the market tremendously improved with 618 as the number of listed companies, USD 306.17 billion market capitalization and the value of total traded stock increased to USD 178.01 billion. In 2007 the performance of the market is still remain the same during pre-Asian financial instabilities with 986 listed companies, USD 325.29 billion as market capitalization and USD 169.72 as the total shares traded. However, the 2008 global financial crisis affected the performance of the market with a sharp reduction of number of listed companies to 976, market capitalization declined to USD 189.09 billion and overall share traded becomes USD 93.78 billion in 2008. The market is still recouping from the recent global financial gloom as it recorded a net gain of RM28 million in the first quarter ended 2010 March with 81% increase when compared with the RM15.5 million for the same period last year (World federation of exchanges, 2015).

4. Data, methodology and empirical results

The study obtained its data from two sources, share prices as proxied by market capitalization is obtained from BURSA Malaysia (Malaysian stock market), and exchange rates which is measured by the Malaysian Ringgit in relation to American dollar ($USD) is obtained from Bank Negara Malaysia (Malaysian Central Bank) for the period between January, 1999 to September, 2014 respectively.

4.1. Econometrics modelspecification

$$LSP_t=\beta_0+ \beta_1 LER_t+\mu_t \quad (1)$$

LSP mean log of stock prices and LER log of exchange rates, β_0 is the intercept and β_1 is the slope of the coefficient that describes the association between the two variables, and μ_t is the error term. The stationarity of the variables is important in time series analysis, therefore Augmented Dickey Fuller and Phillips Perron tests shows the order of integration of the variables in table 1 below;

Table 1. *Results of ADF and PP unit root tests (1999-2014)*

	ADF	PP
LSP_t	-0.75	-0.82
	(0.82)	(0.80)
ΔLSP_t	-11.84	-11.86
	(0.00)*	(0.00)*
LER_t	-1.20	-1.18
	(0.67)	(0.68)
ΔLER_t	-13.29	-13.28
	(0.00)*	(0.00)*

NB: The ADF and PP test equations include both constant and trend terms. The Schwarz information criterion (SIC) is used to select the optimal lag order in the ADF test equation. The values in brackets are corresponding p-values. *denote significance level at 1%, **5%, and ***10% respectively.

The result of ADF and PP unit root tests above indicated that both variables are non-stationary at level but stationary at first difference for both two different unit root tests, therefore we rejected null hypothesis at 1% significance level. Since the two variables are I(1) we can therefore move to test Engle-granger cointegration test based on the equation (2) below;

$$\Delta\mu_t = \rho\mu_{t-1} \sum_{i=1}^{q} \delta_1 \Delta X_{t-1} + v_t \quad (2)$$

The long-run estimated equation and Engle-Granger estimation is shown below;

Table 2. *Long-run equation and Engle-Granger estimation*

LR Equation	$\boldsymbol{LSP_t = 12.406 - 4.544LER_t + \mu_t}$ (0.00) (0.00)
E-G Cointegration	$\Delta\mu_t = -0.06\mu_{t-1}$ (-2.44)**

N.B: Figures in parenthesis are standard errors

Based on Engle-Granger test the t-statistics shows the existence of cointegration (-2.44), to identify whether the cointegrating relationship is asymmetric we employed Engle & Granger (1998) and Enders and Siklos (2001). Therefore equation 2 will be estimated which is based on ρ and λ, the equation will be altered below;

$$\Delta\mu_t = I_t\rho_1\mu_{t-1} + (1 - I_t)\rho_2\mu_{t-1} + \sum_{i=1}^{p-1} \gamma_i\Delta\mu_{t-1} + \varepsilon_t \tag{3}$$

The above and below threshold is determine by (τ) as shown by the equation below;

$$T_t = \begin{cases} 1 \; if \; \mu_{t-1} \geq \tau \\ 0 \; if \; \mu_{t-1} < \tau \end{cases} \tag{4a}$$

$$M_t = \begin{cases} 1 \; if \; \Delta\mu_{t-1} \geq \tau \\ 0 \; if \; \Delta\mu_{t-1} < \tau \end{cases} \tag{4b}$$

Combining equation 3 and 4a refers to Threshold Auto Regressive (TAR) model and equation 3 and 4b is the Momentum Threshold Auto Regressive (M-TAR) model. The model implies that $\mu_{t-1}$is above the threshold the coefficient for the adjustment is $\rho 1\mu_{t-1}$, whereas whenthe μ_{t-1} is below the threshold the adjustment coefficient is $\rho 2\mu_{t-1}$. To investigate whether the variables are symmetric or asymmetric in their speed of adjustment we test (Enders & Siklos, 2011), Ho:$\rho_1 = \rho_2 = 0$. When the null hypothesis is rejected based on our F-joint and F-equality means adjustment speed is asymmetric while if we failed to reject means they are symmetric.

Table 3. *TAR and M-TAR cointegration estimates for share prices and exchange rates*

	TAR	TAR Consistent	M-TAR	M-TAR Consistent
$\rho_1{}^a$	-0.01 (-0.32)	-0.00 (-0.14)	-0.02 (-0.50)	0.02 (0.57)
$\rho_2{}^a$	-0.16 (-3.98)	-0.25 (-5.37)	-0.13 (-3.48)	-0.12 (-3.87)
Φ	7.95 (5.92)**	14.47 (6.61)*	6.17 (6.38)	7.74 -
$\rho_1 = \rho_2$	7.38 (2.89)**	19.86 (6.21)*	3.98 -	6.98 -
τ	0	-0.19	0	0.02

N.B: a indicates values of ρ_i with their t-statistics in parentheses. Entries in a row Φ are F-statistics $\rho_1 = \rho_2 = 0$) * & ** denote rejection of the null hypothesis at the 1% and 5% significant levels

Table 3 indicated TAR and TAR consistent as well as MTAR and MTAR consistent respectively. The F-statistics Φ is use to reject null hypothesis of no cointegration ($\rho_1 = \rho_2 = 0$) TAR consistent 1%, and M-TAR at 5%. Therefore symmetric adjustment hypothesis of the existence of cointegration ($\rho_1 = \rho_2$) as initiated by Enders and Siklos (2001) can be rejected both at 1% and 5%. Our results based on TAR consistent reveals that variables were asymmetrically cointegrated, while M-TAR consistent shows variables were not related in the long-run and the speed of adjustment is symmetric. The next is to test for asymmetric error correction model based on TAR consistent model in order to examine both short-run and long-run dynamics among the variables.

Table 4. *Asymmetric error correction models estimated results*

ΔSP_t = 0.009 + 0.000 $7Z_{t-1}^{+}$ - 0.003 Z_{t-1}^{-} - $0.211\Delta SP_{t-10}$ - $0.173\Delta SP_{t-20}$ – $0.051\Delta ER_t + \varepsilon_t$

(0.025) (0.833) (0.433) (0.002) (0.003) (0.824)

The asymmetric error correction estimate above indicated that share prices and exchange rates shows a degree of convergence as shown by (Z-) that when variable deviated from the equilibrium it adjust faster below the equilibrium more than when it is (Z+) above the equilibrium such behaviour is more common among some economic variables more especially prices. All the coefficient of lagged share prices is negative which reconfirmed convergence to equilibrium, when the variable deviated above the threshold it doesn't converge to steady state, while when the deviation is downward it quickly converge to equilibrium at about 0.3%.

5. Conclusion and policy recommendations

The present paper examines the impact of exchange rates on share prices in Malaysia for a long time series of January, 1999 to September, 2014. The findings suggest that variables have long-run relationship based on Engle-granger cointegration technique. The threshold autoregressive (TAR) result confirmed that variables are asymmetrically cointegrated as null hypothesis is rejected at 1% based on Enders & Siklos (2001) table, while momentumthreshold autoregressive (MTAR) shows opposite result. We therefore used TAR result and test for asymmetric error correction modelling. In the long-run it means share prices have significant impact on exchange rates in Malaysia as increase in share prices could lead to appreciation of Malaysian Ringgit and the speed of adjustment is non-linear as revealed by TAR model. The policy makers should try and monitor the movement of the exchange rates in relation to share prices which if not properly regulated will affect the market competitiveness as well foreign investors' participation.

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