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Abstract

This study investigates the impact of trade openness on Malaysian exchange rate. The findings show that most of the variables are statistically significant and carried the expected signs. As predicted by the theory, the rise of the income level and stock market index in Malaysia will lead to the appreciation of domestic currency. On the other hand, the increase in trade openness and interest rate can lead to depreciation of Malaysian Ringgit. In addition, the results suggested that a rise in money supply differential caused RM to appreciate. However, increase in trade balance caused the depreciation of RM.

JEL Classification code

F31 (Foreign Exchange), F41 (Open Economy Macroeconomics), G15 (International Financial Markets)

Keywords

Foreign Exchange, Stock Price, Trade Openness

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1. INTRODUCTION

Since the early 1990s, the world started to abandon the protectionism in international finance and international trade. Due to this reason, the roles of international trade have become prominent over the last few decades. Most of the countries have already involved heavily in international trade and the degree of trade openness has also increased, including Malaysia.

Heavy involvement in the international trade has caused the economic condition of one country linked closely with the external conditions. Exchange rate movement has been said to be linked to the level of trade openness too. The changing of trade openness can influence the currency movement in the sense that, the larger exposure of a country's economy to external trade, the more pressure to depreciate the domestic currency to compete with the international competitors. In spite of the increasing international trading involvement, Malaysian Ringgit experienced appreciation during the recent float. During the 1997 – 98 Asian financial crisis, Malaysian pegged their currencies to US Dollar at the rate of RM3.80 = USD1 on 1 September 1998. The peg system had ended on 20 July 2005 and starting from 21 July 2005, its exchange rate system was back to the managed float system. It can be observed that the RM/USD was appreciating from the rate of RM3.80/USD in July 2005 to around RM3/USD in November 2011.

Since the early 1990s, Malaysia trade openness has increased following the increasing demand for Malaysian industrial products. However, the rising of new emerging market like China, India, and Vietnam after 2000 has exerted great pressure on the Malaysian international trade competitiveness. Since the economic

theory suggested by Dornbush (1974) highlighted that the elimination of tariff (greater trade openness) will cause currency depreciation by reducing the price of exportable goods and increase the price of importable goods[1], the objective of the study is to access the impact of trade openness on the movement of RM/USD after Malaysia de-peg RM against USD. Indeed, the historical dataset has unveiled that the movement of RM/USD was in tandem with the trade openness. This research is relevant as the changing of international economics landscape has caused changes in degree of Malaysia trade openness. As desirable as this kind of study is, our extensive review of the relevant literature revealed that there is only a few studies on Malaysia that investigated the impact of trade openness on its exchange rate. Besides, there are only a few of the researches that purely focus on the period after de-peg of currency.

The presentation of this paper is organized as followed. Part one is the brief introduction of the research, followed by theoretical background and literature reviews in part two. Part three, on the other hand, shows the methodology of the model estimation. Part four discusses the empirical results. Finally, part five is the conclusions, policy recommendations, limitation and suggestions for improvement.

2. LITERATURE REVIEW

2.1 Theoretical Backgrounds

In this section, two theoretical approaches to exchange rate modelling are briefly presented. They are monetary exchange rate model and portfolio balance approach.

[1] Refers to theoretical backgrounds in the latter part of this article for more explanation.

The basic purpose is to use the existing economic theory to obtain the determinants of exchange rate.

The idea of monetary approach is that the exchange rate will be at its equilibrium if the real money supply is equal to money demand. The simplest form of monetary model is

$$\hat{e} = (\hat{m} - \hat{m}^*) - (\hat{y} - \hat{y}^*) + (\hat{r} - \hat{r}^*) \quad (1)$$

where e is exchange rate, m and m^* are domestic and foreign nominal money stock, r and r^* are domestic and foreign interest rate, y and y^* are domestic and foreign output. According to the theory, an increase in the money supply differential and interest differential will cause the depreciation of RM against USD whereas a rise in the output differential will lead to RM appreciation against USD.

Baharumshah *et al.* (2002) pointed out that prior studies on this subject matter have mostly ignored the relationship between exchange rate and the stock markets. The authors had incorporated the stock prices into monetary model. Indeed, the 1997 Asian financial crisis tends to suggest that the equity market and the exchange rate market are closely interrelated. From 1 July to 30 September 1997, the ringgit dropped by 37 percent. Over the same period, the stock market plunged by 31 percent. Therefore, we will include stock market index in our modelling. The impact of stock index differential is ambiguous, depending on the influence of income effect and substitution effect of increasing wealth following the increase in the stock price.

Furthermore, the portfolio balance approach assumes individuals hold their asset in the form of domestic money, domestic bond and foreign bond. Branson, Haltunen and Masson (1977) identifies the holdings of foreign assets, measured by current account balance, as a major determinant of exchange rate in portfolio balance approach. The appreciation (depreciation) of a currency is associated with the surplus (deficit) in the current account of the country. We include the trade balance as a proxy for the current account balance.

Although the monetary and portfolio balance approaches had been the cornerstone for exchange rate modelling, these approaches had ignored the role of open economy in exchange rate determination. Globalization and liberalization has allowed the goods and capital to move across the border of countries more freely, causing more and more factors that able to cause the changes in the value of currency. The exchange rate between two currencies is determined by the supply and demand for those two currencies. The supply and demand for currencies on the international markets is largely determined by the international trade and investment. The relative demand for currencies from investors will be affected by the relative interest rates which had been one of the fundamental variables in monetary model. However, the impact of international trade is not capture in monetary and portfolio balance approaches. Therefore, this study tries to fill the gap by adding trade balance and trade openness in exchange rate modelling besides the usual determinants of monetary and portfolio balance approaches.

Balance of trade variables are included in the model to proxy for the relative demand for currencies relating to international trade. The intuitive is that a positive trade

balance indicates higher demand for a country exports, subsequently higher demand for the country's currency. Hence, an increase in the trade balance differential is expected to cause the RM to appreciate.

Dornbusch (1974) explained the linkage between trade openness and exchange rate by taking the assumption that reduction in trade tariff represents larger trade openness. To make it simple, the tariff change the import and export price as showed by the following equations.

$$\hat{P}_e = -\frac{\theta_e}{\theta_m + \theta_e}\hat{T} \qquad (2)$$

$$\hat{P}_m = \frac{\theta_e}{\theta_m + \theta_e}\hat{T} \qquad (3)$$

where P_m denotes the domestic relative prices of importables relative to nontradable, P_e denotes the domestic relative prices of exportables relative to nontradable, T denotes the tariff, and θ_m and θ_e are the excess demand elasticities of nontradables with respect to the relative price of importables and exportables.

Now, when the nontradable are replaced for both traded goods and the cross-price elasticity of excess demand for nontradables, θ_m and θ_e is positive, then the decrease in the tariff will cause $\hat{P}_e$ to drop and $\hat{P}_m$ to increase. Thus, both the domestic price of importables and nontradables increase as compared to exportables that the price is determined by the world market. This resulted in the depreciation in the real exchange rate. So, the theory expected that increased in trade liberalization leads to real exchange rate depreciation.

2.1 Empirical Tests of the Determinants of Exchange Rate

In terms of literature, there are extensive researches on monetary model of the exchange rate determination. To name a few, MacDonald and Taylor (1991, 1993, 1994a, b); Kouretas (1997); Diamandis *et al.* (1998); Tawadros (2001); Husted and MacDonald (1999); Groen (2000) and Rapach and Wohar (2002). However, there have been only a few analyses for Malaysia. Those have came to our notice are Lee *et al.* (2007); Baharumshah *et al.* (2009); Lee *et al.* (2009) for Malaysia, and Husted and MacDonald (1999), Chinn (2000a, 2000b) and Liew *et al.* (2011) for a group of Asian countries including Malaysia. In particular, Lee *et al.* (2007), Lee *et al.* (2009), Baharumshah *et al.* (2009) used the monetary model to explain the Malaysian ringgit/US dollar (RM/USD) rate. Generally, their findings tend to suggest that the fundamental variables in monetary model are capable to explain the movement of exchange rates.

Few studies have attempted to include stock prices into conventional exchange rate models (except Sarantis, 1987; Egert (2010); Smith, 1992a, b and Baharumshah *et al.*, 2002). Sarantis (1987) apply an extended version of the asset market model of exchange rate determination developed by Branson *et al.* (1977) to five U.K. bilateral exchange rates. The study found that equity holdings exert a positive and statistically significant impact on all exchange rates. Utilizing an augmented monetary model that includes the effect of stock prices, Baharumshah *et al.* (2002) tried to identify the determinants of RM/USD. Their result reveal that the fundamental variables in monetary model have the expected sign and statistically significant. Beisdes, the stock price differential is positive and highly significant, implying that an increase in the stock price differential lead to appreciation of the ringgit against US dollar.

Empirical examinations on the relationship between stock price and exchange rate during the flexible exchange regime have largely provided mixed evidence. The studies of Smith (1992a, b), Solnik (1987), Abdalla and Murinde (1997), Aydemir and Demirhan (2009) shown that a significant relationship exists between equity prices and exchange rates. On the other hand, Bahmani-Oskooee and Sohrabian, (1992) as well as Rahman and Uddin (2009) found that the stock market fails to give any impact on exchange rate. Related studies for Malaysia are Ibrahim (2000), Azman Saini, Habibullah and Mohamed (2003), Doong, Yang, and Wang (2005) and Pan, Fok, and Liu (2007). Ibrahim (2000) revealed that there is a uni-directional causality running from stock market to exchange rate. The results of Azman Saini *et al.* (2003) show that there are bi-directional causal relationships between the stock price indices and exchange rate. Both papers by Doong, Yang, and Wang (2005) and Pan, Fok, and Liu (2007) focus on the East Asia markets, including Malaysia conclude that in the long run, there is no cointegration between exchange rate and stock price.

In order to take account of real shocks, overall trade balances was introduced by Hooper and Morton (1982) into the traditional monetary model. Parikh (1992) attempts to model the determinant of the Yen/Pound by Hooper and Morton (1982) monetary model. Their results indicated that the trade balance is a significant variable and it carried the expected negative signed for all model. Other studies that have established a direct link between the exchange rate and the trade balance, in addition to other determinants of the exchange rate are Jeong (2000); Egert (2010); Beckmann, Belke and Kuhl (2010); Yuan (2011) and Lane and Milesi-Ferretti (2002).

Basically, the previous researches findings derived difference results about the relationship between exchange rate and trade openness. Li (2004), Caldelon, Kool, Raabe and Veen (2007), Carrera and Restout (2008), Broeck and Slok (2001) and Egert (2005) are among the scholars that conclude there are positive relationship between exchange rate and trade openness. Put it in other words, increasing in trade liberalization, will cause the domestic currency to depreciate. However, Meleckly and Komarek (2007) failed to establish significant relationship between the trade openness and exchange rate movement. In the case of Malaysia, Sidek and Yusoff (2009) examine the relationships between the Malaysian real exchange rate and trade openness in a BEER framework. Employing Johansen cointegration and VECM methods, the authors found negative and significant coefficient on openness, thus suggested that openness through increased demand for tradables causes a real depreciation.

3. DATA AND METHODOLOGY

3.1 Model

To determine the effect of trade openness on exchange rate, this study incorporated a few prominent exchange rate approaches into a more general framework. In accordance with the current literature, this study specified the exchange rate model as a function of output, money supply, interest rate, stock, trade balance and trade openness:

$$EXC = f\ (\ \overset{-}{IPI},\ \overset{+}{M2},\ \overset{+}{I},\ \overset{+/-}{INDEX},\ \overset{-}{TB},\ \overset{+}{MTO}\ ) \tag{4}$$

An increase in the money supply differential and interest differential will cause the depreciation of RM against USD whereas a rise in the output differential will lead to RM appreciation against USD. The impact of stock index differential is ambiguous,

depending on the relative strength of income effect and substitution effect from increasing wealth due to the increase in the stock prices[2]. An increase in the trade balance differential is expected to cause the RM/USD to appreciate. As for the Malaysia degree of openness, the more openness an economy, the domestic currency will experience real depreciation. Lastly, the existence of financial crisis will also cause the depreciation as the international capital might pull out from domestic market during crisis, reducing the demand for domestic currency.

3.2 Methodology

The unit root tests is conducted to check the level of stationarity of a variables. For this study, Augmented Dickey-Fuller (ADF) and Philip Perron (PP) test are adopted to achieve that purpose. After that the autoregressive distribured lagged (ARDL) bounds testing approach proposed by Pesaran, Shin, and Smith (2001) is used to estimate the long-run and short-run relationship between the exchange rate with its determinants. Hendry's general to specific method is utilised to get the most parsimonious model of estimation. To make sure that the model is well specify and suitable for inference, several diagnostic tests are conducted. Those tests are Breusch-Godfrey Serial Correlation LM test, Durbin-Watson-*d* autocorrelation test, Jacque-Bera test, Autoregressive Conditional Heteroskedasticity (ARCH) LM test and Ramsey RESET test.

3.3 Data Description

[2] The wealth effect derived from the increasing financial transaction, risk aversion which increases the money demand when the stock price increases. On the other hand, the substitution effect said that higher returns of stock market will draw more funds to equities, which reduce the money demand. Increase in the money demand lead to increase in interest rate, which end up with appreciation in the domestic currency.

The sample of this study is from July 2005 to September 2009. All collected data are transformed into the logarithm form first. Exchange rates are monthly averages in terms of RM/USD. The chosen monetary aggregates are broad money stock (M2). The industrial product indices (IPI) are utilized as proxies for output. The interest rates (I) are the monthly market rates. Stock market indices (STOCK) are used for the stock price. The trade balance (TB) is defined as the total exports minus total imports. All the independent variables, except for the Malaysia trade openness (MTO), are in form of variable differential against US.

The Malaysia trade openness is calculated as the ratio of sum of monthly export of import of Malaysia over the monthly Malaysian GDPs as per shown below.

$$MTO_t = \frac{X_t + M_t}{GDP_t} \qquad (5)$$

where the X_t, M_t and GDP_t are the Malaysian monthly exports, Malaysian monthly imports and Malaysian monthly GDP, respectively. The monthly GDPs for Malaysia are interpolated from the quarterly Malaysian GDPs by the interpolation formula suggested by Gandolfo, Matinengo and Padoan (1981) due to unavailability of the monthly data for the variable. Last but not least, the dummy variable takes the value of 1 to represent the period when the financial crisis occur and value of 0 to represent otherwise. Referring to Economy of Malaysia (n.d.), the financial crisis that hit Malaysia during the period of observation is the subprime mortgage crisis started from September 2008 and persistent until the end of the study period, which are September 2009 .

3.4 Model Specifications

The relationships between the exchange rate and its determinants are determined by using the ARDL method. The following equation shows the unrestricted error correction model of the ARDL approach in this research.

$$\Delta \ln(EXC) = \alpha_0 + \sum_{i=1}^{P} \alpha_{1i} \Delta \ln(EXC)_{t-i} + \sum_{i=0}^{P} \alpha_{2i} \Delta \ln(INDEX)_{t-i} + \sum_{i=0}^{P} \alpha_{3i} \Delta \ln(IPI)_{t-i} + \sum_{i=0}^{P} \alpha_{4i} \Delta \ln(TB)_{t-i} + \sum_{i=0}^{P} \alpha_{5i} \Delta \ln(M2)_{t-i} + \sum_{i=0}^{P} \alpha_{6i} \Delta \ln(I)_{t-i} + \sum_{i=0}^{P} \alpha_{7i} \Delta \ln(MTO)_{t-i} + \beta_1 \ln(EXC)_{t-1} + \beta_2 \ln(INDEX)_{t-1} + \beta_3 \ln(IPI)_{t-1} + \beta_4 \ln(TB)_{t-1} + \beta_5 \ln(M2)_{t-1} + \beta_6 \ln(I)_{t-1} + \beta_7 \ln(MTO)_{t-1} + \beta_8 DUM + \varepsilon_t \quad (6)$$

where α_0 is constant. EXC is the exchange rate, INDEX is the stock market index, IPI is industrial production index, TB is the trade balance, M2 is money supply, I is the interest rate, MTO is the degree of trade openness of Malaysia and DUM is the dummy variable that represents the occurance of the financial crisis.

4. RESULTS DISCUSSIONS

Table 1 shows that IPI, MTO, INDEX and TB are I(0), while the rest of the variables are I(1). Because of the mixture of I(0) and I(1) data in the model and the dependent variable, which is nominal RM/USD is I(1), the estimation of RM/USD is conducted by applying the ARDL test.

Table 1

Table 2 demonstrates the most parsimonious ARDL model generated from the Hendry' general to specific method. This model has the lowest AIC value and passed all the diagnostic test. The Wald test of ARDL rejects the null hypothesis if the calculated F-statistic is above the upper bound critical value. As per shown in Table

3, the F-statistic value is 9.5423, well above the critical value at all significant level. Hence, the results indicate the presence of long-run relationship.

Table 2

Table 3

Thus, the long-run elasticities are generated and the coefficient of all variables are summarized and reported in the Table 4. All the variables are statistically significant and carried the expected signs, except for money supply and trade balance. The results suggest that the increase in Malaysian degree of trade openness and interest rate can lead to depreciation in Malaysian Ringgit. Besides, the rise of the income level in Malaysia will lead to the appreciation of domestic currency which are in line with the theory. As per expected, the occurrence of financial crisis in 2008 brought down the value of RM against USD.

It is worth to discuss about the sign of coefficient of stock market index. As per discussed in the section of theoretical framework, the impact of the rise in the exchange rates depend on the relative strength of wealth effect and substitution effect. The result in Table 4 indicates that there is negative relationship between exchange rate and stock price. This means, the wealth effect excess the substitution effect in Malaysia. This is actually in line with the findings of Baharumshah, Masih & Azali (2002) and Broome and Morley (2003).

Table 4

Although money supply did not carried the expected sign, the negative coefficient sign of money supply can be explained by neo-classical growth theory and Tobin effect. Both theory proposes that the increasing money supply will drive up the inflation rate. This causes a rational individual to switch the asset allocation from money in hand into another form of asset, like bond and lead to decrease in the interest rate. Thus, the capital accumulation will increase and cause the increase in output. As the increasing in output will cause the decrease in the domestic price level and thus the appreciation in the exchange rate[3]. The Parikh (1992) also find out the same conclusion. Nevertheless, this outcome contradicts with Baharumshah, Masih & Azali (2002) findings. This may due to difference proxy for the money supply where they adopted the M1 as the proxy for money supply.

Meanwhile, the positive coefficient of trade balance differential might be explained by the reason that even though Malaysian trade balance increases in relative to the US trade balance, the international capital might not flow into Malaysia as there are many more options for the investor to invest in. At the same time, the increasing trade balance in Malaysia could induce the Malaysian authority to depreciate the Malaysian Ringgit intentionally in the effort to maintain the trade balance performance.

In short, the long-run relationship can be expressed in the following equation

$$ECH = 2.7639 - 0.2880IPI - 0.4568M2 + 0.0217I + 0.0063TB + 0.1654MTO - 0.0775INDEX + 0.0843DUM \quad (7)$$

[3] More information about the neo-classical growth theory and Tobin effect is available in Gokal and Hanif (2004)

In the short-run, the error correction term is significant with negative coefficient. This indicates that any disequilibrium that deviate the exchange rate from its long-run equation in the short-run will be corrected. Only changes in ECH, IPI, MTO and INDEX can change the exchange rate in the short-run as per shown in Table 5. The magnitudes of the impact of the changes of statistically significant variables are also much lower than the magnitudes in the long-run. The INDEX has the opposite sign, means that in the short run, people tends to invest in the stock market and reduce the money demand, hence depreciates Malaysian Ringgit.

Table 5

5. SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Summary and Conclusions

Exchange rate stability has become the external targets of Malaysia, aside of the internal target, which is the price stability. Since Malaysia is a small and open economy which involved heavily in international trade and the economic theory suggested by Dornbush (1974) highlighted that the elimination of tariff (greater trade openness) will cause currency depreciation by reducing the price of exportable goods and increase the price of importable goods, this study attempts to examine the impact of trade openness on Malaysian exchange rate. Variables from monetary and portfolio balance approach are included beside trade openness in the model of exchange rate.

The findings from ARDL estimation show that in the long-run, all independent variables are statistically significant and carried the expected signs, except for money

supply and trade balance. As predicted by the theory, the rise of the income level and stock market index in Malaysia will lead to the appreciation of domestic currency, increase in trade openness and interest rate lead to depreciation of Malaysian Ringgit. The negative coefficient of the stock market index also indicates that the wealth effect surpass the substitution effect when the equity price increase. However, not all the independent variables behave according to the theories. In this study, rise in money supply differential caused RM to appreciate. Neo classical growth theory and Tobin effect have been offered as the explanation of the appreciation of RM/USD following increase in the domestic money supply. On the other hand, increase in trade balance caused the depreciation of RM due to country has involved in the currency manipulation to maintain their surplus position on the trade balance. In the short-run, only Malaysia trade openness, stock market differential, industrial production index (income) differential and RM/USD itself influence the RM/USD.

5.2 Policy Recommendations

Several recommendations are suggested from the outcomes of the study. Since the results showed that open economic policy can cause the depreciation of RM/USD, Malaysia should maintain the policy of open economic. Open economic policy has successfully raised Malaysia position in the international trade. Currency depreciation increases the competitiveness of Malaysia exporters and encourage domestic producer and importer to venture into cost effective production mode to save costs. Although increase in Malaysia trade balance tends to depreciate RM, but the control of Malaysia on the trade balance is limited as the increase in trade balance depend on the purchasing power of the foreign importers and the competitiveness level too.

Results also indicate that increment in domestic interest rate will dampen our exchange rate and increase in money supply, on the other hand, strength the RM. This findings shows that monetary policy is a useful tool in controlling the movement of Malaysian Ringgit. While increase in the interest rate could cause further capital inflows that might weaken the soundness of Malaysian Financial market, Malaysian government has done well in sterilizing the excess monetary base.

In order to strength RM, government share increase the productivity in the long run. High productivity can increase the level of income in Malaysia as Malaysian products and services become more competitive internationally. This can be done by encouraging more high technology production and increase the quality of human capital.

Since the bull stock market strengthen RM, government should encourage more listing of local and foreign companies with good fundamental in domestic bourse. To do this, more incentives to companies to list their entities in bourse and better surveillance on stock exchange trading and operation can stimulate positive development in the stock market. In the short-run, booming stock market can depreciate the Malaysian Ringgit. Ensuring the transparent and complete dissemination of market information and good governance in government and companies can create vivid stock market and let the value of companies with good foundation to be fully realized and increase the stock market return. However, the relatively small significant level suggests that the impacts will be minimal.

5.3 Limitations and Suggestions

There are several limitations and suggestions that can be issued in this section. Others measurements of trade openness can be used to replace the measurements applied in this research. Besides, there could be exist non-linearity among the dependent variable and independent variables[4]. Future research can consider adding in the financial linkage between Malaysia and US in the estimation. Finally, the rising of China as the 'world factory' and increasing trade volume with China makes it desirable for the future researcher to focus about the determinants of RM/China Renminbi.

[4] See Liew (2009) for the discussion about linear and nonlinear monetary approaches to the exchange rate.

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Table 1. Stationary tests

Level				
Variables	ADF		PP	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
EXC	-1.7742[1]	-1.7082[1]	-1.6578[3]	-1.3607[3]
I	-0.3395[2]	-1.5734[2]	0.1418[1]	-1.7513[2]
INDEX	-0.4274[2]	-3.5205[0]**	-0.6658[22]	-3.2908[7]**
IPI	-4.9229[0]*	-5.8042[0]*	-4.9570[2]*	-5.8042[0]*
M2	-1.5925[0]	-1.5919[0]	-1.5665[1]	-1.5919[0]
MTO	-1.3095[1]	-5.2267[0]*	-1.9107[2]	-5.2867[3]*
TB	-4.8656[0]*	-4.9042[0]*	-5.0544[4]*	-5.0788[4]*
First Difference				
Variables	ADF		PP	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
ΔEXC	-4.2010[0]*	-4.2067[0]*	-4.1578[2]*	-4.1608[2]*
ΔI	-5.3123[1]*	-5.5998[1]*	-3.4845[11]**	-3.3883[12]***
ΔINF	-7.9031[1]*	-7.8357[1]*	-12.0828[48]*	-13.725[48]*
Δ IPI	-11.7428[0]*	-11.6186[0]*	-29.1066[21]*	-31.7815[23]*
ΔM2	-5.8053[0]*	-5.8311[0]*	-5.8174[2]*	-5.8094[3]*
ΔMTO	-11.3366[0]*	-11.2352[0]*	-13.3665[5]*	-13.2698[5]*
ΔTB	-11.7048[0]*	-11.6131[0]*	-13.6970[4]*	-13.6917[4]*

Asterisk(*), (**) and (***) denote significant at 1%, 5% and 10% level, respectively. For both tests, the 1%, 5% and 10% critical value for equation without trend and with trend are -3.6, -2.9 and -2.6 and -4.2, -3.5 and -3.2 respectively. The statistical tests are based on Mackinnon (1996). The Optimal lag length is stated in the parentheses. The lag length of ADF test is set by Schwarz Information Criterion with maximum lag of 10. The bandwidth of PP test is set by Newey-West bandwidth.

Table 2. Estimated ARDL model for RM/USD

A. Estimated Model:		
Variables	Coefficient	t-statistic
C	1.9642	3.7392*
EXC_{t-1}	-0.7946	-6.1434*
IPI_{t-1}	-0.3338	-3.5406*
$M2_{t-1}$	-0.4187	-5.7471*
I_{t-1}	0.0213	2.5184**
TB_{t-1}	0.0007	0.3673
$INDEX_{t-1}$	-0.0668	-1.7248***
MTO_{t-1}	0.1874	2.6817**
ΔEXC_{t-1}	0.4860	3.9008*
ΔIPI	-0.1657	-3.0853*
ΔIPI_{t-1}	0.1246	1.6516
ΔIPI_{t-2}	0.0587	1.0757
$\Delta M2$	-0.1644	-1.5367
$\Delta M2_{t-1}$	0.2139	1.8582***
ΔI	-0.0094	-0.8400
ΔI_{t-1}	-0.0091	-0.8697
ΔI_{t-2}	-0.0234	-2.3288**
ΔTB	-0.0006	-0.5465
ΔTB_{t-1}	0.0017	1.0320
ΔMTO	0.0634	1.7572***
ΔMTO_{t-1}	-0.1128	-1.8017***
ΔMTO_{t-2}	-0.0670	-1.6747
$\Delta INDEX$	-0.0484	-1.4359
$\Delta INDEX_{t-1}$	0.0692	2.5651**
DUM	0.0601	3.2520*
B. Model Criteria/ Goodness of Fit:		
R^2=0.8768	Adjusted R^2=0.7482	F stat=6.8204[0.000]
C. Diagnostic Tests:		
Ramsey RESET= 1.4213 [0.2459]		
AR(2) = 1.6298 [0.4427]	AR(4) = 2.7156[0.6065]	
ARCH(2) = 0.4010 [0.8183]	ARCH(4) = 5.5316[0.2370]	
JB test= 1.1473[0.5635]		

The asterisk (*), (**), & (***) denote the statistically significant at 1%, 5%, & 10%, respectively. *P-value* are shown in the squared bracket. AR(i) & ARCH(i) represent Breusch-Godfrey Serial Correlation LM test & ARCH test at lag i where i =2 & 4.

Table 3. Bound test for exchange rate model cointegration analysis

Model	F-Statistic	
$ECH = f(IPI, M2, I, TB, INDEX, MTO, DUM)$	9.3118	
Significant level	Lower bound	Upper
1 %	3.424	4.989
5 %	2.556	3.904
10 %	2.181	3.398

Note: Critical values are based on Narayan (2005), case III: Unrestricted intercept and no trend.

Table 4. The long-run elasticities of exchange rate model for RM/USD

Variable	Coefficient	Expected sign
CONSTANT	2.7639*	
IPI	-0.2880*	-
M2	-0.4568*	+
I	0.0217**	+
TB	0.0062**	-
INDEX	-0.0775***	+/-
MTO	0.1654**	+
DUM	0.0843*	+

IPI= industrial production index differential, M2=Money supply differential, I=interest rate differential, TB= trade balance differential, INDEX=stock market index differential, MTO= Malaysian degree of trade openness, DUM =dummy for financial crisis. The asterisk (*), (**), & (***) denote the statistically significant at 1%, 5%, & 10%, respectively. All variables are transformed into logarithm form

Table 5. The short-run elasticities of exchange rate model for RM/USD

Variable	Coefficient
$CONSTANT$	0.8695
ECT_{t-1}	-0.3466*
ΔECH_{t-1}	0.5269*
ΔIPI	-0.1415*
ΔIPI_{t-1}	-0.0382
$\Delta M2$	-0.1346
$\Delta M2_{t-1}$	-0.0113
ΔI	-0.0091
ΔI_{t-1}	-0.0101
ΔTB	-0.0011
ΔMTO	0.0703**
$\Delta INDEX$	0.0001
$\Delta INDEX_{t-1}$	0.0478***
DUM	-0.0036

IPI= industrial production index differential, M2=Money supply differential, I=interest rate differential, TB= trade balance differential, INDEX=stock market index differential, MTO= Malaysian degree of trade openness, DUM =dummy for financial crisis. The asterisk (*), (**), & (***) denote the statistically significant at 1%, 5%, & 10%, respectively. Δ denotes the first difference of the variable. All variables are transformed into logarithm form.