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2009

Online at <https://mpra.ub.uni-muenchen.de/44922/>  
MPRA Paper No. 44922, posted 23 Dec 2013 08:26 UTC



## HOW DID THE MALAYSIAN REAL EXCHANGE RATE MISALIGN DURING THE 1997 ASIAN CRISIS?

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### ABSTRACT

Currency overvaluation seems to be the prominent explanation for the 1997–98 Asian financial crisis. Although this is the case, the reinstatement to managed float exchange rate regime in mid-2005, as well as the instability of commodity prices and the recent 2008–2010 global economic crisis, leads to the question of how far the fluctuation in the Malaysian ringgit is consistent with the changes in its economic fundamentals. Based on the theory of real equilibrium exchange rate, this paper estimates the NATREX approach to modeling the Malaysian equilibrium exchange rate from 1991 to 2009. The empirical results show that the ringgit took a U-turn from being overvalued during the pre-crisis (1991–1997) to being undervalued in the post-crisis (1997–2002) periods, before fluctuating around its long-run equilibrium for the rest of the period. This corroborated the hypothesis that an overvaluation leads to a currency crisis, which is followed by substantial currency devaluation. The misalignment rates then reduce and remain close to the equilibrium path.

JEL Classification: C32, F31, F41

Key words: Asian crisis, Global financial crisis, Real exchange rate misalignment, NATREX model, Malaysia

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## 1. INTRODUCTION

In the history of development economics, concern about exchange rate misalignment that is associated with the extent of over- or undervaluation of currencies has been thought of as a key factor, especially for emerging economies, including Malaysia. Over the past decade, Malaysia has managed to develop strong macroeconomic fundamentals as well as a strong financial sector until the 1997-98 financial crisis. In the 1990s, Malaysia exhibited strong economic performance, where the inflation rate was low, unemployment was below 3 percent, the exchange rate remained stable at around RM2.50 per US dollar, the current account improved, and the international reserves remained high. All these factors led to an impressive real GDP growth of around 8 percent per annum, which was several times faster than the US and other western industrial countries (Lee et al., 2002). This reflected that Malaysia was a well-managed country, both in terms of economic development and political stability. However, in mid-1997 the Malaysian economy was caught in a financial crisis that arose from a regional contagion effect. The crisis swept Southeast Asian countries into dramatic currency chaos and forced the Malaysian ringgit to depreciate by about 80 percent, from RM2.50 to RM4.50 per US dollar. In defeating the crisis, the Bank Negara Malaysia (BNM) had pegged the ringgit against the US dollar at RM3.80 per US dollar. The continued shackling of the ringgit to the US dollar led to a 38.1 percent depreciation of the ringgit<sup>1</sup>. The BNM, however, later removed the peg and allowed the ringgit to operate in a managed float in July 2005.

The ringgit depreciation that was caused by the regional crisis can be interpreted as a disequilibrium phenomenon, suggesting that the ringgit was severely affected by exchange rate misalignment. From the literature, real exchange rate misalignment can be defined as the deviation between the actual and the real equilibrium exchange rates, which is labeled as being overvalued (undervalued) when the actual real exchange rate is below (exceeds) the equilibrium real exchange rate (Richaud, Varoudakis and Vezanones, 2000; Zhang, 2001). Leape et al. (1997) document that an exchange rate misalignment may arise when there is a degree of fixity in exchange rate in terms of managed or fixed exchange rates or in the situation where floating markets are not efficient.

Furthermore, Bouoiyour and Rey (2005) notice that the fixed exchange rate system allows serious misalignment of the exchange rate. It is also acknowledged that a chronic misalignment in real exchange rate was the major source of slow growth in Africa and Latin America (World Bank, 1984 and Gulhati, Bose and Atukorala, 1985).

The findings from the earlier studies imply that the Malaysian exchange rate is at risk of misalignment from actual market rates, which could distort the country's comparative advantage based on the Ricardian theory of international trade, hence, inhibiting the Malaysian economy as its external sector is the main engine of economic growth. If the ringgit were to remain pegged to the dollar, a depreciating ringgit would cause the cost of imports to rise significantly; fuelling domestic inflationary pressures and forcing the export sector to become less competitive (Ariff, 2005). A dramatic currency devaluation or depreciation is the most likely outcome of a currency crisis that is generated by an "overvalued" exchange rate (Kaminsky and Reinhart, 1999; Goldfajn and Valdes, 1999; Edwards and Savastano, 1999; Chinn, 2000; Edwards, 2000). Stein and Lim (2004) further corroborate that overvaluation of the exchange rate is a vital determinant, which is very costly and has been the cause for most currency or balance of payments crises.

In this respect, the determinants of exchange rates or the misalignment of exchange rates pose a number of questions and challenges to policymakers and researchers in terms of how to measure the misalignment of the real equilibrium exchange rate. The 1997 turmoil is believed to be the cause of the temporal ASEAN exchange rate misalignment. The rise of the global economic crisis of 2008–09 which epicentered in the United States, and the instability in global commodity prices such as food and oil prices have sparked an increase in the number of empirical studies examining the topic of exchange rate misalignment, leading to much debated policy implications and reactions.<sup>2</sup> This encourages us to exclusively scrutinize the misalignment of the Malaysian ringgit during 1991–2009, which spans the years of the development of the foreign exchange market and financial opening of the country, the 1997–98 financial crisis, as well as the recent 2008–09 global economic crisis.

The generalizability of much published research on this issue is problematic and assorted. Among previous studies that have dealt with such matters are: Furman and Stiglitz (1998), and Sazanami and Yoshimura (1999), who measure real exchange rate misalignment using the purchasing power parity (PPP) in long-run averaging (“stylized facts” base period) and mean reverting as base period, respectively, and discover that the Malaysian ringgit was overvalued on the eve of the currency crisis. Moreover, Husted and Macdonald (1999), who estimate the equilibrium exchange rate via panel cointegration in the unrestricted version of the flexible monetary model, corroborate that the Malaysian ringgit was overvalued at the end of 1996.

In other major studies, Chinn (1998), Chinn and Dooley (1999) and Chinn (2000) gauge Asian currencies overvaluation through a long-run PPP model, a productivity-based model and a monetary model of the nominal exchange rate, respectively. The results found are conflicting. In a long-run PPP framework, the ringgit appeared to be overvalued. The productivity-based model reveal that the ringgit was undervalued, while the monetary model indicate that misalignment of the ringgit was small or did not imply much deviation from short-run equilibrium at the eve of the currency crisis. Later, Kwek and Yoong’s (2002) real equilibrium exchange rate model establish that the ringgit was undervalued before the eruption of the 1997 Asian currency crisis. Stein and Lim (2004) find further evidence that the ringgit was misaligned but not prolonged, where the Malaysian ringgit seemed to be depreciated. In addition, Lee and Azali (2005) report that by utilizing the sticky-price monetary exchange rate model, the Malaysian ringgit appeared to be overvalued on the eve of the crisis. A recent study by Sidek and Yusoff (2009), using Malaysian real effective exchange rate, show a persistent overvaluation of the ringgit in the early 1990s until mid-1997, but generally close to the equilibrium after the crisis period due to the ringgit’s peg to the US dollar.

Given the limited empirical studies on currency misalignment, particularly of ASEAN countries, this study attempts to bridge the gap as well as to shed some light by assessing this issue based from a theoretical framework using the most recent methodology. Therefore, this study investigates the measurement of Malaysian exchange rate misalignment from two alternative estimates: (a) the bilateral real equilibrium exchange rate (RER) of the ringgit against

the US dollar; and (b) the real effective equilibrium exchange rate (REER), where the sample period spans from 1991:1 to 2009:4. In this study, RER and REER are defined as the ratio of domestic consumer price index (CPI) to foreign producer price index (PPI) based (PPI-CPI based), which broadly represents both tradable and nontradable goods. The choice of PPI is due to it being weighted with traded goods, representing a greater proportion of traded goods (Edwards, 1989).<sup>3</sup> The Natural Real Exchange Rate (NATREX) equilibrium model is used to estimate whether there is any currency misalignment of the ringgit's observed real exchange rates with the underlying macroeconomic fundamentals of the Malaysian economy, which may serve as a warning signal for currency crises. Furthermore, the average total sum of squares due to error (ATSSE) is employed to compute and disentangle the degree of exchange rate misalignment across different exchange rate regimes. This is due to the action taken by Malaysia to switch from managed float to a conventional pegged arrangement under a risk management policy in the midst of the 1997-98 Asian financial crisis, and the reinstatement of exchange rate by scrapping the ringgit's peg to the US dollar to operate in a managed float in mid-2005. Hence, the findings obtained in this study will bring new dimensions to the literature as it leads to estimating the Malaysian exchange rate misalignment based on the NATREX equilibrium model across different exchange rate regimes throughout the series of financial crises. The estimation process is carried out by incorporating the macroeconomic fundamentals in the form of economic theories and econometric perspectives.

The remainder of this paper is organized as follows. Section 2 explains the development of the Malaysian exchange rate arrangement while Section 3 describes the measurement of misalignment and the NATREX equilibrium model that is used to estimate the real exchange rate misalignment. An econometric formulation and cointegration analysis are carried out in Section 4. Section 5 reports the empirical results obtained from the econometric analysis and Section 6 concludes with the findings and policy implications.

## 2. MALAYSIAN EXCHANGE RATE ARRANGEMENT: THE DEVELOPMENT OF THE RINGGIT

Malaysia implemented two different exchange rate regimes from the 1970s to the present, as shown in Table 1. Malaysia adopted the managed float system with intervention of the government via open market operation from 1978 to September 1998, before deciding to peg its currency to the US dollar as the outcome of the 1997 Asian financial crisis. In July 2005, Malaysia switched back to the managed float system to further boost its economic growth.

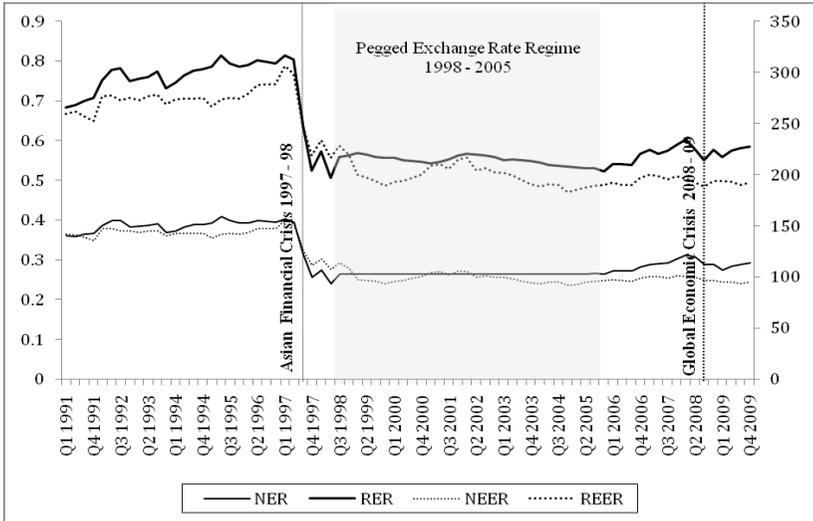
TABLE 1  
Official Exchange Rate Policy for Malaysia

Periods	Regime
September 1978-September 1998	Managed Floating
September 1998-July 2005	Conventional Pegged Arrangement (Pegged to U.S dollar)
July 2005-present	Managed Floating

Source: *IMF International Financial Statistics and Exchange Arrangement and Exchange Restrictions*, several issues.

The series of Malaysian bilateral and effective exchange rates (in terms of both nominal and real) are illustrated in Figure 1. It seems that the Malaysian exchange rate has turned 180 degrees at the outbreak of the 1997–98 Asian financial crisis. The co-movement of exchange rate in both cases was relatively stable under managed float in the 90s. A rising trend in the RER and REER was apparently observed from 1991:1 to 1997:3, indicating an appreciation of the ringgit. This signifies that the value of the ringgit was increasing faster than the US dollar. Later, the eruption of the regional financial crisis led the RER and REER to become volatile in 1997:3 before dwindling in 1998:3, when the ringgit was tied against the US dollar at RM3.80. Since then the ringgit seemed to have soothed with only a slight fluctuation until mid-2005. Following the reinstatement of the managed float regime in July 2005, the ringgit began to appreciate until the beginning of 2008 before bumping into another episode of global economic crisis, which once more plunged the ringgit into depreciation. Conjointly the appreciation and depreciation lead to a sign of exchange rate alignment for both the RER and REER.

FIGURE 1  
The Malaysian Exchange Rates



Note: NER is the Nominal Exchange rate and RER is the Real Exchange Rate while NEER is the Nominal Effective Exchange Rate and REER is the Real Effective Exchange Rate.

### 3. MEASUREMENT OF MISALIGNMENT

The measurement of real exchange rate misalignment has long been argued as it engages with an unobserved variable, which is the real equilibrium exchange rate. Numerous previous studies relied on the Purchasing Power Parity (PPP) model. Although, the PPP model is debatable, as the real equilibrium exchange rate is assumed to be static or remain at stationary.<sup>4</sup> However, the poor empirical performance of the monetary models (the flexible and the sticky-price models) particularly underpinned by the fact that the monetary models hardly beat a random walk (Meese and Rogoff, 1983), and the lack of micro-foundations (Obstfeld and Rogoff, 1995) has led to other theoretical developments.

This resulted in a major breakthrough for estimating real equilibrium exchange rate using the model based approach, which originates from Stockman’s (1980, 1988) real equilibrium model. In particular, the real equilibrium exchange rate is derived from a more sophisticated alternative—the increasingly influential “fundamentals

approach”—which has received considerable interest in assessing misalignment (Nurkse, 1945; Edwards, 1989; Williamson, 1994; Faruqee, 1995; MacDonald, 1997; Baffes, Elbadawi and O’Connell, 1997; and Zhang, 2001). The consistency of the real equilibrium exchange rate is driven by the underlying macroeconomic variables through a set of steady-state values of supply-side, demand-side and policy variables (e.g. terms of trade, productivity and investment). According to Edward (1987), exchange rate misalignment that occurs due to the change in the real determinants of the real equilibrium exchange rate, which is not translated in the short-run into actual changes of the real exchange rate, is known as “structural misalignment”.<sup>5</sup> That is, the observed real rate can no longer be justified by the existing fundamentals in the economy. Among others, the family of fundamental approach that estimates long-run real equilibrium exchange rate includes Fundamental Equilibrium Exchange Rate (FEER), Behavior Equilibrium Exchange Rate (BEER) and Natural Real Exchange (NATREX), which is mainly based on the analysis of the goods and services market.

### 3.1 EXCHANGE RATE MISALIGNMENT: THE NATREX MODEL

In line with the development, this study employs the Natural Real Exchange Rate (NATREX) model developed by Stein (1994, 1996) to estimate the real equilibrium exchange rate. The NATREX model generates an equilibrium benchmark using prevailing real economic fundamentals that determine the misalignment of the exchange rate. Based on Stein and Lim (2002), NATREX is a moving equilibrium exchange rate, which varies over time in response to the changes in the current real macroeconomic fundamental variables. Indeed, the NATREX approach does not require that the actual and the real equilibrium exchange rate be stationary (Edwards and Savastano, 1999). Therefore, the NATREX model will be an appropriate measurement to acquire a good fit for exchange rate misalignment as it takes into account real economic activities that comprise all adjustments made by the underlying real macroeconomic fundamentals of their respective economies, (Edwards, 2000). This makes it more efficient to consider NATREX as a real equilibrium exchange rate. The general form of the NATREX model, which depends upon a vector of real equilibrium exchange rate, is demonstrated via the following single-equation econometric model:<sup>6</sup>

$$(1) \quad NATREX_t = f(\Phi_t);$$

where  $NATREX_t$  represents the real equilibrium of long-run exchange rate for REER and RER, while vector  $\Phi$  consists of the real economic fundamentals ( $RGC, RIRD, TOT, PROD$ ).  $RER$  is the Malaysian real exchange rate,  $REER$  is the Malaysian Real Effective Exchange Rate<sup>7</sup>,  $RGC$  is the ratio of government consumption to GDP deflator,  $RIRD$  is the real interest rate differential between the domestic ( $i_{mas}$ ) and world ( $i^*$ ) real interest rates,  $TOT$  is the terms of trade (ratio of the export price index to the import price index) and  $PROD$  is the productivity index.<sup>8</sup>

$$(2) \quad \begin{aligned} RER_t = & \alpha_0 + \sum_{i=0}^r \alpha_1 RGC_t + \sum_{i=0}^r \alpha_1 RIRD_t + \sum_{i=0}^r \alpha_1 TOT_t \\ & + \sum_{i=0}^r \alpha_1 PROD_t + \varepsilon_t \end{aligned}$$

$$(3) \quad \begin{aligned} REER_t = & \delta_0 + \sum_{i=0}^r \delta_1 RGC_t + \sum_{i=0}^r \delta_1 RIRD_t + \sum_{i=0}^r \delta_1 TOT_t \\ & + \sum_{i=0}^r \delta_1 PROD_t + \varepsilon_t \end{aligned}$$

The above set of selected exogenous fundamental variables is consistent with the nature of the Malaysian economy, which has been quite frequently used in the literature on the determination of equilibrium real exchange rates generated from the NATREX model (Edwards and Savastano, 1999; Edwards, 2000; Siregar and Har, 2001; Rajan and Siregar, 2002; Rajan, Sen and Siregar, 2004; and Bouoiyour and Rey 2005).<sup>9</sup> The equilibrium real exchange rate is acquired using the coefficient estimates from Equations (2) and (3) that best fit to the real exchange rate on the country's pertinent real economic fundamentals.

Theoretical literature on the expected sign of the coefficient estimates for the selected real economic variables is briefly highlighted based on theory. The real government consumption ( $RGC$ ) may have a positive or negative impact on real exchange rate, depending on the relative importance between substitution effect and income effect. If  $RGC$  is disproportionately devoted to nontradable goods, the substitution effect dominates and the rise in  $RGC$  leads to a real appreciation of the exchange rate as the price for nontradable

goods increases. The income effect implies that an increase in *RGC* creates an incipient trade deficit, which needs a real depreciation of the exchange rate to maintain external equilibrium. Regarding the real interest rate differential (*RIRD*), a rise in *RIRD* will lead to an increase in foreign capital inflows, which mainly depends on both the composition of capital flows between the foreign direct investment (FDI) or portfolio (Athukorala and Rajapatirana, 2003), and which eventually tends to worsen the net foreign assets of the country. Therefore, it requires a real depreciation of the exchange rate to promote the competitiveness of a country through its export sector. In addition, the terms of trade (*TOT*) have an ambiguous effect based on the dominance of either the substitution effect or the income effect (Elbadawi and Soto, 1994). An improvement in the terms of trade leads to a reduction in the cost of imported inputs in the production of nontradable goods, reducing the price of nontradables in relative terms, hence, generating a real depreciation of the exchange rate through the substitution effect (switching effect). While the income effect signifies that a rise in the terms of trade increases the national income, creating excess demand for nontradable goods, which leads to a real appreciation of the exchange rate through an improvement in the current account balance (spending effect). For productivity (*PROD*), the Balassa-Samuelson theory represents the domestic supply-side in which a productivity shock favors the tradable goods sector. A positive productivity shock improves trade balance, which requires a real appreciation of the exchange rate to restore the balance of payment at equilibrium.<sup>10</sup>

### 3.2 THE LEVEL OF EXCHANGE RATE MISALIGNMENT: THE ATSSSE TECHNIQUE

The rate of misalignment can be calculated through the difference between the actual and the natural real equilibrium exchange rate (NATREX), implying the deviation of a currency from its equilibrium rate. The deviations indicate that a currency is misaligned; either overvalued or undervalued, which occurs at any point of time. For that reason, this study endeavors to discern the degree of exchange rate misalignment across different exchange rate regimes, between managed float and pegged exchange rate regimes, throughout the study sample. The level of exchange rate

misalignment is captured through a technique of average total sum of squares error (ATSSE), as in Equation (4) below:

$$(4) \quad ATSSE = \frac{\sum_{i=1}^n e_i^2}{n};$$

where  $e_i^2$  is the error between the actual and the natural real equilibrium exchange rate (NATREX) whilst  $n$  is the number of observations.

#### 4. METHODOLOGY

This section discusses the properties of time series and the econometric methodology used to estimate the real equilibrium exchange rate and the measure of misalignment that may serve as a warning signal for currency crises; explicitly, the impacts across different exchange rate regimes.

The vector autoregressive (VAR) model of multivariate cointegration test is employed to gauge the NATREX model. This is to test for the existence of an equilibrium relationship between the exchange rate and its determinants. As a prelude to the cointegration test, the integration order for all time series variables are necessarily verified through the unit root tests, namely, Augmented Dickey-Fuller (1981) test and the Kwiatkowski et al. (1992) test. Conditional on the outcome, the cointegration test developed by Johansen (1988) and Johansen and Juselius (1990) is utilized. This method has been widely applied in the empirical economic model to scrutinize the presence or absence of long-run equilibria among the variables. It is based on two likelihood ratio (LR) test statistics, which are the trace and maximum eigenvalue ( $\lambda$ -max) statistics that identify the number of unique cointegrating relationships between the variables. The trace statistics confirm the null hypothesis of at most  $r$  cointegrating relationship, against a general alternative hypothesis while the null hypothesis of  $\lambda$ -max statistic is  $r$  cointegrating vectors, against the alternative of  $r + 1$  cointegrating relationship. The critical values for both tests are tabulated in Johansen and Juselius (1990).

This is then followed by the vector-error-correction modeling (VECM), which is derived from the long-run cointegrating vectors to identify the direction of Granger causality between the variables in the system. Based on Engle and Granger (1987), series that are cointegrated of order one  $I(1)$  can diverge in the short-run but will move together in the long-run. Therefore, there must be a causality relationship in at least one direction. In particular, a generating mechanism called the “error correction model” always exists, which restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationship while allowing a wide range of short-run dynamics. The inclusion of lagged vector error-correction terms (ECT) in the causality test may avoid the misspecification problem for information lost in the first-difference process, thereby allowing for short-run correction to form long-run equilibrium as well as to capture the short-run adjustment of the cointegration variables (Granger, 1988). The existence of Granger causality can be proved through a  $t$ -test of the lagged error correction term(s) (ECT) and/or an  $F$ -test attributed to the joint significance of the sum of lags of each independent variable. That is, the causal impact can occur either through the lagged changes in the independent variable of short-run effect or through the lagged error correction term(s), which contains long-run information.

## 5. DATA AND EMPIRICAL RESULTS

### 5.1 DATA ANALYSIS

This paper employs quarterly data that covers the period 1991:1 to 2009:4 for the case of Malaysia. The data is primarily gathered from various issues of the IMF’s International Financial Statistics that includes exchange rates (MYR: USD), government consumption, GDP deflator, interest rates, and consumer price index. For real GDP per capita and terms of trade, the data are extracted from various issues of the Malaysia Economic Statistics: Time Series, Department of Statistics, Malaysia and the Malaysian Economy Figures, Economic Planning Unit, Prime Minister’s Department, Malaysia, respectively. However, due to unavailability of quarterly data, these variables (real GDP per capita and terms of trade) have been interpolated from yearly to a quarterly base using Gandolfo (1981) in order to facilitate the utility of the system.

## 5.2 THE UNIT ROOT TEST RESULTS

Table 2 shows the results of ADF and KPSS unit root tests. The results clearly show that all variables tend to be non-stationary in their levels. The ADF test fails to reject the null hypothesis of non-stationary while the KPSS test successfully rejects the null hypothesis of stationary at the 1 percent significant level. In the first difference or  $I(1)$ , the ADF test rejects the null hypothesis of unit root at the 1 percent significant level whilst the KPSS test refuses to reject the null hypothesis of stationary. This implies that these variables are integrated of order one or  $I(1)$ , suggesting the existence of cointegrating relationships among the series of exchange rate and its real economic fundamental variables. These results are consistent with the findings that most macroeconomic variables follow an  $I(1)$  process (Baharumshah, Thanoon and Rashid, 2003).

TABLE 2  
Unit Root Tests

Variable	ADF		KPSS	
	No Trend	Trend	No Trend	Trend
	Level			
<i>RER</i>	-1.404(0)	-2.479(0)	48.25(0)*	2.215(0)*
<i>REER</i>	-1.089(0)	-2.359(0)	78.02(0)*	2.319(0)*
<i>RGC</i>	-0.716(2)	-1.476(2)	1.189(3)*	5.079(3)*
<i>RIRD</i>	-2.284(4)	-2.750(4)	0.747(4)*	0.218(4)*
<i>TOT</i>	-1.751(0)	-1.820(0)	12.61(1)*	16.68(1)*
<i>PROD</i>	-1.713(3)	-3.135(3)	0.892(2)*	0.456(2)*
	First Difference			
<i>RER</i>	-8.479(0)*	-8.420(0)*	0.092(0)	0.092(0)
<i>REER</i>	-6.885(1)*	-6.842(1)*	0.063(1)	0.061(1)
<i>RGC</i>	-4.873(3)*	-4.943(3)*	0.095(4)	0.089(4)
<i>RIRD</i>	-5.474(0)*	-5.849(0)*	0.286(2)	0.113(2)
<i>TOT</i>	-9.539(0)*	-9.487(0)*	0.019(2)	0.015(2)
<i>PROD</i>	-10.36(1)*	-10.87(1)*	0.047(3)	0.036(3)

Notes: ( ) represents the number of lag length included which is selected based on Akaike Information Criterion (AIC) for ADF test and spectral OLS AR based on AIC for KPSS test. The asterisk (\*) denotes the statistically significant at 1% level. These values are provided by the EVIEWS output based on Kwiatkowski-Phillips-Schmidt-Shin (1992) and Mackinnon (1996).

### 5.3 COINTEGRATION TESTS AND LONG-RUN EQUILIBRIUM ESTIMATES

Given that each of the series is considered to be an  $I(1)$  process, the Johansen multivariate cointegration tests are subsequently performed to scrutinize the existence of a cointegration relationship between the exchange rate and its determinants. However, due to the sensitivity of the Johansen cointegration tests to the sampling period and/or having too many variables, the degree of adjusted version of the trace and  $\lambda$ -max statistics are applied (Cheung and Lai, 1993).<sup>11</sup> The trace and  $\lambda$ -max statistics indicate that there is one cointegration relationship at the 1 percent significant level in each of the single equation models as reported in Table 3. This suggests the presence of a long-run equilibrium relationship between the real exchange rate (*RER*) and the real effective exchange rate (*REER*) and their determinants, respectively.

TABLE 3  
The Johansen Multivariate Cointegration Test

Tests		Trace Statistics		Critical Value	$\lambda$ -Max Statistics		Critical Value
$(H_0)$	$(H_A)$	<i>RER</i>	<i>REER</i>	1%	<i>RER</i>	<i>REER</i>	1%
$r = 0$	$r = 1$	85.63*	107.82*	76.07	43.49*	56.46*	38.77
$r \leq 1$	$r = 2$	42.14	51.36	54.46	26.81	25.69	32.24
$r \leq 2$	$r = 3$	15.33	25.67	35.65	11.55	18.13	25.52
$r \leq 3$	$r = 4$	3.78	7.54	20.04	3.78	6.51	18.63
$r \leq 4$	$r = 5$	0.00	1.03	6.65	0.00	1.03	6.65

Notes:  $r$  indicates the number of cointegrating vectors. The (\*) denotes the rejection at the 1% critical values. The statistics are computed with linear trend in the VAR equation. The crisis dummy is included in the cointegration regression equation to restrain the impact of the 1997-98 financial crisis. The system optimal lag length is determined through the Akaike Information Criterion (AIC).

The estimated cointegrating vectors are summarized in Table 4. By normalizing *RER* and *REER*, the estimated cointegrating vectors which reflect the long-run relationships are obtained. The normalized equations are attained by dividing each cointegrating vector by the negative of the estimated *RER* and *REER* coefficients, together with their respective  $t$ -values. The normalization process yields estimates

of long-run equilibrium parameters. The results in Table 4 indicate that all fundamental variables for both *RER* and *REER* have significant and theoretically consistent coefficient estimates at the 1 percent and 5 percent levels.

TABLE 4  
Results of Cointegrating Relationship

	<i>C</i>	<i>GC</i>	<i>RIRD</i>	<i>TOT</i>	<i>PROD</i>
<i>RER</i>	-4.3980	-0.3673* (0.0343) [-10.700]	-0.0380** (0.0176) [-2.1592]	0.8782* (0.2010) [4.3689]	0.3072* (0.1012) [3.0348]
<i>REER</i>	2.32201	-0.3901* (0.0445) [-8.7772]	-0.0607** (0.0258) [-2.3529]	0.7267** (0.2825) [2.5730]	0.3175** (0.1490) [2.1317]

Notes: The asterisks (\*) and (\*\*) denote the statistically significant at 1% and 5% levels, respectively. The standard errors are in () while *t*-statistics are in []. The diagnostic test conducted for normality, serial correlation, and heteroscedasticity were found to be satisfactory, suggesting the estimated model is adequately specified. These results are available upon request.

The estimated coefficients show that an increase in *RGC* and *RIRD* has a negative impact on *RER* (*REER*), which indicates that any elevation in these fundamental variables will cause a depreciation of the real exchange rates. In other words, *RGC* and *RIRD* for both measurements of exchange rates (*RER* and *REER*) move in the opposite direction of exchange rate. This reveals that a rise in government expenditure is biased toward the tradable sector, which deteriorates the trade balance and causes increased pressure on the exchange rate to depreciate in maintaining the equilibrium path. Ravn, Stephanie, and Martín (2007) found that government consumption may lead to a depreciation of the exchange rate due to the enlargement effect in output and private consumption, which aggravates the fiscal balance and weakens the position of the current account. This supports the hypothesis that government spending in total GDP focuses on consumption spending, and that imported goods are financed by deficit, which consequently will cause exchange rates to depreciate. In the meantime, an increase in real interest rate differential tends to persuade an inbound of foreign

capital flows, inducing FDI inflow and involves forging long-term relationships with enterprises in foreign countries. Such connections might worsen the country's net foreign assets position and weaken the indebtedness of the country. Therefore, it is likely that decreasing the rates of exchange would offset the destructive effect in order to increase the country's export competitiveness to further stimulate the Malaysian economic development.

In contrast, *TOT* and *PROD* have a positive influence on *RER* (*REER*), implying that both *TOT* and *PROD* are moving in the same direction as exchange rates; an increase in *TOT* and *PROD* lead to a real appreciation of the exchange rate. Conventionally, an improvement in the terms of trade for middle-income countries, such as Malaysia, is habitually linked with a decrease in the prices of import goods in comparison with those of export goods, which leads to an increase in purchasing power, thereby inducing an increase in the demand of both imported and domestic goods, raising the price of domestic goods and, as a result, forces a real appreciation of the domestic currency (Dufrenot and Yehoue, 2005). This finding supports the bulk of previous empirical studies, for instance, Edwards (1989) and Baffes, Elbadawi and O'Connell (1997), which suggest that a positive sign obtained in the terms of trade on real exchange rate means that the income effect is predominant. Meanwhile, Lommatzsch and Tober (2004) propose that productivity gains experienced in the process of economic development imply an increased capacity to produce high-quality export goods that stems from FDI and causes exchange rates to appreciate. This can be seen through a steadily increasing trend of Malaysia's net FDI inflows in the 1990s, which have contributed to almost a quarter of the country's annual gross fixed capital formation and is equivalent to over 8 percent of the country's GDP (Tham, 2003).<sup>12</sup> Since the opening up of the investment regime in 1985, the total value-added of the manufacturing sector, due to the contribution of foreign establishments, has increased to almost 50 percent up until 1999. It can, therefore, be viewed as an equilibrium phenomenon leading to a stronger economy and hence, a stronger currency which forces real exchange rates to appreciate in terms of both PPI and CPI with manufacturing products having a considerable proportion of the shares. This corroborates the findings of the recent study by Saborowski (2009), which finds that the spillover effect of FDI inflows might improve local productivity through the transfer of

technology and managerial know-how, which is indeed attenuated due to the active and liberalized financial and capital markets.

#### 5.4 ERROR CORRECTION MODEL (ECM)

Once the long-run cointegration relations are ascertained using the Johansen approach, the short-run dynamics of both rates of exchange, *RER* and *REER*, are estimated through the Hendry's general-to-specific approach, where insignificant lags are sequentially removed from the estimation, as shown in Table 5. The reliability of the error correction model for both *RER* and *REER* are determined through a number of diagnostic tests, which were found to fulfill the conditions of non-autocorrelation, homoskedastic, normality of residual and zero mean of disturbance. In addition, the results of CUSUM and CUSUMSQ stability tests are well within the critical bounds implying that regressions are stable at the 5 percent significance level, as illustrated in Figure 2. Therefore, the estimated models for the real exchange rate (*RER*) and real effective exchange rate (*REER*) are sufficient and can be used to construct the subsequent explanations on the behavior of Malaysian real exchange rates.

As displayed in Table 5, the estimated error correction term  $ECT_{t-1}$  for *RER* (-0.34) and *REER* (-0.23) is negative and highly significant, suggesting almost 34 and 23 percent of the disequilibria of the previous period's shock adjustment back to the long-run equilibrium in the current quarter. This indicates that the speed of adjustment is fairly rapid in perceiving changes in its determinants before converging to its equilibrium level. For instance, the short-run adjustment process will gradually correct any deviations from the long-run equilibrium. As such an upward adjustment will be taken to the real exchange rate, which appears to be undervalued.

The results indicate that all the macro-fundamental variables are important determinants throughout various short-term horizons. The coefficient of real government consumption (*RGC*), enters with a positive sign in the first quarter, and is negative in the fourth quarter. This implies that in the earlier period, both rates of exchange (*RER* and *REER*) appear to appreciate, suggesting that the substitution effect is greater than the income effect. It seems that in the short-run, increase in government expenditure may cause a real appreciation of

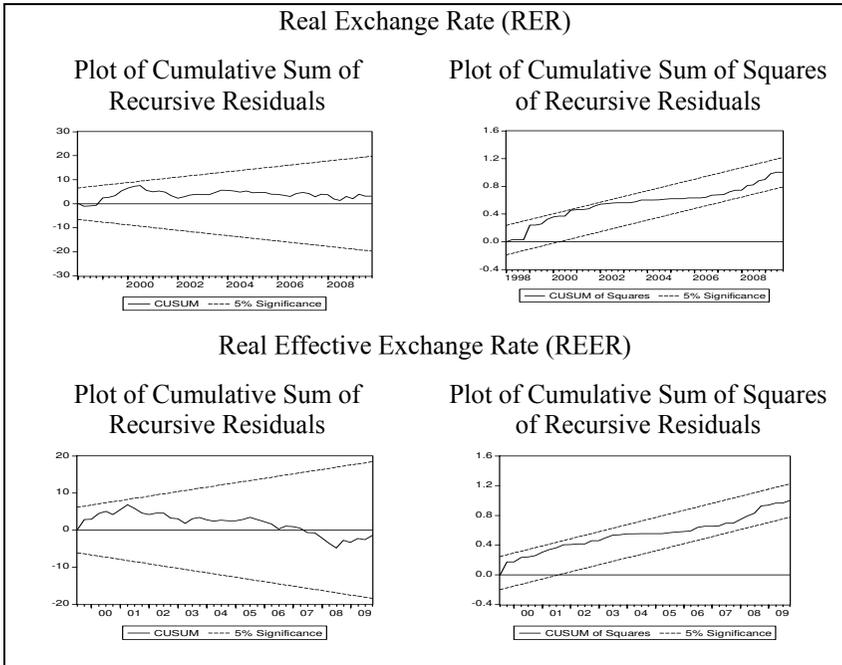
the exchange rate because government consumption complements the utility from private consumption (Balvers and Bergstrand, 2002). It can therefore, be assumed that the adjustment process takes place in the fourth quarter in order to restore the equilibrium and leads the rates of exchange to depreciate. This finding is consistent with that of Sidek and Yusoff (2009) which finds that government expenditure leads to a real appreciation of exchange rate in the short-run before transforming into real depreciation in the medium- to long-run equilibrium.

TABLE 5  
Error Correction Model

$\Delta RER = 0.0161 - 0.3423ECT_{t-1} + 0.0723\Delta RER_{t-3} + 0.1342\Delta RGC_{t-1}$					
$(0.0066)** \quad (0.0736)* \quad (0.1148) \quad (0.0461)*$					
$- 0.0684\Delta RGC_{t-4} - 0.0243\Delta RGC_{t-5} + 0.0811\Delta RIRD_{t-5}$					
$(0.0202)* \quad (0.0241) \quad (0.0429)***$					
$+ 0.0293\Delta RIRD_{t-5} + 0.1596 \Delta TOT_{t-4} - 0.1311\Delta PROD_{t-1}$					
$(0.0328) \quad (0.0676)** \quad (0.1038)$					
$- 0.2190\Delta PROD_{t-3} - 0.1477\Delta PROD_{t-4} - 0.0857\Delta DUM$					
$(0.1110)*** \quad (0.1090) \quad (0.0125)*$					
$\Delta REER = 0.0102 - 0.2278ECT_{t-1} - 0.3563\Delta REER_{t-1} - 0.3172\Delta REER_{t-4}$					
$(0.0043)** \quad (0.0479)* \quad (0.0960)* \quad (0.0979)*$					
$+ 0.0306\Delta RGC_{t-1} - 0.0540\Delta RGC_{t-4} + 0.0437\Delta RIRD_{t-4}$					
$(0.0132)** \quad (0.0138)* \quad (0.0173)**$					
$+ 0.2140\Delta TOT_{t-5} - 0.1439\Delta PROD_{t-3} - 0.0818\Delta DUM$					
$(0.1276)*** \quad (0.0653)** \quad (0.0173)*$					
Diagnostic Tests					
	$R^2$	AR (6)	ARCH(10)	JB	RESET(1)
<i>RER</i>	0.704	1.5127 (0.2019)	1.0884 (0.3893)	2.4020 (0.3009)	0.2723 (0.6035)
<i>REER</i>	0.761	1.6333 (0.1663)	1.6861 (0.1110)	1.5258 (0.4663)	0.7162 (0.4003)

Notes: The asterisks (\*), (\*\*) and (\*\*\*) denote the statistically significant at 1%, 5% and 10% levels, respectively. *P*-values are shown in parentheses. AR(*i*) and ARCH(*i*) represent LM-type Breusch-Godfrey Serial Correlation LM and ARCH test at lag *i*, where *i* = 2. JB refer to Jarque-Bera Normality Test while RESET stand for Ramsey Regression Specification Error Test. The optimal lag-length is determined by the Akaike Information Criterion (AIC).

FIGURE 2  
CUSUM and CUSUMSQ Plots for Stability Tests



Note: The straight lines represent critical bounds at the 5% significance level.

For real interest rate differential (*RIRD*), the sign on the coefficient for both rates of exchange is positively significant. This asserts that high domestic return encourages portfolio investments, pushing to a real appreciation of the exchange rate in which speculative capital flight seeks higher short-term yields and can be a source of instability (Athukorala and Rajapatirana, 2003). At the expense of the long-run, FDI inflows might weaken the country’s net foreign assets position, forcing the real exchange rates to depreciate.

However, the effect of terms of trade (*TOT*) on real exchange rates is positive and statistically significant. This indicates that the positive sign obtained for both rates of exchange leads to real exchange rate appreciation, advocating the spending effect of this variable’s dominant substitution effect in addition to its long-run effects. Furthermore, productivity has a negative effect on both real exchange rates, showing negative productivity shock in the short-run. This reflects that in the transition period (over the short-run), Malaysia probably faces a negative effect on the likelihood of attracting new FDI as well as having real shocks to the economy, such as undergoing various stages of trade liberalization and a shift

towards a more flexible exchange rate arrangement in the 1980s, which have been the key driving forces of Malaysian real exchange rate depreciation.<sup>13</sup> However, in the long-run, diversification towards new exports of electronic products that have emerged as a spillover effect of FDI in upgrading old machinery and equipment, and privatization policy lead to significant productivity gains (future improvement of local productivity), which improve the trade balance. Hence, it could cause real appreciation of the exchange rates in order to retain equilibrium and intensify international competitiveness.

### 5.5 GRANGER-CAUSALITY TESTS

The estimated results of the Granger-causation that accounts for the short-run dynamic interactions in the environment of VECM among the four variables of the two measurements of Malaysian exchange rates, *RER* and *REER*, are scrutinized and summarized in Table 6. The results clearly indicate that in both cases, the selected macro-fundamental determinants do Granger-cause *RER* and *REER*. This confirms that there is a uni-directional connection from the changes in real government consumption ( $\Delta RGC$ ), real interest rate differential ( $\Delta RIRD$ ), terms of trade ( $\Delta TOT$ ) and productivity ( $\Delta PROD$ ) to the changes in real exchange rate ( $\Delta RER$ ) and real effective exchange rate ( $\Delta REER$ ), respectively.

The results further reveal that the short-run adjustments are generally insignificant except for *RGC*, which is significant at the 1 percent level for both *RER* and *REER*. This implies that changes in *RGC* holds the burden of the short-run endogenous adjustments of both rates of exchange towards their equilibrium path, meaning that government consumption contributes more than 55 percent of *RER* depreciation and approximately 23 percent of *REER* depreciation in each quarter. This suggests that the depreciation effect of *RGC* on both the equilibrium exchange rates (*RER* and *REER*) is not only in the long-run but also in the short-run. Hence, *RGC* is believed to play a main role in correcting the long-run disequilibrium. Moreover, changes in *RGC* are responsive to changes in *RER*, *REER*, *RIRD* and *PROD*. This shows a bi-directional causality relationship between government consumption and both exchange rates (*RER* and *REER*), signifying a feedback effect where government consumption tends to correct the exchange rates while the rates of exchange lead to changes in government consumption. In addition, the uni-directional relationships that run from real interest rate differential and productivity to government consumption underline the importance of the foreign sector and national output to the development of the Malaysian economy in the short-run.

TABLE 6  
The Granger Causality Result based on VECM

Dependent Variables	F-statistic (Significance levels)					
	$\frac{\Delta RER}{\Delta REER}$	$\Delta RGC$	$\Delta RIRD$	$\Delta TOT$	$\Delta PROD$	$ECT_{t-1}$ (t-statistics)
Real Exchange Rate ( <i>RER</i> )						
$\Delta RER$	-	7.7926* (0.0069)	3.7760** (0.0174)	5.2483* (0.0051)	2.6468*** (0.0677)	-0.2822* (-4.4483)
$\Delta RGC$	5.0737* (0.0060)	-	2.9870*** (0.0886)	0.0004 (0.9947)	2.2577 (0.1377)	-0.5580* (-3.9103)
$\Delta RIRD$	0.5461 (0.4625)	0.7514 (0.3892)	-	0.3496 (0.5564)	1.9736 (0.1648)	-0.4676 (-1.1287)
$\Delta TOT$	0.0160 (0.8999)	1.0697 (0.3048)	2.7450*** (0.0976)	-	1.0108 (0.3184)	0.0596 (1.4021)
$\Delta PROD$	0.0630 (0.8027)	1.4454 (0.2336)	0.1259 (0.7238)	0.0140 (0.9062)	-	0.0891 (1.1090)
Real Effective Exchange Rate ( <i>REER</i> )						
$\Delta REER$	-	3.6522* (0.0078)	5.3325* (0.007)	2.4105*** (0.0831)	3.2353** (0.0264)	-0.2298* (-3.4170)
$\Delta RGC$	3.1107** (0.0177)	-	2.0486*** (0.0913)	1.2339 (0.3104)	6.5584* (0.0001)	-0.2383* (-4.0955)
$\Delta RIRD$	1.4618 (0.2227)	1.6893 (0.1583)	-	0.5433 (0.7424)	0.5677 (0.7242)	-0.6033 (-1.1829)
$\Delta TOT$	1.2704 (0.2946)	1.2220 (0.3158)	2.2596*** (0.0954)	-	1.3822 (0.2504)	0.0557 (0.7813)
$\Delta PROD$	1.2111 (0.3207)	1.8431 (0.1252)	0.5485 (0.7385)	0.2627 (0.9309)	-	0.0136 (0.17261)

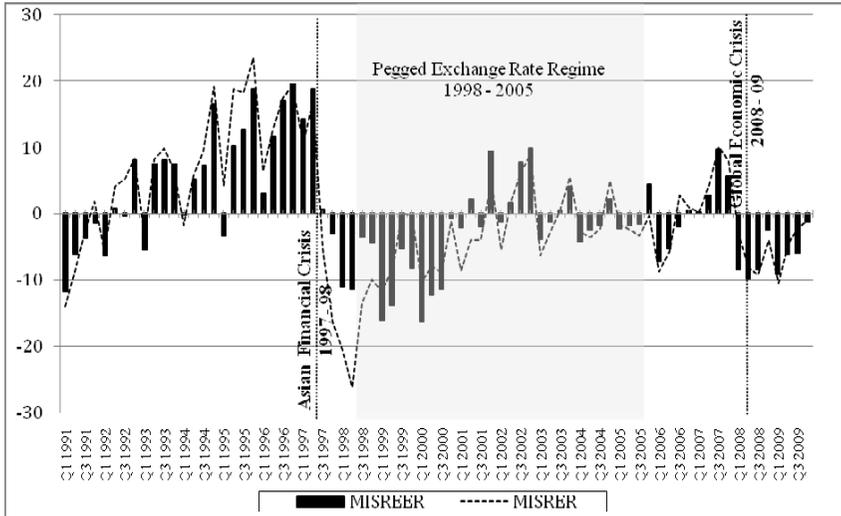
Notes:  $\Delta RER$  is Real Exchange Rate,  $\Delta REER$  is Real Effective Exchange Rate,  $\Delta RGC$  is Real government consumption,  $\Delta RIRD$  is Real Interest Rate Differential,  $\Delta TOT$  is Terms of Trade and  $\Delta PROD$  is productivity. The asterisks (\*), (\*\*), and (\*\*\*) denote the statistically significant at 1%, 5% and 10% percents, respectively. The *F*-statistic tests are the joint significance of the lagged values of the independent variables. The *t*-statistic tests are the significance of the error correction term (ECT). The optimal lag structure is determined based on the Akaike Information Criterion (AIC).

## 5.6 AN ASSESSMENT ON THE EXCHANGE RATE MISALIGNMENT

The series of Malaysian exchange rate misalignments are illustrated in Figure 3. It is apparent that during the study period the Malaysian real exchange rate was distorted by vigorous misalignments. The results disclose that the size of misalignments for MISRER is moderately bigger than MISREER while having an almost identical mold throughout the study sample. It is also identified that MISREER is generally smaller than the rate of MISRER, suggesting that the dynamic behavior of the ringgit may be greatly influenced by the US dollar, as a large portion of Malaysia's total trade is denominated in US dollars with the US-Malaysia trade share accounting for one-fifth of the total trade (Ariff, 2005). Based on both cases MISRER and MISREER, the ringgit experienced a persistent overvaluation scenario in the early 1990s until mid-1997, in the aftermath of the Asian crisis. This validates the argument that the ringgit was severely overvalued before the eruption of the 1997 Asian financial crisis, which is in line with Furman and Stiglitz (1998), Chinn (1998), Sazanami and Yoshimura (1999), Husted and Macdonald (1999), Chinn and Dooley (1999), Chinn (2000), Lee and Azali (2005) and Zahirah and Yusoff (2009) who notice that the Malaysian ringgit was overvalued on the eve of the currency crisis.

However, following the outbreak of the Asian financial crisis in July 1997, the Malaysian real exchange rates appear to be undervalued. Subsequently, an undervaluation is monitored until the end of 2001. The currency crisis leads MISRER to record more than 20 percent of undervaluation in the second quarter of 1998. This is in agreement with the hypothesis that a currency crisis, which results from an overvaluation of the exchange rate, is most likely to face dramatic currency devaluation (Kaminsky and Reinhart, 1999; Goldfajn and Valdes, 1999; Edwards and Savastano, 1999; Chinn, 2000; Edwards, 2000; and Stein and Lim, 2004). In addition, both MISRER and MISREER remain mostly undervalued until mid-2006 with a narrow margin of deviation of less than approximately 10 percent. The pegged exchange rate regime imposed by Malaysia might have fortified the value of the ringgit with less misalignment. It means that the ringgit is intimately related to the US dollar, in which the ringgit most likely follows the movement of the dollar especially during the years of the implementation of the pegged regime, such that the ringgit is bound to depreciate along with the US dollar *vis-a-vis* other currencies, where it can be considered as a tool to maintain price competitiveness by retaining an undervalued currency (Sidek and Yusoff, 2009).

FIGURE 3  
The Misalignment of Malaysian Exchange Rates



Notes: MISREER is the Misalignment of Real Effective Exchange Rate. MISRER is the Misalignment of Real Exchange Rate.  
 The level of misalignment =  $[(RER - NATREX) / NATREX] * 100$ , where a positive (negative) number implies an overvaluation (undervaluation).

It is also noticeable that the ringgit was overvalued in both cases (MISREER and MISRER) during the period of 2006–07. This may conceivably be due to the persistence of large global disparities and surging food and commodity prices, with a poorer standard of living among developing and less developed countries. In the last phase, both measurements of the ringgit seem to have depreciated and broken into an undervaluation until the end of 2009. The rise of a global financial crisis with the economy of the United States contracting sharply, may possibly have forced the ringgit to depreciate as it sent ripples across export-dependent Asian economies, including Malaysia, to face a contraction in aggregate demand caused by a collapse in Malaysian exports (Abidin and Rasiah, 2009). The decline in exports was due to the drastic reduction in manufactured exports such as electronics, electrical machinery and appliances being exported to the US, which accounted for about 50 percent of total Malaysian exports and caused the ringgit to depreciate (Khoon and Mah-Hui, 2010).

However, the degree of exchange rate misalignment between MISRER and MISREER across the different exchange rate regimes shows some improvement in the average total sum of squares error (ATSSE), as displayed in Table 7. Among others, the managed float II (2005:Q3–2009:Q4) regime indicates the least deviation from its equilibrium rate, with MISREER experiencing a lesser deviation than MISRER. It is believed that the Malaysian exchange rate adjusted well to its macro-fundamentals during the implementation of the pegged rate and managed float II. This suggests that the primary sources of misalignment were bubble factors such as speculative activity that pushed the exchange rate out of its equilibrium path under the managed float I (1991:Q1–1998:Q2) regime, as well as the political unrest in 1998. This finding is consistent with Sidek and Yusoff (2009) which establish that the Malaysian ringgit remained intact since the implementation of the pegged regime, which brought it to its appropriate level based on the macro-fundamentals regardless of the different exchange rate regimes that have been imposed. The immediate effect of the ringgit reinstatement to operate in a managed float seems to be timely as it allows stability and ensures that the exchange rate remains close to its fair value determined by its economic fundamentals. Therefore, it can be assumed that the flexible exchange rate regime permits the stability of the real exchange rate and helps to avoid misalignment (Bouoiyour and Rey, 2005).

TABLE 7  
The Degree of Real Exchange Rate Misalignment

Exchange Rate Regimes	Average total sum of square error between real exchange rate and equilibrium exchange rate (ATSSE)			
	MISRER	$\Delta\%$	MISREER	$\Delta\%$
Managed float I (1991:Q1 - 1998:Q2)	0.0169	-	0.0104	-
Pegged exchange rate (1998:Q3 - 2005:Q2)	0.0042	-75	0.0052	-50
Managed float II (2005:Q3 – 2009:Q4)	0.0035	-16	0.0036	-30

In order to verify the overall performance of the rate of misalignment, the stability of the Malaysian real exchange rate regime is assessed by analyzing the deviation between the actual and the natural real equilibrium exchange rate (NATREX). The results reported in Table 8 indicate that the ADF test statistics for both cases of misalignment significantly reject the null hypothesis of non-stationary at its level. That is, the misalignment rates for both measurements are stationary at level or  $I(0)$ , implying that the misalignment of Malaysian real exchange rates was stable throughout the study period, 1991–2009.

TABLE 8  
Stability Test for Misalignment

Variable	ADF Unit-root test	
	No Trend	Trend
	Level	
<i>RER</i>	-3.156(4)**	-3.483(4)**
<i>REER</i>	-4.286(4)*	-4.643(4)*

Notes: ( ) represents the number of lag length included which is selected based on Akaike Information Criterion (AIC) for ADF test. The asterisk (\*) and (\*\*) denote statistically significant at the 1% and 5% levels. These values are provided by the EViews output based on Mackinnon (1996).

## 6. CONCLUSION AND POLICY IMPLICATIONS.

Based on the economic theory of equilibrium real exchange rate, this paper estimates the long-run equilibrium path for real exchange rates (RER and REER) in Malaysia using the NATREX equilibrium model that covers from 1991:Q1 to 2009:Q4. In this investigation, the systematic relationship between the actual real exchange rate and fundamental economic variables is taken as the basic equilibrium concept, where the real exchange rates are in equilibrium when its movements reflect the economic fundamentals. Subsequently, the rate of misalignment is evaluated based on the gap between the evolutions of the actual and the generated real equilibrium exchange rates. Empirical findings based on the Johansen multivariate cointegration analysis point out the presence of a unique long-run relationship of the NATREX equilibrium model, interpreting that the rates of real exchange are communicated to the selected real fundamental variables throughout the study sample. Specifically, the

estimated coefficients reveal that government consumption, real interest rate differential, terms of trade and productivity are important determinants of the Malaysian equilibrium real exchange rates (RER and REER), which conform with the economic theory. In addition, it can be seen that the function of government consumption is vital for the adjustment of the ringgit towards its long-run equilibrium path.

The heart of the findings shows that Malaysian real exchange rates were overvalued during the early 1990s. However, with the onset of the 1997–98 Asian financial crisis, the ringgit appeared to be undervalued in mid-1997–2001. The prolonged overvaluation experienced by Malaysia due to the considerable capital inflows in the mid-1990s might be associated with the outbreak of the 1997–98 Asian financial crisis, which provided sufficient capacity for speculative attack and drew the ringgit into a vicious circle of depreciation. This provides empirical corroboration for claims in the literature that “an overvaluation leads to a currency crisis”, implying that the 1997–98 Asian financial crisis was due to the real exchange rate being overvalued, which was followed by a substantial currency devaluation or depreciation. Such explanation is consistent with the model results, by which changes in the underlying fundamental variables may not be translated into the rates of exchange (RER and REER), causing the real exchange rates to diverge from their equilibrium path due to some speculative activity, widening the gap between the actual and the equilibrium rates.

The adoption of the pegged exchange rate regime against the US dollar in September 1998 has fruitfully moved the Malaysian ringgit towards restoring the equilibrium while reducing the size of misalignment. This outlived the efficacy of the ringgit’s peg, as it may carefully be determined based on the macroeconomic fundamental, which brought stability and predictability to the Malaysian economy and continuously maintained its international competitiveness. The fact is that Malaysia has now become even more dependent on exports for growth after the ringgit had undergone a period of sustained undervaluation, which helped bolster its exports sector. In other words, the shift to a fixed or pegged exchange rate system under risk management sounds superior, as it is more effective to regulate a fixed rate rather than flexible rate particularly during a time when speculative activities might be very active, especially for emerging economies like Malaysia.

In addition, the immediate effect of the ringgit reinstatement to operate in a managed float in mid-2005 seems, comparatively, to be more efficient when the economy is back on its normal and stable track. This promotes steadiness and makes sure that the exchange rate remains close to its fair value, thus, flushing out most speculative plays. The rise of the ringgit since the removal of the peg determined by market forces is not surprising, but should be seen as a sign of confidence and maturity. As the ringgit gradually regains its strength, the temporary loss of export competitiveness will be tempered by the reducing cost of imported inputs, generating a better atmosphere for domestic demand through lower prices with the rate of inflation being expected to remain moderate. This is deemed as an opportune measure, expressly after taking into account changes in the global economic environment and the development of Malaysia's major trading partners, in particular, regional countries like China, for which it is believed that the real exchange rates are not expected to deviate significantly from the current prevailing level. Given that, as a small open-dynamic country, Malaysia is apparently more likely to be affected by its major trading partners, namely the United States, Japan and China, which play an important role as the world's main economic powers. Hence, it is essential to determine the value of the ringgit based on a trade-weighted index among Malaysia's main trading partners. It is also comforting to note that the present managed float is considered to bode well for the Malaysian economy with more ammunition for macroeconomic measures, which include greater monetary policy control as well as exchange rate policy instrument, mainly during the phenomenon of the world's commodities price hike, such as rising food and oil prices, which stoke inflation pressures.

However, the contraction in external demand due to the impact of the global economic crisis has severely hurt the Malaysian exports sector and brought big capital outflows, which have driven the Malaysian economy into a recession with real GDP falling by 6.2 percent in the first quarter of 2009 and recording negative growth for the first time since 2001. The shocks have somewhat deteriorated the ringgit, forcing the ringgit to depreciate, as portrayed in Figure 1, and turn into undervaluation, as reflected in Figure 2. In weathering

the crisis, the Government's response through the injection of a fiscal stimulus and the acceleration of development expenditure has shown some signs of stabilizing the economic contraction. However, the ongoing fiscal stimulus packages may cause the government to have a budget deficit and lead to hastily rising inflation in the long-run, which may have dreadful consequences on economic growth. Therefore, it is necessary for the monetary authorities to formulate a cautious plan in monitoring the behavior of economic and financial indicators as well as to keep optimal measurements of monetary and fiscal policies that might circumvent a similar financial crisis from being repeated in the future. The depreciation of the ringgit may also be useful to protect against the negative impact of the global recession as well as to improve Malaysia's export performance. With the recent development in the liberalization of its foreign exchange transactions, the ringgit is believed to need to further strengthen among its trading partners in order to boost its international competitiveness and the flexibility of the economy. Although the trend of the ringgit is comfortable, with the ringgit remaining stable against the US dollar at RM3.10, it is essential to take prudent action to prevent any recurrence of the destabilizing effects of financial meltdown with a globally synchronized recession.

To this end, different levels of exchange rate misalignment would have different effects on the allocation of output. Hence, acknowledgement of the exchange rate misalignment is crucial for the design of exchange rate policy, which is vital in modeling any trade agenda, forecasting and policy formulation. As a consequence, one can generalize that the policies under consideration should include an appropriate measure that leads to a reduction in exchange rate fluctuations as well as restoring the equilibrium of exchange rate. Maintaining a flexible exchange rate and monetary independence is increasingly important towards more open and greater integration with the rest of the world. This indicates that the Malaysian financial system has revitalized and is geared to face the challenges in the recent dynamic, competitive and globalized international economy for the health of its economic development.

## ENDNOTES

1. See Economic Report (1998/1999), for further explanation regarding the depreciation of ringgit.
2. See Abidin and Rasiah (2009).
3. In previous studies, CPI was used to reflect both tradable and nontradable goods due to the data unavailability and matter of expediency. This external real exchange rate adjustment has been widely applied in analyses of developing countries (Dornbusch, 1984).
4. The disadvantage of PPP could be due to the existence of tariff and non-tariff barriers, transport cost, menu cost and imperfect information.
5. For instance, when a country's international terms of trade worsen, it will cause the real equilibrium exchange rate to change because a relatively higher price of tradable is required to maintain economic equilibrium. As a result, real exchange rate misalignment will take place, as the changes are not accompanied by a change in the actual real exchange rate (Edward, 1987).
6. This study merely focuses on an operational of the NATREX model as the theoretical background discussion on the NATREX model has been widely explained (see Stein, 1994 and 1996; and Stein and Paladino, 1998).
7. The *REER* conversion is based on Bahmani-Oskooee and Mirzai (2000), where the *REER* (*RER*) is calculated against 15 of Malaysia's major trading partners' currencies, namely, Australia, China, Hong Kong, Japan, Germany, France, the Netherlands, India, Indonesia, Korea, Thailand, the Philippines, Singapore, the United Kingdom and United States (against the US dollar). For the *REER*, the trade-weighted average is generated using the trade shares in 2000 for Malaysia's 15 main trading partners.
8. The series of real GDP per capita is employed due the lack of data to proxy the productivity index (Siregar and Har, 2001; Rajan and Siregar, 2002 and Rajan, Sen and Siregar, 2004).
9. The model is set up to customize the 'open economy' and 'domestic economy' properties of countries, such as Malaysia that heavily depend on

international trade (*TOT*) and cross border capital flow ( $i_{mas}$ ,  $i^*$ ), as well as the domestic economic performance of high productivity (*PROD*) and government consumption (*RGC*).

10. This suggests that a rise in productivity increases wages in both tradable and nontradable sectors would lead to an increase in relative price of tradable and nontradable, inducing a real appreciation of exchange rate.

11. This is consistent with the issue of finite sample bias addressed by Reinsel and Ahn (1992), which recommended an adjustment factor to the estimated trace and  $\lambda$ -max statistics. Based on Reinsel and Ahn (1992) the degree-of-freedom correction factor is multiply to the test statistics by  $(T-nk)/T$ , where  $T$  is the size of sample,  $n$  is a number of variables and  $k$  is the lag length order of the estimated VAR model.

12. However, due to the 1997 – 98 Asian financial crisis and the 9/11 terrorist attack, the FDI inflows sharply dropped in 1999 and having moderately low fund inflows into Malaysia until 2001 before increasing in 2002, continued the progressive liberalization process.

13. In order to enhance the trade liberalization process, Malaysia went through various phases of trade regimes – Import-Substitution 2 (IS2) in 1980 to 1985, followed by the Export-Oriented 2 (EO2) strategy in 1985 to the present.

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