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Exchange Rate Misalignment and Economic Growth: Recent Evidence in Malaysia

N. A. M. Naseem[1,2]* and M. S. Hamizah[2,3]

[1]*Department of Economics, Faculty of Economics and Management, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia*
[2]*School of Economics, Faculty of Economics and Management, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia*
[3]*Faculty of Economics and Administration, Universiti Malaya, 50603 Kuala Lumpur, Malaysia*

ABSTRACT

The present study aims at investigating the growth effects of real exchange rate misalignments in Malaysia over the period 1991:1-2009:4. The RER misalignment is built through the estimation of the NATREX equilibrium model. Using the Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration framework, the results indicate the presence of positive and significant relationship between the RER misalignment and economic growth. This finding obtained is consistent with the notion that the RER misalignment through the distortion in relative price has systematic influence on the pattern of economic development.

JEL Classification: C13, C32, F43, O41

Keywords: Real Exchange Rate, Misalignment, NATREX Model, Output Growth, ARDL

INTRODUCTION

In recent years, there has been ongoing concern on the link between real exchange rate (RER) and economic growth. Although RER is not a formally feature in economic growth model, its important role appears to be the core constituent in the affiliation of the development strategy (Eichengreen, 2008). A large numbers of literature on the growth studies employ RER proxies directly. Typically, the finding of RER instability used to be hindered or slower growth (Gavin *et al.,* 1995). Indeed, the evidence provided through the time series movement of the real effective exchange rate (REER) per se is misleading, as it does not distinguish between equilibrium and

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E-mail address:
naseemniaz@upm.edu.my (N. A. M. Naseem)
* Corresponding author

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disequilibrium episodes of the movement (Clark *et al.,* 1994; Mongardini, 1998). Since then, the subject of significance of the exchange rate movement on output growth has increasingly received profound interest in economic circles, due to the proposal of the deviation level of the actual RER relative to its equilibrium value or so-called "RER misalignment". The motivation towards increased effort to date with the RER misalignment stems from the fact that its stability and proper alignment tend to lead correct RER pricing in the market, which is essential for the achievements of growth in the tradable sector (Naseem *et al*., 2009, 2010), as well as, the economy at large (Mbaye, 2013). Agarwala (1983), for instance, argues that although there are many forms of distortions that can affect macroeconomic performance, RER misalignment is by far the single most important price distortion affecting economic performance.

The symptom of RER misalignment can be interpreted as exchange rate disequilibrium, characterizing the distortion in relative prices of non-tradable goods to tradable goods, which has been regarded as an important indicator for international competitiveness of a country vis-à-vis the rest of the world (Edwards 1988, Guergill and Kaufman, 1998, Rogoff, 2005 and Candelon *et al.,* 2007). In other words, the RER misalignment is a persistence and significance departure of the actual RER from its long-run equilibrium path. The equilibrium RER usually refers to the value of the RER that is associated with reasonable growth and simultaneous attainment of internal and external balance for specified values of the "structural fundamentals" that may influence these objectives (Nurkse, 1945 and Edwards, 1988)[1]. The magnitude of the RER misalignment through the difference between the actual (observed) RER and its "equilibrium value" can be empirically labeled as overvalued when the actual RER is below the equilibrium RER, with an "undervalued" RER indicating the opposite (Richaud *et al.,* 2000; Zhang, 2001).

Based on Goldstein (1995) and Leape *et al.,* (1997), both exchange rate regimes, in fixed and floating originate misalignment. In particular, the degrees of fixity in exchange rate in terms of fixed or managed exchange rates or in the situation where floating markets are not efficient appear to be a crucial source of RER misalignment. In a floating exchange rate regime, bubble factors, such as speculative attacks, are the primary cause of misalignments that move the exchange rate too much in relation to economic fundamentals. While in fixed regimes, misalignments attribute to poor policy fundamentals that preclude the exchange rate to regulate to changes in economic fundamentals. In addition, the absence of institutional or other types of rigidities (i.e. price stickiness), frictions, and

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[1]The internal balance refers to a situation in which the market for nontraded goods is in a sustainable equilibrium, operating at full employment and full capacity output, while the external balance refers to a situation in which the value of the current account deficit is financed through a sustainable level of capital inflows.

other short-run factors preventing the RER from adjusting rapidly towards its medium to long run equilibrium level, which would be the focal caused of an implicit "ideal" underlying RER misalignment to the extent may have great implications on the balance of the economy (Razin & Collins, 1997; Edwards & Savastano, 1999).

In spite the fact that the research of mechanisms involving relationships between exchange rate misalignment and growth is not extensive, but has grown recently with two dominant explanations has been established. One of the main arguments in favor of growing interest, especially in emerging and developing countries, is that the persistent of exchange rate misalignment results in a severe reduction in welfare and efficiency cost hurts economic growth. Among others, Edwards (1988) and Toulaboe (2006) investigates the effect of RER misalignment (i.e. the relative price distortions in the tradable and non-tradable goods sectors) on growth, and discover that a non-optimum allocation of resources through different sectors of the economy leads to a negative impact on growth. In fact, Krugman (1979) and Kaminsky *et al.,* (1998) underlines that misalignment in terms of exchange rate overvaluation, is often the sign of the inconsistency of the decisions of macroeconomic policies, leads to an unsustainable current account deficit and increasing external debt. The empirical literatures have also provided evidence that the presence of protracted overvaluation of currencies is also viewed as a precursor to the most recent currency crisis such as the Asian crisis of 1997 (Frankel & Rose, 1996; Sachs *et al.,* 1996; Kaminsky & Reinhart, 1999; Edwards & Savastano, 1999; Chinn, 2000; Edwards, 2000; Stein & Lim, 2004; Ahmad *et al.,* 2010a). Similarly, the situations of prolonged overvalued RER are associated with poor economic performance (Dollar, 1992; Easterly, 1993, 2001; Clark et al 1994; Easterly *et al.,* 1997; Ong, 1997; Razin and Collins, 1997; Benaroya and Janci, 1999; Domac and Shabsigh, 1999; Acemoglu *et al.,* 2003; Hausman *et al.,* 2005; Gala, 2008). Most notably, a chronic misalignment or overvaluation in RER is the major source of low growth in Africa and Latin America (World Bank, 1984; Gulhati *et al.,* 1985; Cottani *et al.,* 1990; Ghura & Grennes, 1993; Elbadawi & Soto, 1997; Klau, 1998; Fosu, 2000, Fajnzylber *et al.,* 2005; Toulaboe, 2006).

Although the impact of overvaluation is more accentuate, one suggests that small to moderate undervaluation of a currency provides favorable atmosphere to spur output growth. That is, undervaluation is said to enhance international competitiveness while promote exports (Ahmad *et al.*, 2010b) and investment (Dooley *et al.*, 2005), leading to boost economic growth as the adoption of technologies, based on economies of scale (Razin & Collins, 1997; Dooley *et al.,* 2005). China and East Asian countries, for example, have experienced additional growth effect through the lower rate of exchange adjusted for productivity and inflation (Bhalla, 2007). Polterovich and Popov (2004), Rodrik (2008), Eichengreen (2008) and Macdonal and Vieira (2010) further corroborate the existence of a positive relationship between economic growth and undervalued currencies, which helps fostering long-run economic growth. In return, large undervaluation of a currency also suppresses economic performance through a higher inflation (Adams & Gros, 1986). It reduces consumption and investment (Kahn, 1994; Aguirre & Calderón, 2006). Meanwhile, further substantial exchange rate undervaluation through the policy of sterilization may also result in loss of country's accumulated reserves.

Given the fact that the evolution of the RER misalignment through time can result in misleading conclusions in affecting economic performance, exploring some ideas on the relationship between these two "hot issues" for Malaysia becomes necessarily important. Hence this study exclusively focuses on exchange rate misalignment as an indicator of Malaysian economic growth for the period 1991-2009 that span over three main economics events: (1) 1991 – 2009 the development years of the foreign exchange market and financial opening of the country; (2) 1997 – 1998 the financial crisis; (3) 2008 – 2009 the recent global economic crisis. According to the authors' best knowledge, this study is going to be the first authentic study in Malaysia in examining the linkages between real exchange rate misalignments and output growth. One of the benefits of undertaking single country study is the ability to incorporate the special character of particular country. Such study evades the assumption of similarities among countries in terms of social, geography, economic level and politically (Sun *et al.,* 2002). Malaysia provides an interesting country case study as the competitiveness of real exchange rate plays the key role in its development strategy through its heavily depends on external sector, which acts as its main engine of economic growth. In particular, Malaysia has switched from a flexible regime to a pegged regime under the risk management during the 1997 – 1998 Asian financial crises. Also, the restoration to operate in a managed float by scraping the ringgit's pegged to the U.S. dollar in mid-2005 is an effort to further stimulate its economic performance.

An interesting feature of the finding is that it corroborates the important role of RER misalignment in enhancing the output growth throughout the post-1990 era. The omission of such variables can lead to serious misspecification and instability of the economic development. The findings obtained from this study will bring a new dimension to the understanding of RER misalignment and economic growth. The rest of this paper is organized as follows:

a. Equilibrium Exchange Rate and Misalignment; briefly explains the measurement of Malaysian exchange rate misalignment through the NATREX equilibrium model.
b. Growth Model; describes the growth model used to estimate the effect of real exchange rate misalignment on economic growth.

c. Econometric Methodology and Data; outlines the econometric methodology and presents the data set.
d. Empirical Results; reports the empirical results and respective interpretations.
e. Robustness Check; ascertains the sensitivity of the findings.
f. Summary and Conclusion; concludes the findings and policy implications.

EQUILIBRIUM EXCHANGE RATE AND MISALIGNMENT

The measurement of the real exchange rate misalignment has long been argued as it engages with an unobserved variable. It is the equilibrium RER or modeling the determinants of the long-run equilibrium RER. Based on the economic literature, there are voluminous competing theories and concepts of equilibrium RER such as purchasing power parity (PPP), monetary model, black market premium (BMP), desirable equilibrium exchange rate (DEER), behavioral equilibrium exchange rate (BEER), natural equilibrium real exchange rate (NATREX) and fundamental equilibrium exchange rate (FEER) (see Williamson, 1994 and Hinkle & Montiel, 1999 for a survey).

In line with the development, this study follows the estimation in Ahmad *et al.,* (2010a). The estimation employs the NATREX model to estimate Malaysian real equilibrium exchange rate. The NATREX model developed by Stein (1994, 1996) is a moving equilibrium exchange rate, which varies over time in response to the changes in the prevailing current real macroeconomic fundamental variables. Edwards (2000) has noticed that the NATREX model is an appropriate measurement to acquire a good fit for exchange rate misalignment as it takes into account real economic activities comprise all adjustments made by the underlying real macroeconomic fundamentals of their respective economies[2]. The equilibrium RER is defined as the ratio of the foreign producer price index (PPI) to the domestic consumer price index (CPI) based (i.e. PPI-CPI based) which is a function of a set of macroeconomic fundamental variables, namely government expenditure (GOVTEXP), interest rate differential (RIRD), terms of trade (TOT) and productivity (PROD) (see for example Rajan *et al.,* 2004)[3]. The NATREX equilibrium model is derived via vector error correction technique (VECM) and can be expressed as an Equation (1)[4]:

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[2]For detailed discussion on the NATREX equilibrium model, please consult Stein (1994 and 1996), Stein and Paladino (1998) and Stein and Lin (2002).

[3]The choice of the PPI has been widely applied in analyses of developing countries due to the influenced by it being weighted with traded goods, signifying a greater proportion of traded goods (Dornbusch, 1984; Edwards, 1989). In addition, the wide used of CPI in most of previous studies is justified by the matter of expediency and the data unavailability.

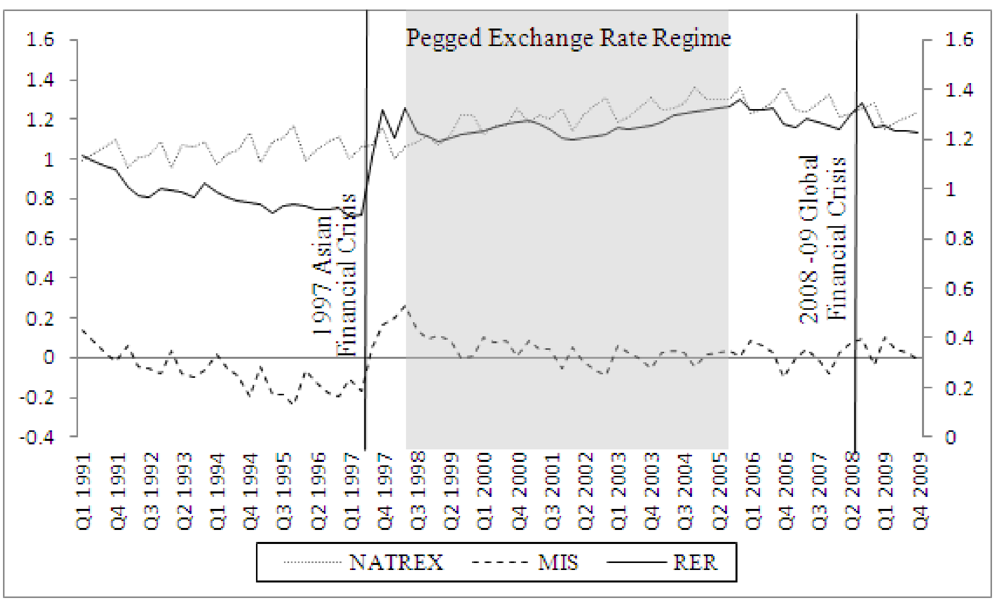
[4]For the theoretically predicted signs of independent variables, among other, see Elbadawi and Soto (1994), Baffes *et al*. (1999), Clark and MacDonald (1998), Edwards and Savastano (1999) and Edwards (2000).

$$RER = 0.367GOVTEXP - 0.038RIRD + 0.878\,TOT + 0.307PROD - 4.398 \quad (1)$$

From the above equation, the rate of misalignment can be calculated through the difference between the actual (RER) and the natural real equilibrium exchange rate (NATREX), implying the deviation of a currency from its equilibrium path. The series of misalignment rate (MIS) is demonstrated in Fig.1. The RER is said to be misaligned in terms of overvaluation when NATREX is higher than RER, (RER < NATREX) and vice versa.

GROWTH MODEL

The econometric framework adopted in this study relies on the standard growth equation augmented by including the term 'misalignment effect' to the right-hand side variables that are usually considered in growth equations. The specification of the output growth equation is consistent with the nature of the Malaysian economy. The equation has been commonly used in the literature on the determination of growth model (see for example Kormendi & Meguire, 1985; Barro, 1991; Levine & Renelt, 1992; Mankiw *et al.,* 1992). Based on the neoclassical model of Solow (1956), the rate of economic growth is



Notes: RER is the Malaysian real exchange rate, ringgit against the US dollar. An increase in RER implies a real depreciation of exchange rate. NATREX is the Malaysian natural real equilibrium exchange rate. MIS is the Malaysian Real Exchange Rate Misalignment. The level of misalignment = [(RER – NATREX)/ NATREX] * 100, where a negative (positive) number implies an overvaluation (undervaluation).

Fig.1: The Malaysian Real Exchange Rate Misalignment

the function of capital stock and rate of population. It is also widely hypothesized to measure human capital as the key factor of growth (Barro, 1991) and Easterly (2001). Following the developments of the endogenous growth theory, a number of determinants are included to reflect the macroeconomic stabilization policies (inf) and the institutions development (FD). In addition, the currency misalignment is integrated in order to measure the impact of RER misalignment (mis) on economic growth. Among those that measure the impact of exchange rate misalignment to long-run growth model are Fajnzylber *et al.,* (2005), Aguirre and Calderón (2006) and Zakaria (2010). To be more specific , the following form of dynamic growth model summarizes the basic thrust of the output growth model:

$$GROWTH_t = f(KS_t, HC_t, POP_t, FD_t, inf_t, mis_t) \quad (2)$$

$$GROWTH_t = \gamma_0 + \gamma_1 KS_t + \gamma_2 HC_t + \gamma_3 POP_t + \gamma_4 FD_t + \gamma_5 inf_t + \gamma_6 mis + u_t \quad (3)$$

where, $GROWTH_t$ is the growth rate in real GDP per capita, KS_t is the capital stock per worker (calculated as a ratio of total capital stock to labor force), HC_t is the life expectancy (as a proxy for human capital), POP_t is the level of population, FD_t is the financial depth (defined as the ratio of broad money supply (M2) to GDP), inf_t is the rate of inflation (as a proxy of lack of price stability), mis_t is the degree of exchange rate misalignment, u_t is the disturbance term and t refers to time period. The uppercase letters designate that the underlying variables are in natural log form.

The sensitivity of the variables in the output growth model is measured through their parameters. Usually, the output growth equation will have γ_1 (capital stock elasticity of output growth) > 0, γ_2 (human capital elasticity of output growth) > 0, γ_3 (population elasticity of output growth) < 0, γ_4 (financial depth elasticity of output growth) > 0. γ_5 (rate of inflation semi-elasticity of output growth) < 0. As mentioned earlier, γ_6 can either be positive or negative depending on the significance of over or under-valuation of a currency. Thus, γ_6 (misalignment in terms of undervaluation semi-elasticity of output growth) > 0.

The capital stock is constructed through the perpetual inventory method (PIM). It estimates capital stock from time series of gross fixed capital formation. Basically, it allows the estimation on how many of the fixed assets installed as a result of gross fixed capital formation carried out in previous years have continued to the current periods. It can be defined as follows:

$$K_t = (1-\delta)K_{t-1} + I_t \quad (4)$$

where K denotes the capital stock, δ is the rate of physical depreciation and I is investment described as the gross fixed capital formation. The initial capital stock is computed based on the assumption that both capital and output grow at the same level. Explicitly, the initial capital stock for data commencing in 1991, for example can be derived as $K_{1990} = I_{1991}/(g+\delta)$, where g is the 3 year growth rate of output (e.g. 1991, 1992 and 1993) and $\delta(0.06)$ is the assumed rate of depreciation (See Hall & Jones, 1999; Bernanke & Gurkaynak, 2001). However, due to the unavailability of quarterly base data, these variables (capital stock, life expectancy and level of population) have been interpolated from yearly to quarterly base using Gandolfo (1981) to facilitate the utility of the system.

ECONOMETRIC METHODOLOGY AND DATA

In this study, the autoregressive distributed lag (ARDL) bound test proposed by Pesaran *et al.,* (2001) is utilized to estimate the growth model. It is well-known that one of the major advantages of ARDL bounds test is that it is applicable regardless of the stationary properties. It is irrespective of whether the regressor in the output growth equation is purely $I(0)$ or $I(1)$, or mutually cointegrated. This proposes a useful approach that bypasses the need for pre-testing the integration order of variables. The potential biased associated in the unit root test can be avoided. Besides, the issue of endogeneity is less of a problem. The ARDL model takes sufficient number of lags to capture the data generating process in general to specific modeling framework (Laurenceson & Chai 2003). According to the bounds test procedure, it is essential to model equation (3) as a conditional ARDL as follows:

$$\begin{aligned}&\Delta GROWTH_t \\ &= \theta_0 + \delta_1 GROWTH_{t-1} + \delta_2 KS_{t-1} \\ &\quad + \delta_3 HC_{t-1} + \delta_4 POP_{t-1} + \delta_5 FD_{t-1} \\ &\quad + \delta_6 Inf_{t-1} + \delta_7 mis_{t-1} \\ &\quad + \sum_{i=1}^{n} \lambda_1 \Delta GROWTH_{t-i} + \sum_{i=0}^{n} \lambda_2 \Delta KS_{t-i} \\ &\quad + \sum_{i=0}^{n} \lambda_3 \Delta HC_{t-i} + \sum_{i=0}^{n} \lambda_4 \Delta POP_{t-i} \\ &\quad + \sum_{i=0}^{n} \lambda_5 \Delta FD_{t-i} + \sum_{i=0}^{n} \lambda_6 \Delta \inf_{t-i} \\ &\quad + \sum_{i=0}^{v} \gamma_7 mis_{t-i} + u_t \qquad (5)\end{aligned}$$

where Δ is first difference operator and u_t is a white-noise disturbance error term. The long-run relationship between the concerned variables can be conducted based on the Wald test (F-statistic) by imposing restrictions on the estimated long-run coefficients of one period lagged level of the variables equal to zero, $Ho: \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = 0$. Then, the computed F-statistic is compared to the critical value tabulated in Pesaran *et al.,* (2001) and Narayan (2005). The lower bound values assume that all explanatory variables are integrated of order zero, or $I(0)$, while, the upper bound values assume that all explanatory variables are integrated of order one, or $I(1)$. Therefore, if computed F-statistic falls below the lower bound value, $I(0)$, the null hypothesis of no cointegration cannot be rejected. Conversely, if the computed F-statistic exceeds the upper bound value, $I(1)$ then, it is concluded that growth and its determinants are moving together to a long-run equilibrium. A conclusive inference cannot be reached if the computed F-statistic falls within the bound values.

Once a cointegration relationship has been ascertained, the long-run and short-run parameters of the cointegration equation are then estimated. The long-run cointegration relationship is estimated using the following specification:

$$GROWTH_t = \gamma_0 + \sum_{i=1}^{p}\gamma_1 GROWTH_{t-i} + \sum_{i=0}^{q}\gamma_2 KS_{t-i} + \sum_{i=0}^{r}\gamma_3 HC_{t-i} + \sum_{i=0}^{s}\gamma_4 POP_{t-i} + \sum_{i=0}^{t}\gamma_5 FD_{t-i} + \sum_{i=0}^{u}\gamma_6 \inf_{t-i} + \sum_{i=0}^{v}\gamma_7 mis_{t-i} + u_t \quad (6)$$

However, the speed of adjustment back to equilibrium might not able to adjust immediately. Thus, the output for growth is most likely to be varied from its actual level of growth. It may have been caused by the adjustment process and lags in perceiving changes in any of the growths' determinants. Hence, the speed of adjustment of the growth model can be captured through the estimation of the error correction model as expressed below:

$$\Delta GROWTH_t = \beta_0 + \sum_{i=1}^{p}\beta_1 \Delta GROWTH_{t-i} + \sum_{i=0}^{q}\beta_2 \Delta KS_{t-i} + \sum_{i=0}^{r}\beta_3 \Delta HC_{t-i} + \sum_{i=0}^{s}\beta_4 \Delta POP_{t-i} + \sum_{i=0}^{t}\beta_5 \Delta FD_{t-i} + \sum_{i=0}^{u}\beta_6 \Delta \inf_{t-i} + \sum_{i=0}^{v}\beta_7 \Delta mis_{t-i} + \beta_8\ \varepsilon_{t-1} + u_t \quad (7)$$

where, ε_{t-1} is the error correction term of one period lagged estimated from the equation (7), while the coefficient (β_8) measures the speed of adjustment of the model's convergence to equilibrium.

The analysis of this study uses quarterly data that covers for the period 1991:1 to 2009:4 with 76 observations. The quarterly frequency data are utilized as monthly data would precludes the use of macroeconomic data such as output growth and monetary. All of these data are primarily gathered from the International Financial Statistics published by the International Monetary Fund, excluding the human capital and capital stock per worker, where are sourced from the World Development Indicator, published by the World Bank.

EMPIRICAL RESULTS

The estimated ARDL bounds test for the presence of a long-run output growth equation is provided in Table 1. The outcome of the bounds test critically depends on the comparisons of computed *F*-statistics against the critical values extracted from Pesaran *et al.,* (2001), as well as, the critical values that account for small sample sizes provided by Narayan (2005). The result shows that the computed *F*-statistics, F_{GROWTH}(GROWTH|KS,HC,POP,FD,inf,mis) = 7.605, is higher than that the upper bound critical value of 4.96 at the 1% significant level. This implies that the null hypothesis (Ho: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = 0$) of no long-run coefficient cannot be accepted. There is compelling evidence for cointegration between growth and its determinants. Notice that when the rest of the variables [KS,HC,POP,FD,inf,mis] in the model are repetitively taken as a dependent variable, the calculated *F*-statistics are less than the lower bound critical value at the 1% level.

Thus, the null hypothesis of no cointegration cannot be rejected. Conclusively, a unique cointegration relationship exists among the variables in Malaysian output growth model for the observed period, specifically when economic growth is the dependent variable.

Next, following the order of ARDL (2,2,2,0,0,0) specification as selected through the AIC, the long run parameter estimates of the output growth model are obtained. The results in Table 2 exhibit that the coefficients of the key regressors considered in the equation have a significant and theoretically consistent coefficient estimates at least at 5% significance levels. An appealing part of the results is that the RER misalignment exerts a positive sign and is statistically significant at 1% level. Economically, an increase by one basis point in actual RER misalignment leads the growth rate to increase by 0.07 basis points per quarter. This result implies that the growth rate in Malaysia is enhanced by the RER misalignment (Polterovich & Popov, 2004; Rodrik, 2008; Eichengreen, 2008; Zakaria, 2010; Macdonal & Vieira, 2010). The outcome is in accordance with the theory, which stipulates that currency in relative below of its equilibrium level encourages international competitiveness, embodies better exports performance and output growth (see for example, Razin & Collins, 1997; Dooley *et al.,* 2005; Bhalla, 2007). Therefore, the results confirm the critical nature of RER behavior in determining economic growth.

In Malaysia, a more difficult and sometimes controversial question is the implementation of different exchange rate regimes in moving its economic performance. Although Malaysia has practiced the managed float and pegged regimes, it is evident that RER misalignment appears to be the major concern in the process of economic development. It is the result of relying heavily on the external

TABLE 1
ARDL Bound Test

				Critical Bound (*F*-test)			
				Pesaran *et al.* (2001)		Narayan (2005)	
Model	*F*-test	Lag	Critical Value	*I(0)*	*I(1)*	*I(0)*	*I(1)*
F_{GROWTH}(GROWTH|KS,HC,POP,FD,inf,mis)	7.605♣	3	99%	3.15	4.43	3.49	4.96
F_{KS}(KS|GROWTH,HC,POP,FD,inf,mis)	1.586♠	3	95%	2.45	3.61	2.64	3.90
F_{HC}(HC |GROWTH,KS,POP,FD,inf,mis)	2.109♠	5	90%	2.12	3.23	2.24	3.39
F_{POP}(POP|GROWTH,KS,HC,FD,inf,mis)	2.062♠	4					
F_{FD}(FD|GROWTH,KS,HC,POP,inf,mis)	1.814♠	4					
F_{inf} (inf|GROWTH,KS,HC,POP,FD,mis)	2.039♠	3					
F_{mis}(mis|GROWTH,KS,HC,POP,FD,inf)	1.384♠	5					

Notes: Critical values are extracted based on Pesaran *et al.,* (2001) and Narayan (2005), Table (C1.iii), Case III: unrestricted intercept and no trend. The structural lags are determined by using minimum Akaike's Information Criteria (AIC). The superscript ♣ point out that the statistic lies above the upper bound, while superscript ♠ designates that it falls below the lower bound.

sector to further spur the output growth. The finding is also consistent with the view that both exchange rate arrangements, in fixed and floating initiate RER misalignment. The degree of fixity in the exchange rates, the rigidness of prices and the absence of institutional seem to be the key of failure that drawn the RER into a vicious circle of misalignment (Goldstein, 1995, Leape *et al.,* 1997, Razin & Collins, 1997; Edwards & Savastano, 1999). Sekkat and Varoudakis (2000) and Bouoiyour and Rey (2005), for instance, demonstrate that the mismanagement of economic strategies, inconsistency between the monetary policy and fiscal discipline along with exchange rate arrangement may lead developing countries to experience great influence from the presence of RER misalignment on economic performance. This finding further supports the study's contention that RER misalignment cannot be ignored in the analysis of economic development in the output growth model, especially in emerging economies, like Malaysia.

It is also reassuring that capital stock per worker, human capital and financial development have a positive and significant impact on growth. In other words, this finding validates that growth is enhanced by the high capital stock per worker, increased investment in human capital and aggressive financial development. Other control variables show that the inflation rate is significantly negative. As part of a broad macroeconomic stabilization policy, price instability is an important condition to adversely affect growth. Finally, as an agreement with the Solow growth model, the population coefficient appear to be negative and statistically significant.

TABLE 2
ARDL Long-run Estimates

Dependent Variable: GROWTH Regressors	coefficient	*t*-statistics
KS	0.039	2.046♠
HC	0.034	3.102♠
POP	-0.171	-9.103♣
FD	0.065	2.360♠
inf	-0.096	-4.194♣
mis	0.073	3.322♣
Constant	-0.585	-2.338♠

Diagnostic test	*AR(2)*	*ARCH(3)*	*JB(2)*	*RESET(2)*
χ^2	0.397	0.109	0.321	0.335
p-value	0.802	0.741	0.851	0.563

Notes: The superscript ♣ denotes statistical significance at the 1% level and ♠ indicates statistical significance at the 5% level. The diagnostic test statistics are: AR(*i*) = LM-type Breusch-Godfrey Serial Correlation LM; ARCH(*i*) = Engle's *i*th order autoregressive conditional heteroskedasticity test; JB[2] = Jarque-Bera test for normality of residual; RESET = Ramsey's test for functional form misspecification.

In addition, the adequacy of the model specification is measured through a number of diagnostic tests. As reported in Table 2, the computed Breusch-Godfrey serial correlation LM test is statistically insignificant at usual significance levels. It suggests that the disturbances are serially non-autocorrelation. On the other hand, the heteroskedasticity test signifies that the residual has a constant variance. The model also passes the Jarque–Bera test for normality and the Ramsey's RESET statistics. This means that the estimated growth models are well specified, which fulfill the conditions of normality of residual and zero mean of disturbance with no serious omission of variables. Hence, the estimated output growth model is sufficient and it can be used to construct the subsequent explanation on the behavior of Malaysian economics development.

Once a stable long-run output growth equation is ascertained, the estimation of short-run dynamics model is carried out through the re-parameterization of the estimated ARDL (2,2,2,0,0,0) model. Based on the results in Table 3, the estimated error-correction term, ECT_{t-1} for the output growth model has its expected negative sign and is highly significant. This ensures that the series is non-explosive and the long-run equilibrium is attainable. According to Kremers *et al.,* (1992), a significant error-correction term is comparatively more efficient to establish cointegration. The ECM coefficient of -0.14 depicts that the speed of adjustment of the output growth in perceiving changes in its determinants is fairly slow before converging to its equilibrium level. This implies that approximately 14 percent of the discrepancy of the previous period's shock adjusts back to the long-run equilibrium in the current quarter.

A significant error-correction term embodies causality from capital stock, human capital, population, financial depth, inflation and RER misalignment to growth. The causality relationship can be captured by the lagged differences and conventional tests of causality through the significance of these terms. The error-correction terms characterize the possibility of deviation evolving

TABLE 3
ARDL Model ECM Results

Estimated coefficients (*t*-statistics)

$$\underset{}{\Delta GROWTH_t} = \underset{(8.865)^{♣}}{0.745\Delta GROWTH_{t-1}} - \underset{(-2.369)^{♠}}{0.041\Delta HC_t} + \underset{(4.861)^{♣}}{0.058\Delta HC_{t-1}} - \underset{(-0.949)}{0.177\Delta HC_t} + \underset{(1.817)^{♦}}{0.183\Delta HC_{t-1}}$$

$$- \underset{(-2.064)^{♠}}{0.026\Delta POP_t} - \underset{(-0.978)}{0.016\Delta POP_{t-1}} + \underset{(1.882)^{♦}}{0.015\Delta FD_t} - \underset{(-2.989)}{0.032\Delta inf_t} + \underset{(2.222)^{♠}}{0.023\Delta mis_t} - \underset{(-2.831)^{♣}}{2.015}$$

$$- \underset{(-2.969)^{♣}}{0.141 ecm_{t-1}}$$

$\bar{R}^2$ = 0.78

Notes: Δ indicates the first difference and ECM_{t-1} is the error correction term. The superscripts ♣, ♠ and ♦denote statistical significance at the 1%, 5%, and 10% levels, respectively.

from the long-run equilibrium. The size and the significance of the error correction term reflect the propensity of each explanatory variable to fit in the equilibrium of the output growth model. The sign of the individual coefficient of RER misalignment (mis_t) appears to be positive and statistically significant at conventional significance levels for the current lag, as displayed in Table 3. The impact of RER misalignment on growth is relatively small, which a 1 per cent increase in RER misalignment leads to induce a 0.02 per cent increase in output growth. The positive sign means that hasten in RER misalignment tends to surge the real balance held in growth.

In order to assess the stability of the long-run relationship between growth and its determinants, the cumulative sum (CUSUM) and the cumulative sum of square (CUSUMSQ) test advocated by Brown *et al.,* (1975) are performed. Fig.2 and Fig.3 illustrate that the plots of CUSUM and CUSUMSQ statistics are well within the critical bounds. That indicates the estimated regressions are stable at 5% significance level. The result justifies that

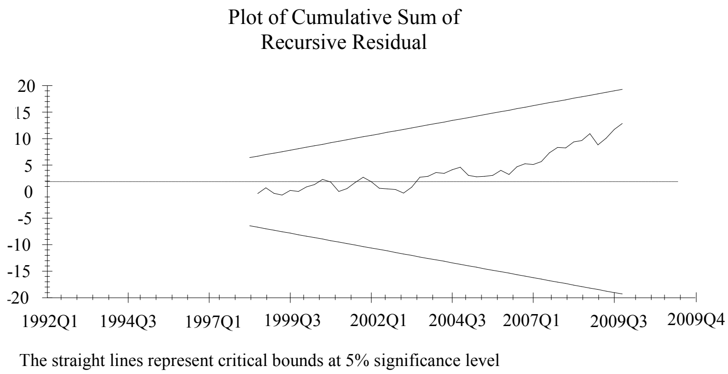


Fig.2: Plot of CUSUM

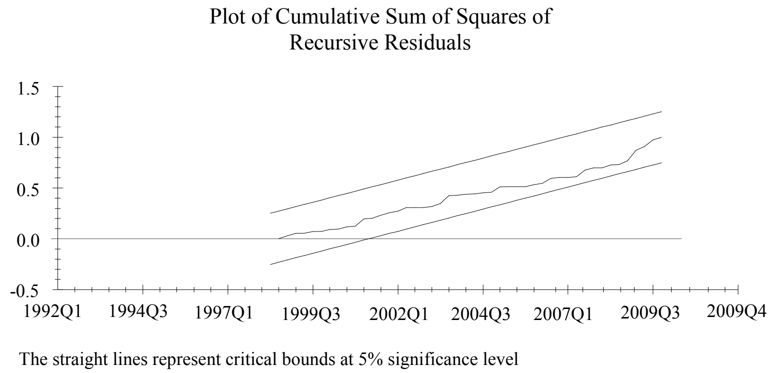


Fig.3: Plot of CUSUM-squared

the presence of RER misalignment turns out to be important in the output growth model, where its exclusion may lead to the function exhibiting some instability. The goodness of fit of the estimated models to the data is also found to be satisfactory, as indicated by the high values of adjusted R-squared ($\bar{R}^2 = 0.78$). This finding is comforting as it implies that over the periods under consideration, a stable long-term relationship exists between growth, capital stock, human capital, population, financial depth, inflation and RER misalignment.

ROBUSTNESS CHECK

The sensitivity of the results is ascertained through a number of robustness checks to alternative measure of human capital and growth. The first set of robustness check explores the application of different variables of human capital, such as secondary school enrollment (EDUC). The results obtained in Panel A, Table 4, remain similar to the main results as reported in Table 2. Specifically, the coefficient of EDUC is close to the one described in the main result. In fact, all

TABLE 4
Robustness Check

Dependent Variable: GROWTH	**Panel A: HC = EDUC**		**Panel B: GROWTH = Y**	
	coefficient	*t*-statistics	coefficient	*t*-statistics
KS	0.043	2.608♠	0.054	2.678♠
HC	0.029	2.059♠	0.023	2.222♠
POP	-0.287	-3.758♣	-0.361	4.314♣
FD	0.057	2.174♠	0.052	4.861♣
inf	-0.061	-3.129♣	-0.063	-4.092♣
mis	0.084	2.497♠	0.076	2.099♠
Constant	-0.438	-5.465♣	-0.616	4.202♣
Bound Tests (*F*-stat)	5.945		7.041	
Diagnostic test (*p*-value)				
AR(2)	0.434 (0.514)		0.419 (0.811)	
ARCH(3)	0.178 (0.673)		0.137 (0.713)	
JB(2)	0.221 (0.641)		0.106 (0.745)	
RESET(2)	0.389 (0.533)		0.335 (0.563)	

Notes: EDUC is secondary school enrolment that extracted from Department of Statistics, Malaysia while Y is the real GDP, which gathered from IMF, International Financial Statistics (IFS). The superscript ♣ denotes statistical significance at the 1% level and ♠ indicates statistical significance at the 5% level. Critical values for the ARDL bounds test are extracted based on Pesaran *et al.,* (2001) and Narayan (2005), Table (C1. iii), Case III: unrestricted intercept and no trend. Pesaran *et al.* (2001) (Narayan, 2005) Critical Bound's value at the 1% level – Lower: 3.15 (3.49) and Upper: 4.43 (4.96), at the 5% level – Lower: 2.45 (2.65) and Upper: 3.61 (3.90) and at the 10% level – Lower: 2.12 (3.23) and Upper: 2.24 (3.39). The structural lags are determined by using minimum Akaike's Information Criteria (AIC). The diagnostic test statistics are: AR(*i*) = LM-type Breusch-Godfrey Serial Correlation LM; ARCH(*i*) = Engle's *i*th order autoregressive conditional heteroskedasticity test; JB[2] = Jarque-Bera test for normality of residual; RESET = Ramsey's test for functional form misspecification.

coefficients still have the expected sign and more or less possess the same magnitude in respect to the results of Table 2. The second set of robustness checks involves different variable of GROWTH. It utilizes the real GDP (Y) as demonstrated in Panel B, Table 4. Again, the empirical results appear to hold intact to those displayed in Table 2. They validate the determinants of growth model. This finding concludes that the nature of the results are robust to the alternative measure of human capital and growth.

SUMMARY AND CONCLUSION

Based on the economic theory of economic growth, this paper pays a special attention to the influence of RER misalignment on economic growth in Malaysia. By using the RER misalignment constructed by Ahmad *et al.,* (2010a), the empirical estimation of the ARDL bound testing technique to cointegration signifies the presence of a positive and significant relationship between RER misalignment and economic growth. This reflects that the RER misalignment in Malaysia with different exchange rate regimes, Managed float-to-Pegged regimes, is at a moderate level to enhance its economic growth. It leads Malaysia to reap growth benefits by maintaining the RER at its appropriate value. This manifests that the selection of exchange rate arrangement seems to be timely. Meaning that, the Malaysian RER departs from its equilibrium path at the competitive level, where Malaysia remains competent to further generate economic development.

The finding confirms the hypothesis that the correction of RER misalignment and the RER stability are crucial for economic growth in developing countries. It is also important to maintain their continuous improvement in international competitiveness while retaining its balance of payment at a sustainable level. This suggest, the avoidance of a variable that represents the influence of exchange rate risks, such as RER misalignment, can lead to biased results. Therefore, the espousal of policies should encompass optimal measurement in reducing the exchange rate fluctuations and restoring the equilibrium of exchange rate aimed at stabilizing the domestic economy. Hence, acknowledgement of the RER misalignment is pivotal not only for the design of exchange rate policy but also vital in modeling any trade agenda, forecasting and economic development strategy. Maintaining a flexible exchange rate and monetary independence is increasingly important for Malaysia, especially towards more open and greater integration with the rest of the world. As a result, a plausible assessment of RER misalignment effect on economic growth is essential, particularly in an emerging market with the recent dynamic, competitive and globalized international.

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