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An ARDL Analysis Of The Exchange Rates Principal Determinants: ASEAN-5 Aligned with The Yen

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Abstract

This study examines an empirical analysis of long-run and short-run forcing variables of purchasing power parity (PPP) for ASEAN-5 currencies: Malaysian Ringgit, Indonesian Rupiah, the Philippines Peso, Thailand Bath, and Singapore Dollar, against the Japanese Yen, i.e., their real exchange rate (RER). This study uses a recently developed autoregressive distributed lag (ARDL) approach *to co-integration (Pesaran et al., 2001) over the period 1991:Q1 – 2006:Q2. Our empirical results point out that the* domestic money supply (M1) is the significant long run forcing variable of PPP for ASEAN-5 RER's for the study periods. However, in the short- run the impact of variables have different impact during the sub-periods and full period for ASEAN-5 countries, the results suggest that the domestic money supply (M1) for Malaysia, Indonesia, Philippines ,and Singapore respectively, , have the highest significant short run forcing variable of PPP for countries RER's. However, foreign interest rates followed by domestic money supply are the short-run forcing variables for Thailand's RER. This may be due to the peculiarity of Thailand government's management of the Asian Financial Crisis (AFC).

Introduction

Since the inception of flexible exchange rates in 1973, after the collapse of the Bretton Wood system, we have witnessed a few severe volatilities in various currencies' exchange rates, such as Russian Rubles, Mexican Pesos as well as ASEAN[1] currencies during the financial crisis in 1997, to name a few.

The 1997 Asian Financial Crisis (AFC) plunged some of the most successful economies in the world particularly ASEAN-5 countries namely: Malaysia, Indonesia, Philippines, Thailand, and Singapore into financial chaos. This crisis caused collapse in these economies, i.e. the impact of the financial crisis was very severe not only on the financial sectors but also on the real sectors in these countries. Thus, the 1997 financial crisis was a critical point in the Asian economic history. It was empirically and theoretically argued that the AFC caused the ASEAN-5 economies to become more sensitive to changes and fluctuations in the world economy- particularly the economy of Japan. Therefore, the issue of the degree of sensitivity of ASEAN-5 to Japan economy would be measured in this study.

The objective of this study is: to identify the fundamental determinants of the long-run and short-run forcing variables of PPP on ASEAN-5 RER over the study period and sub-periods. The Autoregressive Distributed Lag (ARDL) approach is employed here because it has several advantages such as: avoiding the classification of variable into I (0) or I (1), free from problems of endogeneity and yielding consistent estimates of the long-run coefficients. In this study also, the emphasis will be on the behavior of the (RER)[2]. The RER indicates how the weighted average purchasing power of a currency has changed relative to some arbitrarily selected base period.

[1] ASEAN-5 consists of Malaysia, Indonesia, the Philippines, Thailand and Singapore. They are the initial members of the economic group when it was first established in 1967.

[2] The term real exchange rate (RER) is defined as the real price in the domestic currency of one real unit of another (foreign) currency. Hence, the nominal exchange rate is part of the RER.

The findings of this study will be useful for the ASEAN-5 policy makers. In the light of the serious implication of the changes and fluctuations of exchange rates in ASEAN-5 economies, it is critically important to conduct a study on the PPP of real exchange rate (RER) determinants that have important impact upon the ASEAN-5 economic growth.

Overview of Purchasing Power Parity (PPP)

The PPP theory was originally developed by a Swedish economist Cassel (1919), stating that the exchange rate of currencies between two countries would move proportionally to the ratio of the price level in the currencies concerned. According to MacDonald and Ricci (2001), Sarno and Taylor (2002), Cheung *et.al.* (2004), and Che and Mansure (2006) point that there are an array of approaches and related methodological frameworks available in the PPP literature, However, there are at least four (4) major competing PPP models that demand special attention (Cheung et al., 2004; Che and Marouane 2006 and Che and Mansure, 2006). They are: Absolute PPP and Relative PPP, Monetary Model of PPP, Portfolio Balance of PPP, and Uncovered Interest Parity (UIP) of PPP.

Absolute PPP and Relative PPP

In literature, there are two versions of PPP theory namely absolute PPP and relative PPP. While absolute PPP refers to the equity of price levels across countries, relative PPP refers to the equity of the rates of change in these price levels. The Law of Comparative Advantage (LCA) theorem of equilibrium exchange rate or the Law of One Price (LOP) of the capitalist system suggests that same basket of goods and services must sell the same price in different capitalist countries Cassel (1919) and Sarno and Taylor (2002). This measure the price of the basket of goods and service is essentially known as absolute PPP and has been repeatedly expressed[3] in the financial and economic literature as::

$$S_t = \mathrm{P}_t - \mathrm{P}_t^* \quad (1)$$

Where, S_t is the spot RER expressed as the domestic price of the foreign currency, p_t is the domestic price level, while p_t^* is foreign price level and t denotes the time period. MacDonald (2001) and Sarno and Taylor (2002) asserted that Equation 1, which represented the absolute PPP theoretical framework, should be specified as a testable regression equation expressed as:

$$s_t = \beta_0 + \beta_t(p_t - p_t^*) + \varepsilon \quad (2)$$

Where β is constant variable and ε is noise error term.

Sarno and Taylor (2002) and Che and Mansure (2006) had transformed equation (2) as:

$$s_t = \beta_0 + \beta_1 v_t - \beta_2 p_t + \beta_3 p_t^* + \varepsilon \, (3)$$

Where υ_t is the *ex- post* nominal exchange rate at time *t.* They argued that if υt pt and p*t are nonstationary integrated process of I(1), the weak form (or random walk) PPP prevail, implying that the residual term: ε is I(0). Adding symmetry, strong and absolute version of PPP prevails, if β2 = 1 and β3 = -1 where "homogeneity" condition exist, theoretically.

Similar to absolute PPP, relative PPP looks at the relationship between exchange rates and prices in terms of growth rates. Relative PPP may still hold i.e. even if the exchange rate is not equal to the exact ratio of the price indices, it may at least be comparable to it. The Dornbusch (1976) and Frenkel (1976) who pioneered the relative PPP suggested that the actual price levels must be considered under the new relative PPP theoretical framework instead of the price. The essence of their suggestions is that some of the actual domestic prices, i.e., commodity goods and services do not necessarily change in accordance to foreign prices. In simple, economics terms, the relative PPP points out that the changes in the foreign exchange rates must equal to the changes in relative domestic prices and Che and Abul Mansuree (2006). These changes may be due not only to exchange rate but also money supply (m), real gross domestic

[3] Goh Soo and Dawood (2000), Caporalea, et al., (2001), Sarno and Taylor (2002), Venus, et al., (2004), Che and Marouane (2006) and Che and Mansure (2006).

products (RGDP), the level of interest rate (i), and inflation rate (π), respectively (Sarno and Taylor, 2002; Brissmis, et. al., 2005, and Baharumshah and Darja (2008).

Monetary Models

Monetary models are considered standard exchange rate determination models. They are based on the view that the exchange rate is the relative price of foreign and domestic money so it should be determined by the relative supply and demand for these moneys. Money market equilibrium condition resides on purchasing power parity, which explains the monetary models with the assumption of flexible prices.

Within the monetary models, there the sticky-price monetary model with sluggish adjustment of prices in the goods markets. As deviations strictly from PPP appeared in the short run, one of the major pillars of the flexible-price monetary model would be called into question. In response, Dornbusch (1976) constructed a sticky-price monetary model that allowed for short run PPP deviations, thus, the underpinning of Dornbusch-Frenkel Sticky Price Monetary Model (DFSP) model:

$$\alpha_1 > 0,\ \alpha_2 < 0,\ \alpha_3 < 0,\ \alpha_4 > 0,\ \alpha_5 = \alpha_6 = 0$$

The sticky price monetary model assumes that the PPP hold in the long run[4] but not in the short run due to the price stickiness. The DFSP is generally re-expressed[5] as:

$$s_t = \alpha_0 + \alpha_1 m_t + \alpha_2 G_t + \alpha_3 i + \alpha_4 \pi_i + ... + \varepsilon \qquad (4)$$

The monetary models of exchange rate determination are concentrated in terms of expected future value and the current exogenous variables. Taylor (1995) stated that exchange rate was a function of expectation of discounted future value of exogenous variables. There are different processes involved for exogenous variables to follow different paths of exchange rates. According to Baillie and MacMahon (1990), Taylor (1995), and Che and Mansure (2006), equation 4 can be reformulated for this study as follows:

$$S_t = \alpha_0 + \alpha_1 R + \alpha_2 R^* + \alpha_3 M + \alpha_5 G$$

$$+\alpha_5 \pi + \alpha_6 NFA + \alpha_7 TOT + U_t \quad (5)$$

Where S_t is real exchange rate in the ASEAN-5 countries against Japan, R is the domestic interest rate in the ASEAN-5 countries, R^* is the foreign interest rate, M1 is money supply in the ASEAN-5 countries, π is the inflation rate, NFA is the net foreign asset in the ASEAN-5 countries, G is the real gross domestic product in the ASEAN-5 countries, and TOT is the term of trade in the ASEAN-5 countries.

Portfolio Balance Model

Portfolio balance model is one of the major models based on PPP. According to the portfolio balance model, exchange rates are determined by the demand and supply of all domestic and foreign assets not just by the supply and demand of money as in the monetary model. The portfolio balance model is therefore a dynamic model of exchange rate determination based on the interaction of goods and service markets, current account balance, prices and the rate of asset accumulation.

The composite IS-LM model of Edwards (1989) had empirically observed that the key factors that could significantly influence the exchange rate of a country's currency were related to the country's stage of development and the state of openness of the economy. Earlier researchers, such as Clerk and MacDonald (1999), Stein (1999), Obstfeld and Rogoff (1995), Cavallo and Ghironi (2002) and Che and Mansure (2006), had attempted to integrate the earlier models together. These researchers further integrated the various theoretical effects upon PPP based on the Portfolio Balance Model and had also included the effects via interest rate, money supply (M), inflation rates and the portfolio balance effects via economic growth rates, terms of trade (tot) and net foreign assets (nfa), which had measured the openness of the economy. According to Che and Mansure (2006), the Portfolio Balance equation for this study could be reformulated as:

[4] MacDonald and Taylor (1994),Chinn and Meese (1995), Kanas (1997), Husted and Kelbergen (1998), Dutt and Gosh (1999), Francis et al. (2001), Rapach and Wohar (2002), Groen and Kelbergen (2003), and Lee et. al. (2007)

[5] Baillie and MacMahon (1990), Taylor (1995), and Che and Mansuree (2006)

$$S_t = \alpha_0 + \alpha_1 R + \alpha_2 R^* + \alpha_3 M + \alpha_4 G + \alpha_5 \pi + \alpha_6 NFA + \alpha_7 TOT + U_t \quad (6)$$

Uncovered Interest Parity Model

The Uncovered Interest Parity (UIP) model theory states that differences between interest rates across countries are explained by the expected change in currencies. In more recent empirical literature on exchange rates, a lot of effort has been devoted to testing international parity conditions, such as PPP and UIP, which have played an essential role in asset market models of the exchange rate MacDonald and Taylor (1990), Chaboud and Wright (2005). Such conditions are normally thought of as arbitrage relationships, which are held continuously especially in the case of UIP. UIP equation is written as:

$$S_{t+k} = S_t + i_{t,k} \quad (7)$$

Where S is the log exchange rate, *i* is the interest rate of maturity *k* and *t* is time to maturity. According to Bjorland and Hungnes (2002), and Che and Mansure (2006):

$$s_{t+1} - s_t = i_t - i^*_t$$
$$\therefore \Delta s^e_{t+1} = i_t - i^*_t \quad (8)$$

Assuming that Δs^e_{t+1} is a function of deviation of s_t from its equilibrium value s_t, equation 8 can be rewritten as:

$$\Delta s^e_{t+1} = i_t - i^*_t = -\lambda(s_t - s_t) \quad (9)$$

In the long run, the equilibrium exchange rate will be given by relative price according to PPP. Hence, substituting equation 1 ($s_t = p_t - p^*_t$) for the equilibrium exchange rate will result in the following equation:

$$s_t = p_t - p^*_t - \theta \quad (i_t - i^*_t) \quad (10)$$

Bjorland and Hungnes (2002), and Che and Mansure (2006) transformed the equation 10 into a testable co-integration model yielding:

$$s_t = \beta_0 + \gamma_1 p_t + \gamma_2 p^*_t + \beta_3 \theta (i_t - i^*_t) + \varepsilon_t \quad (11)$$

The Uncovered Interest Parity (UIP) model theory states that differen

Where β and γ are the coefficient parameters, and θ is the speed of adjustment of interest rate differential and θ = 1/λ suggesting that the real exchange rate is a function of both the price level and interest rates differentials. Equation 11 suggests that all real shocks that force real exchange rate away from PPP have to be captured by the long-run market interest rates, where the rates appear to predict PPP and exchange rates level (MacDonald and Nagayasu, 2000; Caporalea, et. al., 2001; Bjornland and Hungnes, 2002; Jin 2003, Wang, 2004; and Che and Mansure 2006).

Methodology and Source of Data

Our estimates on this study were based on the most up to date quarter data for the sample period 1991:1q-2006:2q for Malaysia, Indonesia, The Philippines, Thailand and Singapore. The published quantitative financial and economic data were extracted from three main sources: the International Monetary Fund (IMF, various issues and home page), central banks of ASEAN-5 countries, various issues of reports published. The data acquired from the above sources compared with the data extracted from DataStream (UUM online library software).

All value entities are defined in terms of national currencies. The models' variables are generating to a percentage quarter data. Che and Mansure (2006) believed that the span of selected period is long enough to empirically test the long run forcing variables influencing the co-integration PPP relationship in economies under review.

Model Specification

In this paper, the exchange rate model applied to explore the forcing factors that determine RER to the ASEAN-5 countries. However, Frenkel (1978), Edison (1985), Dibooglu and Enders (1995), Baharumshah and Ariff (1997), Mehdi and Taylor (1999), Goh Soo and Mithani (2000), Azali and Zubaidi (2001), Taylor (2002), Sarno and Taylor (2002), Baharumshah and Lim (2004), Chaboud and Wright (2005), and Che and Mansure (2006) found that many empirical

and earlier researchers on exchange rate adopted co-integration techniques.

Using the existing theoretical frameworks discussed earlier in Section 2. We can write PPP of equilibrium exchange rates based on the earlier empirical frameworks (models) as follows:

$$S_t = \alpha_0 + \alpha_1 R + \alpha_2 R^* + \alpha_3 M + \alpha_4 G + \alpha_5 \pi + \alpha_6 NFA + \alpha_7 TOT + \varepsilon_t \quad (12)$$

where, S_t denotes real exchange rate in ASEAN-5 countries via Japan[6], R denotes domestic interest rate in ASEAN-5 countries, R* denotes foreign Interest rate, M1 denotes money supply in ASEAN-5 countries, π denotes inflation rate, NFA denotes net foreign asset, G denotes Real gross domestic product, and TOT denotes term of trade. The disturbance term ε is to capture the unobserved effects and is assumed to have zero mean and constant variance.

Econometric Method

This section explaining the econometric methods applied to this studies as explained in the following sub sections.

Unit Root Test: Test for Stationary : The recent development economic through using econometric warrant to examining the characteristics of time series, such as in the studies of (Nelson and Plosser, 1982) stated that the application of standard methods of conventional non-stationarity data, contain any Unit Root problem, may lead to spurious correlation in the regression analysis. The stationary test commonly known as the unit root test is conducted to check the order of the integration of each of the variable that is the number of times they must be differenced before attaining stationary. In order to avoid the problem of spurious correlation in the regression analysis, the time series properties of the variables will use in the regression analysis of this study are investigated using the two most popular unit root tests proposed to examine the stationary, which are the Augmented Dickey-Fuller (ADF) and the Phillips Perron tests.

Autoregressive Distributed Lag (ARDL)

Pesaran *et al*. (1996, 1997, 1999, and 2001) developed a procedure, called Autoregressive Distributed Lag (ARDL). The ARDL approach also allows us to identify long-run and short-run dynamics explanatory variables on a dependent variable. It can be applied regardless of the stationary properties of the variables in the sample and it allows for inferences on long-run estimates, which is not possible under alternative co-integration procedures.

The first step in the ARDL procedure outlined by Pesaran and Shin (1999) is to test the long-run significance of the dependent variables, by computing the F-statistic test the significance of the lagged levels of the variables in the error correction form of the underlying ARDL model. This is similar to testing the significance of the error correction term in an error correction model. It involves the testing of the joint long-run significance of all explanatory variables including the constant.

We apply the ARDL approach proposed by Pesaran et al. (2001) to estimate equation 12 The following ARDL model is estimated to examine the long-run relationship:

$$\Delta S = \alpha_0 + \alpha_1 R_{t-1} + \alpha_2 R^*_{t-1} + \alpha_3 M_{t-1} + \alpha_4 G_{t-1} + \alpha_5 \pi_{t-1} + \alpha_6 NFA_{t-1} + \alpha_7 TOT_{t-1} + \beta_1 \sum_{i=1}^{n} \Delta S_{t-i} + \beta_2 \sum_{i=0}^{n} \Delta R_{t-i} + \beta_3 \sum_{i=0}^{n} \Delta R^*_{t-i} + \beta_4 \sum_{i=0}^{n} \Delta M_{i=0} + \beta_6 \sum_{i=0}^{n} G_{t-i} + \beta_7 \sum_{i=0}^{n} \Delta \pi_{t-i} + \beta_8 \sum_{i=0}^{n} \Delta NFA_{t-i} + \beta_9 \sum_{i=1}^{n} \Delta TOT_{t-i} + \varepsilon \quad (13)$$

where S is the real exchange rate (RER), R and R* are domestic Interest rate and foreign Interest rate, respectively. M1 money supply, π inflation rate, NFA net foreign assets, G is growth rate of real gross domestic product in ASEAN-5 and TOT term of trade. Δ is the first difference, n is the lag number in the

[6] According to Dufrenot and Yehoue (2005), and Che and Mansure (2006), RER was defined as the ratio of the domestic CPI to the foreign CPI. The deflator employ by researchers are varies: some employ Trade Weighted Average (TWA), GNP deflator and so on.

independent variables $\sum_{i=1}^{n}$ and ε is the error term. The main advantages of this procedure are: Firstly, there is no prior endo-exogenous division of variables; secondly, no zero restrictions are imposed, and finally, there is no strict economic theory within which the model is grounded. The ARDL approach also allows us to identify long-run and short-run dynamics explanatory variables on a dependent variable.

Empirical Results

The empirical results of this study is demonstrated and explained in the following subsections of the paper.

Unit Root Test

In this study, we utilized the two most popular unit root tests, the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests, to check if the variables under consideration were integrated of I (0), I (1) or mutually integrated. It is widely known that if any variable in the model integrated of an order higher than I (1), the ARDL technique could not used to provide reliable estimates of the parameters of the model.

ADF and PP tests suggest that most of our variables for ASEAN-5 economies are integrated in order I(0) or I(1) which means that the null hypothesis of unit root rejected for all series in both ADF and PP tests. Thus, we relied on the ARDL approach to estimate and interpret the parameters of the models used in the present study.

Long-Run Equilibrium Estimation

Malaysia: Given the existence of a long-run relationship, the next step is to use the ARDL approach to estimate the parameters of this long run relationship. This method has the additional advantage of yielding consistent estimates of the long-run coefficients that are asymptotically normal irrespective of whether the variables under consideration are I (0), I (1) or factionary integrated, (Pesaran and Shin, 1999; Pesaran et al. 2001).

The results of an ARDL models are reported in table 1. As we can see from the table, most of the variables under consideration are significant and the signs are consistent with a priori expectations. Clearly, for Malaysia the key long-run forcing variable of PPP of RER against Japanese Yen throughout of the sub-period and whole period are observed to be the result shown domestic money supply (M1). This finding is indeed in concert with the characteristics of Malaysia, which is well known as a small, open and well-managed ASEAN-5 free enterprise economy that pragmatically and continuously monitored and adjusted its RER in the international market place.

Indonesia

In table 2, It can be observed throughout the sub-periods and the whole period of study that Indonesia's long- run forcing variables of PPP of RER against Japanese Yen are observed to be the domestic money supply (M1), foreign interest rate (R*) and inflation rate (π), also, it shown and the real gross domestic product (G) jointly serve as the second forcing variable in determining Indonesia long run PPP of RER. Although, Indonesia constantly and continuously adjusted its Rupiah RER as can be noticed from the statistic results, the results also indicated that AFC had left a notable long-term negative impact upon Indonesia's long-term PPP, as well as its economy.

Philippines

The Philippines partly affected by AFC, where the results in table 3 showed key long- run forcing variables of PPP of RER throughout of the sub-period and whole period of study are observed to be the domestic money supply (M1) and domestic interest rate (R). Also, it shown the foreign interest rate (R*) jointly serve as the second forcing variable in determining Philippines' long run PPP of RER. The tabulated statistics can easily be used to explain that the Philippines had too much money (M1) in circulation where the government then attempted to manage the economy through its monetary policy instead of productivity. The monetary authority then began to control the Philippine excessive money supply in circulation (Che & Mansure 2006).

Thailand

Thailand was the first ASEAN-5 economy attacked by the currency speculators in April 1996 and suffered as one of the worst victims among the ASEAN-5 members. Consequently, it was essentially forced to open its economy as one of the condition prescribed by the IMF and the World Bank in order to assist with recovery funds Che and Mansure (2006). The statistics in tables 4 indicate that its significant long-run

forcing variables of PPP of RER is observed to be the foreign interest rate (R*) and domestic money supply (M1). While the G, π, NFA, and TOT jointly serve as the significant long-run forcing variables of PPP of RER, throughout periods study (table 4).

Singapore

After its independence in 1963, Singapore became a successful entre-port city-state. It purchased logs, rubber; tin, semi-finished products as well as finished products such as electric equipments and electrical components for re-export from Malaysia, Thailand, Indonesia and neighboring economies. Its strategic geographical location provided an opportunity for Singapore to be an international wholesale intermediary with many economies (Che & Mansure, 2006). The Japan is major trading partner.

The Singapore results in tables 5 indicated the long-run forcing variables of PPP of RER are observed to be the domestic money supply (M1). Variables, net foreign assets (NFA), and domestic interest rate jointly serve as the second forcing variables in determining Singapore's long run PPP of RER (table 5).

Error correction Model (ECM)

We estimated the short-run dynamic of the RER model for ASEAN-5 using the ARDL approach to co-integration proposed by Pesaran et al. (2001).The explanatory statistics in ASEAN-5 indicated that the RER equations were well specified. None of the statistics in the table (6-10) were significant at the 5% significance level. Thus the explanatory statistics test results obtained revealed that all equations passed the tests successfully, i.e. the $\overline{R}^2$ showed that all the RER equations obtained best goodness of fits and the variation on the selected variables explained almost all the variations of the dependent variables for Malaysia, Indonesia, the Philippines, Thailand and Singapore against Japanese Yen under consideration. The Standard Error (S.E) obtained best goodness of fits of the data, while D.W showed normal distribution of the data for all ASEN-5 RER equations.

In general, the results of the RER models for each of the ASEAN-5 as shown in table 6-10 indicate that the lagged error correction term ECM_{-1} carries the expected negative signs and is highly significant, which is supportive of the inference of a unique co-integration and stable long run RER relationship. Moreover, the results of the significant short- run forcing variable of PPP for ASEAN-5 through out of the sub-period and whole period are observed to be as follow.

For Malaysia the key short- run forcing variables of PPP of RER against Japanese Yen throughout of the sub-period and whole period are observed to be the domestic money supply (M1), while, domestic interest rate (R) and the real gross domestic product (G) jointly serve as the forcing variables in determining Malaysia's short-run PPP of RER. In table 7, Indonesia results showed the key short- run forcing variables of PPP of RER against Japanese Yen throughout of the study sub-period and whole period are observed to be the inflation rate (π), domestic money supply (M1) and the domestic interest rate (R).

The results in table 8, Philippines results showed key short-run forcing variables of PPP of RER throughout of the study sub-period and whole period are observed to be the domestic money supply (M1) and the foreign interest rate (R*). The second forcing variable in determining Philippines short-run PPP of RER is terms of trade (TOT). The statistics in Tables 9 indicate that its significant short-run forcing variables on Thailand PPP of RER throughout of the study sub-period and full period are observed to be the foreign interest rate (R*), R, π and TOT. In table 10, results indicated that the key short-run forcing variables of PPP of Singapore RER throughout of the study before crisis and full period is observed to be the domestic money supply (M1) and NFA.

Finally, we examine the stability of the long run parameters together with the short-run movements for each equation. To this end, we relied on cumulative sum (CUSUM) and cumulative sum square (CUSUMSQ) tests proposed by Brown et al. (1975). The same procedure was applied by Pesaran and Pesaran

(1997) and Bahmani-Oskooee and Ng (2002) to test the stability of the long-run coefficients. The tests applied to the residuals of the ECM models (Tables 6-10) along with the critical bounds are graphed in figures. As can be seen in Figures 1-15, the plots of CUSUM and CUSUMSQ statistics stayed within the critical 5% bounds for all equations. Neither CUSUM nor CUSUMSQ plots crossed the critical bounds, indicating no evidence of any significant structural instability. These results were the same no matter which selection criterion was chosen, which indicated that RER functions in the ASEAN-5 countries against Japanese Yen were stable. They appeared to be unaffected by the recent financial crisis over the sample sub-periods and full period.

Conclusions

In this paper examined the long-run and short-run forcing variables of domestic interest rate, foreign interest rate, inflation rate, domestic money supply, net foreign assets, terms of trade (TOT) and real gross domestic product (RGDP) upon RER in ASEAN-5 countries against Japanese Yen**.** This study found that the long-run and short-run forcing variables of PPP for ASEAN-5 differ due to their different economics environments and these findings are line with the findings of Che and Mansure (2006).

Moreover, the estimated long-run parameters of ASEAN-5 exchange rate model show that most of the variables carried the correct expected signs and their coefficients are statistically different from zero at conventional significant levels. In this regard, the results suggested that the domestic money supply (M1) is the greatest forcing variable of PPP for ASEAN-5 RER's for the three periods of the study. Whereas, in the short-run Malaysia's results suggest that the domestic money supply (M1) is the key fundamental forcing of PPP for Malaysia, RER during the sub-periods and entire period. However, the impact the M1 on Malaysia PPP long run is due to develop its own financial system, as an open and small economy.

in addition, the estimated results in the short-run of the RER model for Indonesia suggested that the inflation rate (π), domestic money supply (M1) and domestic interest rate (R) are the key fundamentals forcing variables of PPP on Indonesia's RER for the study periods. Philippines results suggested that domestic money supply (M1) and foreign interest rate (R^*) are the significant influencers on Philippines' PPP on three periods of the study. Additionally, Thailand Statistical result suggested that the short-run forcing variable of PPP of Thailand's RER is foreign interest rate (R^*), might be due to Thailand borrowing of a large amount of money from the IMF to manage its financial crisis from 1997-2000. On the other hand, Singapore results indicated that the key short-run forcing variables of PPP of RER throughout of the study period observed to be the domestic money supply (M1) and NFA. The impact of M1 and NFA upon Singapore's PPP is due to open and small economy, in addition to the financial sector in Singapore is well developed followed by Malaysia's financial sector compared with the other ASEAN-5 financial sectors.

Consequently, our empirical results had essentially reconfirmed the earlier findings of the researchers who found that the key determinants or the forcing variables for RER for developing economies, in general, are heterogeneous. Thus, the long-run forcing variables of PPP should differ according to a country's economic environment. This is indeed in line with our empirical findings. Thus, the empirical results of this study are also found to be similar to the earlier empirical findings. This includes the findings developed by Frankel (1976, 1978), Papell (1988), MacDonald and Taylor (1994), McCallum (1994), Chinn and Meese (1995), Diamandis and Kouretas (1996), Kanas (1997), Husted and MacDonald (1998), Dutt and Gosh (1999), Francis et al. (2001), Caporalea, et. al. (2001), Rapach and Wohar (2002), Groen and Kelbergen (2003), Chaboud and Wright (2005) and Ahmad Baharumshah and Darja (2008).

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Table 1: The Selected ARDL Model: Long-Run Coefficient Estimation for Malaysia RER via Japan-Yen.

	Dependent Variable RER (S)		
	Study period	**Pre AFC**	**During and post AFC**
Repressors	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**
R	-.1180 [-2.421]**		-.1366 [-3.310]**
R*			
M1	-.3187 [-2.102]**	-.1666 [-2.148]**	-.3053 [-2.666]**
G	.4769 [2.350]**		.5244 [2.782]**
π			
NFA		.1894 [3.840]**	-.0812 [-2.463]**
TOT	.3769 [2.428]**		
C	.1752 [2.775]**	.2688 [3.835]**	.1991 [2.946]**
The period No.of Obs.	1991:Q2-2006:Q2 (61)	1991:Q2-1997:Q2 (25)	1997:Q3-2006:Q2 (35)

Notes: Asterisks ***, **, * represent 1%, 5%, 10% significant levels, respectively. The *t*-ratios are reported in square brackets. The following notation applies: domestic interest rate (R), foreign interest rate (R^*), domestic money supply (M), real gross domestic product (G), inflation rate (π), net foreign assets (NFA) and terms of trade (TOT).

Table 2: The Selected ARDL Model: Long-Run Coefficient Estimation for Indonesia RER via Japan-Yen.

	Dependent Variable RER (S)		
	Study period	**Pre AFC**	**During and post AFC**
Regressors	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**
R		-.5872 [-2.183]*	-.2041 [-3.681]**
R*	.4185 [4.401]***	-.5872 [-3.685]**	-.2960 [-1.803]*
M1	-.2320 [-6.024]***	-.1400 [-3.691]**	-.1580 [-3.891]**
G	.2777 [5.447]***	.5291 [2.875]**	
π	.0677 [13.43]***	-.4059 [-2.378]**	.1076 [4.231]***
NFA		-.7537 [-2.964]**	
TOT	-.2193 [-2.424]**	-.2020 [-4.001]**	
C	-.5089 [-4.089]***	.5917 [2.177]*	.1167 [6.219]***
The period No.of Obs.	1991:Q2-2006:Q2 (61)	1991:Q2-1997:Q2 (25)	1997:Q3-2006:Q2 (35)

Table 3: The Selected ARDL Model: Long-Run Coefficient Estimation for Philippines RER via Japan-Yen.

	Dependent Variable RER (S)		
	Study period	**Pre AFC**	**During and post AFC**
Regressors	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**
R	-.1716 [-2.418]**	-.0555 [-4.707]***	.0749 [3.373]**
R*	.3961 [1.840]*		-.3075 [-8.571]***
M1	.7039 [2.190]**	.7016[8.957]***	.7007 [10.95]***
G		-.2993 [-3.935]**	
π			
NFA		.4691 [5.783]***	
TOT	.3041 [2.145]**		

C	.3654 [3.655]**	.4508 [8.004]***	.1222 [3.239]**
The period No.of Obs.	1991:Q2-2006:Q2 (61)	1991:Q2-1997:Q2 (25)	1997:Q3-2006:Q2 (35)

Table 4: The Selected ARDL Model: Long-Run Coefficient Estimation for Thailand RER via Japan-Yen.

	Dependent Variable RER (S)		
	Study period	**Pre AFC**	**During and post AFC**
Regressors	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**
R		-.0291 [-2.393]**	
R*	-.1886 [-1.853]*	.1271 [6.909]***	
M1		.4831 [14.21]***	-.7243 [-2.447]**
G		-.1808 [-3.045]***	.1060 [2.551]**
π	-.1575 [-1.775]*		-.1474 [-3.794]**
NFA	.4108 [2.271]**		-.8375 [-1.973]*
TOT	.6641 [3.767]***	-.5943 [-7.034]***	
C	.3088 [8.706]***	-.0867 [-2.605]**	-.4718 [-1.407]
The period No.of Obs.	1991:Q2-2006:Q2 (61)	1991:Q2-1997:Q2 (25)	1997:Q3-2006:Q2 (35)

Table 5: The Selected ARDL Model: Long-Run Coefficient Estimation for Singapore RER via Japan-Yen.

	Dependent Variable RER (S)		
	Study period	**Pre AFC**	**During and post AFC**
Regressors	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**
R	-.1216 [-2.712]**	.2153 [5.206]***	
R*			-.8541 [-5.602]***
M1	-.5916 [-2.087]**	-.4875 [-5.397]***	-.2922 [-2.574]**
G			
π			.1055 [3.873]**
NFA	.9285 [1.803]*	.8587 [6.267]***	
TOT			-.2250 [-1.898]*
C	.2478 [5.469]***	.1359 [4.694]***	.12061 [9.577]***
The period No.of Obs.	1991:Q2-2006:Q2 (61)	1991:Q2-1997:Q2 (25)	1997:Q3-2006:Q2 (35)

Table 6: Error correction representation based on the ARDL Model: Short-Run Estimation for Malaysia RER via Japan-Yen.

	Dependent Variable RER (S)		
	Study period 1991:Q1-2006:Q2	**Pre AFC 1991:Q1-1997:Q2**	**During and post AFC 1997:Q3-2006:Q2**
Regressors	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**
ECM(-1)	-.3554 [-4.028]***	-.1561 [-5.113]***	-.4388 [-3.810]**
ΔR	-.0606 [-3.123]**	.4582 [4.520]***	-.0599 [-3.090]**
Δ R*			
ΔM1	-.1095 [-2.093]**	.5563 [2.573]**	-.1339 [-2.5112]**
ΔG	.1992 [2.974]**	-.3545 [-3.158]**	.2301 [3.066]**
Δπ		-.1321 [-2.387]**	
ΔNFA	.0577 [2.737]**		.0604 [2.867]**
ΔTOT	.0919 [1.790]*	.2809 [2.768]**	

C	.0616 [2.422]**	.3202 [5.256]**	.0873 [1.974]*
$\overline{R}^2$	.7607	.7157	.7360
S.E.	.0135	.0089	.0123
S.squared resid	.0097	.0010	.0042
F-statistic	4.694	8.243	6.457
DW-statistic	1.859	2.370	1.994
The period No.of Obs.	1991:Q2-2006:Q2 (61)	1991:Q2-1997:Q2 (25)	1997:Q3-2006:Q2 (35)

Notes: The *t*-ratios are represented in squire brackets. Asterisks ***, **, * represent 1%, 5%, 10% significance levels, respectively. Δ Denotes the first difference of each variable. The following notation applies: domestic interest rate (R), foreign interest rate (R^*), domestic money supply (M), real gross domestic product (G), inflation rate (π), net foreign assets (NFA) and terms of trade (TOT).

$\overline{R}^2$ is Adjusted R-squared, (S.E) is the standard Error of regression, and Sum squared residual.

Figure 1 Plots of CUSUM and CUSUMSQ statistics for Malaysia via Japan RER 1991:Q1-2006:Q2

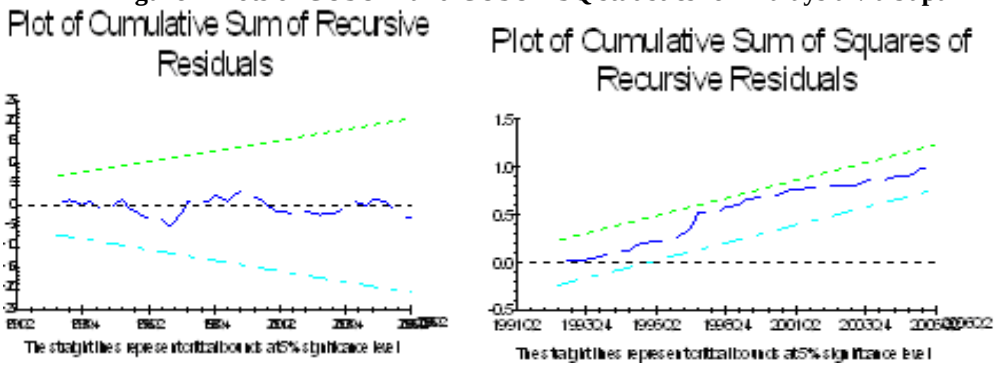


Figure 2 Plots of CUSUM and CUSUMSQ statistics for Malaysia via Japan RER 1991:Q1-1997:Q2

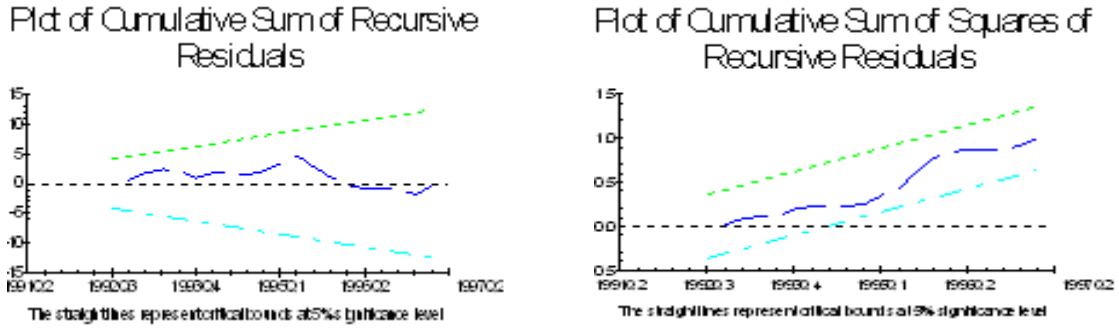


Figure 3 Plots of CUSUM and CUSUMSQ statistics for Malaysia via Japan RER 1997:Q3-2006:Q2

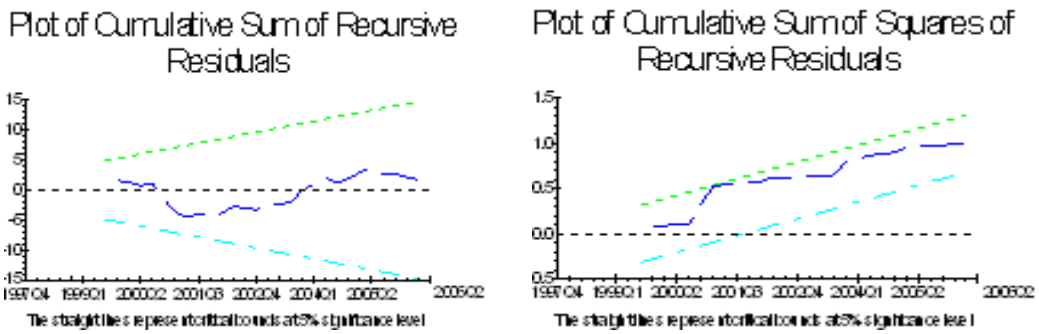


Table 7: Error correction representation based on the ARDL Model: Short-Run Estimation for Indonesia RER via Japan-Yen.

	Dependent Variable RER (S)		
	Study period 1991:Q1-2006:Q2	**Pre AFC 1991:Q1-1997:Q2**	**During and post AFC 1997:Q3-2006:Q2**
Regressors	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**
ECM(-1)	-.1043 [-1.784]*	-.1553 [-3.555]***	-.4622 [-4.894]***
ΔR		.7682 [2.350]**	-.9436 [-3.770]**
Δ R*			-.1368 [-1.800]*
ΔM1	-.8246 [-2.290]**	-.6536 [-1.929]*	
ΔG	.1066 [3.215]**		
$\Delta\pi$	.03191 [2.355]**	-.0829 [-1.759]*	.0497 [3.865]**
ΔNFA	.2252 [8.004]***		.2364 [8.612]***
ΔTOT			
C	-.1820 [-2.546]**	.2225 [4.241]***	.5395 [6.197]***
$\overline{R}^2$	.7076	.73837	.8619
S.E.	.0493	.0104	.04468
S.squared resid	.1243	.0018	.05191
F-statistic	25.69	4.321	36.72
DW-statistic	1.730	2.062	2.19
The period No.of Obs.	1991:Q2-2006:Q2 (61)	1991:Q2-1997:Q2 (25)	1997:Q3-2006:Q2 (35)

Figure 4 Plots of CUSUM and CUSUMSQ statistics for Indonesia via Japan RER 1991:Q1- 2006:Q2

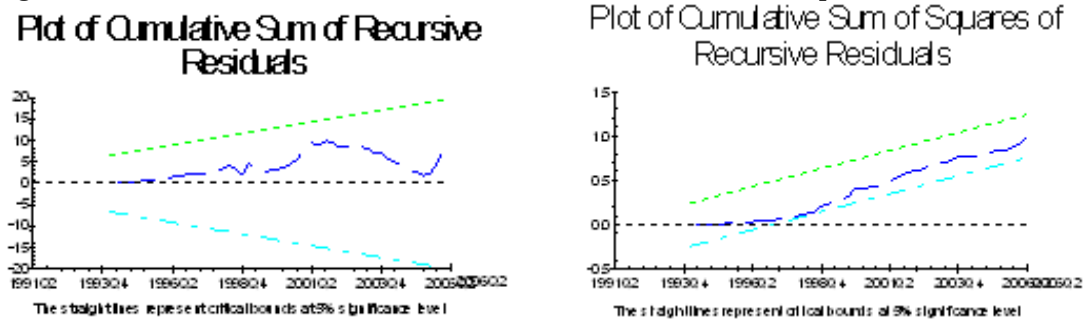


Figure 5 Plots of CUSUM and CUSUMSQ statistics for Indonesia via Japan RER1991:Q1-1997:Q2

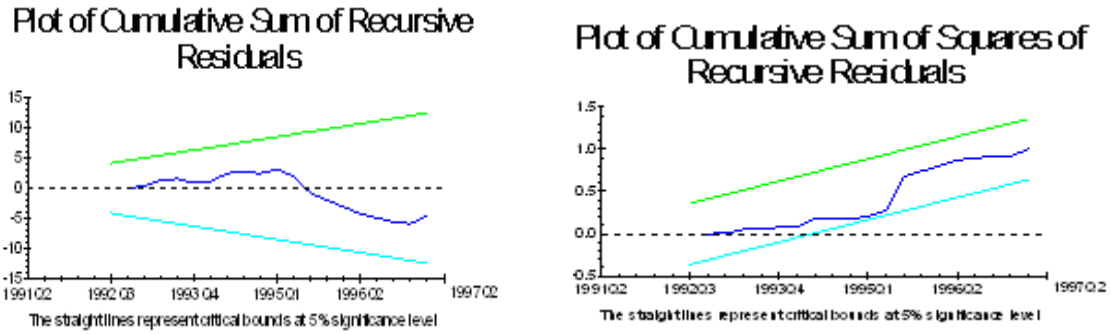


Figure 6 Plots of CUSUM and CUSUMSQ statistics for Indonesia via Japan RER 1997:Q3-2006:Q2

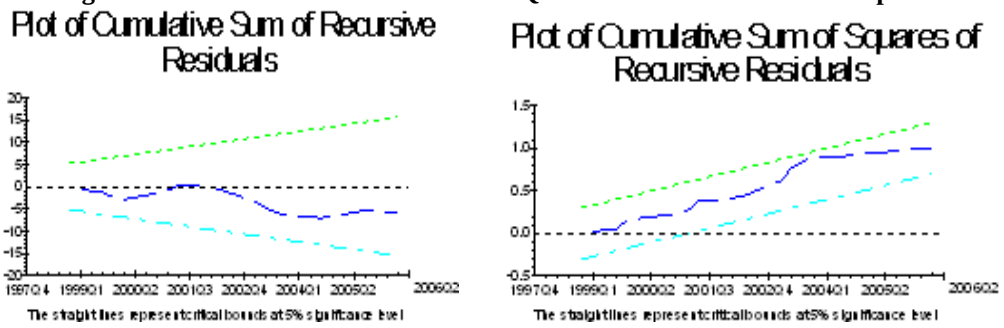


Table 8: Error correction representation based on the ARDL Model: Short-Run Estimation for Philippines RER via Japan-Yen.

	Dependent Variable RER (S)		
	Study period 1991:Q1-2006:Q2	**Pre AFC 1991:Q1-1997:Q2**	**During and post AFC 1997:Q3-2006:Q2**
Regressors	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**
ECM(-1)	-.2739 [-3.406]**	-.4997 [-2.630]**	-.5982 [-6.135]***
ΔR			
Δ R*	.1085 [2.076]**	.2664 [4.143]**	-.1136 [-4.001]***
ΔM1	.1928 [1.958]*	.1026 [3.681]**	.3902 [5.540]***
ΔG		-.2300 [-2.310]**	
$\Delta\pi$			
ΔNFA			
ΔTOT	.0833 [2.281]**		-.1914 [-3.218]**
C	.1001 [3.359]**	.4791 [5.670]***	.0906 [4.738]***
$\overline{R}^2$	.7206	.7406	.8106
S.E.	.0210	.0169	.0185
S.squared resid	.0235	.0051	.0103
F-statistic	3.707	9.758	9.871
DW-statistic	2.147	1.777	2.094
The period No.of Obs.	1991:Q2-2006:Q2 (61)	1991:Q2-1997:Q2 (25)	1997:Q3-2006:Q2 (35)

Figure 9 Plots of CUSUM and CUSUMSQ statistics for Philippines via Japan RER 1991:Q1-2006:Q2

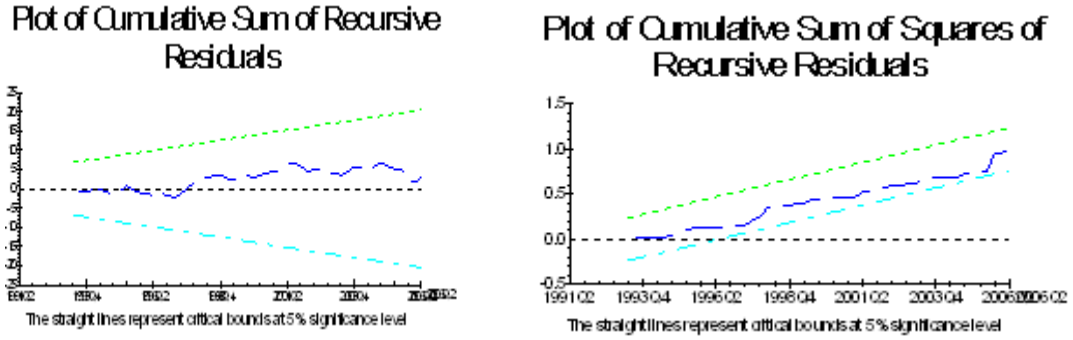


Figure 7 Plots of CUSUM and CUSUMSQ statistics for Philippines via Japan RER 1991:Q1-1997:Q2

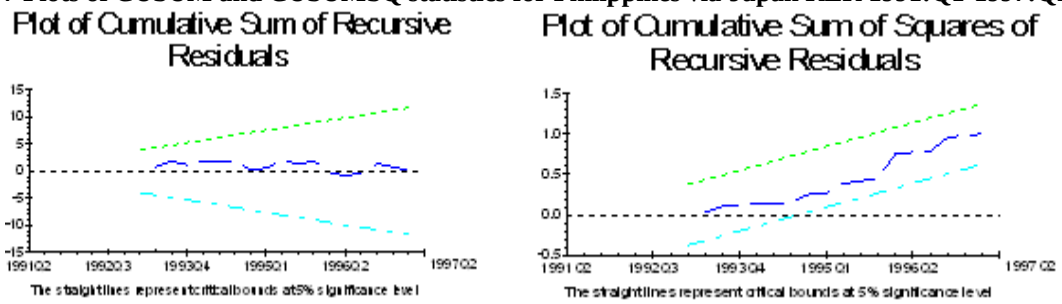


Figure 8 Plots of CUSUM and CUSUMSQ statistics for Philippines via Japan RER 1997:Q3-2006:Q2

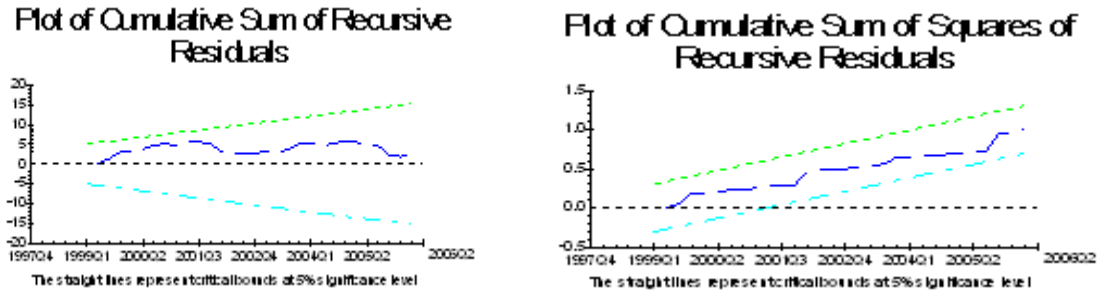


Table 9: Error correction representation based on the ARDL Model: Short-Run Estimation for Thailand RER via Japan-Yen.

	Dependent Variable RER (S)		
	Study period 1991:Q1-2006:Q2	**Pre AFC 1991:Q1-1997:Q2**	**During and post AFC 1997:Q3-2006:Q2**
Regressors	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**
ECM(-1)	-.2683 [-3.196]**	-.4452 [-2.894]**	-.4397 [-3.932]***
ΔR		-.03610 [-2.612]**	
Δ R*	-.0506 [-1.885]*	.2571 [5.925]***	
ΔM1		.6061 [7.748]***	
ΔG			.4662 [4.360]***
$\Delta\pi$	-.0422 [-2.030]**		-.0648 [-5.498]***
ΔNFA	.0110 [1.946]*		-.0368 [-2.575]**
ΔTOT	.1782 [3.069]**	-.2009 [-2.400]**	
C	.0828 [3.027]**	-.0867 [-2.605]**	-.2075 [-1.898]*
$\overline{R}^2$	.7565	.7360	.8047
S.E.	.0180	.0088	.0125
S.squared resid	.0176	.0014	.0044
F-statistic	2.856	4.562	11.60
DW-statistic	1.887	1.716	2.331
The period No.of Obs.	1991:Q2-2006:Q2 (61)	1991:Q2-1997:Q2 (25)	1997:Q3-2006:Q2 (35)

Figure 12 Plots of CUSUM and CUSUMSQ statistics for Thailand via Japan RER 1991:Q1-2006:Q2

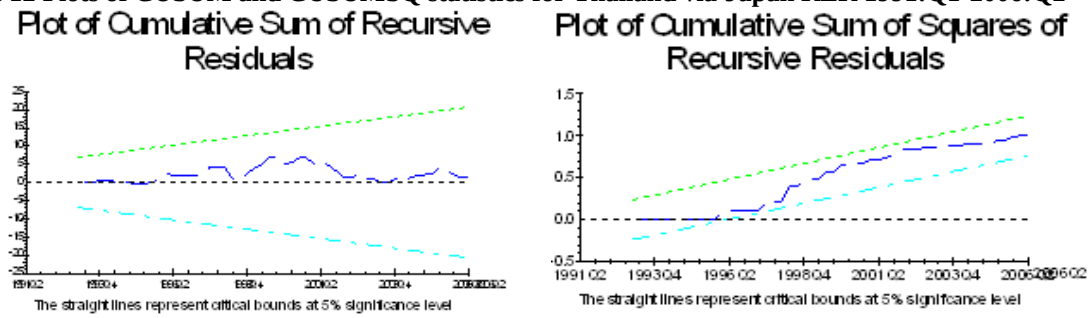


Figure 10 Plots of CUSUM and CUSUMSQ statistics for Thailand via Japan RER 1991: Q1-1997:Q2

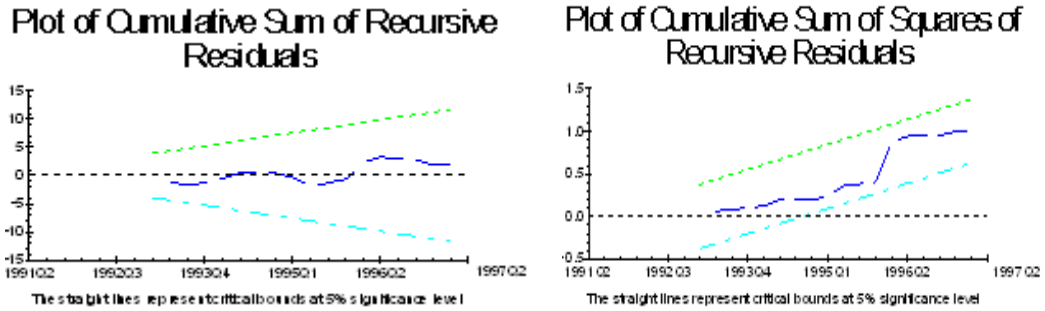


Figure 11 Plots of CUSUM and CUSUMSQ statistics for Thailand via Japan RER 1997:Q3-2006:Q2

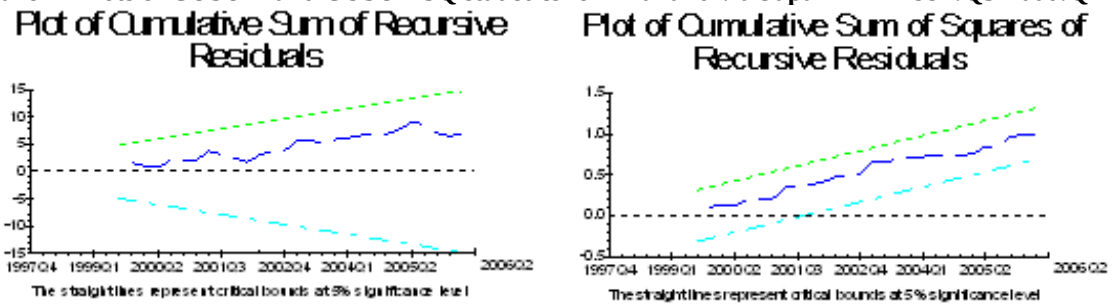


Table 10: Error correction representation based on the ARDL Model: Short-Run Estimation for Singapore RER via Japan-Yen.

	Dependent Variable RER (S)		
	Study period 1991:Q1-2006:Q2	**Pre AFC 1991:Q1-1997:Q2**	**During and post AFC 1997:Q3-2006:Q2**
Regressors	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**	**Coefficient [T-ratio]**
ECM(-1)	-.2116 [-2.741]**	-.4219 [-2.822]**	-.4208 [-3.677]**
ΔR	-.0233 [-2.394]**	.1052 [2.175]**	
Δ R*			-.3593 [-3.765]**
ΔM1	-.1039 [-2.606]**	-.2273 [-3.997]**	-.1398 [-3.019]**
ΔG			
$\Delta\pi$			
ΔNFA	.1830 [2.114]**	.3596 [2.922]**	.4139 [3.530]**
ΔTOT			
C	.0459 [3.480]**	.0289 [1.213]	.0587 [4.206]***
$\overline{R}^2$	.7475	.7481	.7831
S.E.	.0057	.0051	.0048
S.squared resid	.0018	.4468	.7077
F-statistic	4.237	6.241	6.280
DW-statistic	2.164	2.360	2.193
The period No.of Obs.	1991:Q2-2006:Q2 (61)	1991:Q2-1997:Q2 (25)	1997:Q3-2006:Q2 (35)

Figure 15 Plots of CUSUM and CUSUMSQ statistics for Singapore via Japan RER 1991:Q1-2006:Q2

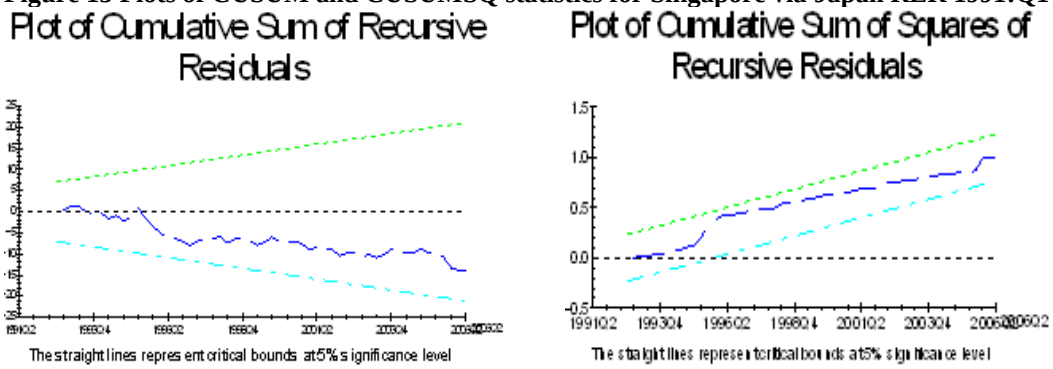


Figure 13 Plots of CUSUM and CUSUMSQ statistics for Singapore via Japan RER 1991:Q1-1997:Q2

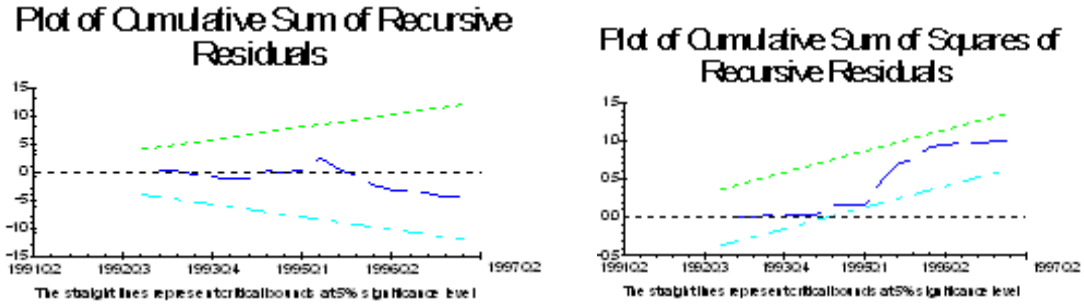
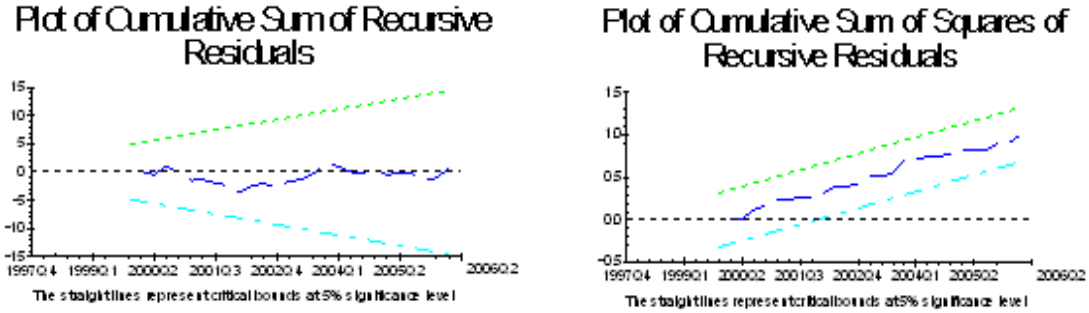


Figure 14 Plots of CUSUM and CUSUMSQ statistics for Singapore via Japan RER 1997:Q3-2006:Q2



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