Asymmetric cointegration relationship between real exchange rate and trade variables: The case of Malaysia

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ASYMMETRIC COINTEGRATION RELATIONSHIP BETWEEN REAL EXCHANGE RATE AND TRADE VARIABLES: THE CASE OF MALAYSIA

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Abstract

The present study attempts to analyze the long-run equilibrium relationship between real exchange rate and trade balance, imports and exports demand by cointegration tests assuming asymmetric adjustment. Following Enders and Siklos (2001), the Engle-Granger two-step cointegration test is expanding to incorporate an asymmetric error correction term. It is found that there exists asymmetric cointegration between balance of trade and real exchange rate when momentum-threshold autoregressive (M-TAR) model is conducted and the study also found asymmetric cointegration between export volume and real exchange rate under threshold autoregressive (TAR) model. From estimation of M-TAR error-correction trade balance model, the adjustment back to equilibrium is more rapid following relative increase in trade balance (above long-run value) compared to relative decrease in trade balance (below long-run value). From TAR error-correction import demand model, the model suggests quick adjustment of import demand once it is below long-run value. The results reflect the evidence of persistence of trade balance deficit in the case of Malaysia which probably due to policies to defend an overvalued exchange rate by protectionist trade policies or capital controls. In addition, the shock of exchange rate on import demand is likely to be temporary in nature.

Keywords: Asymmetric cointegration; Trade balance; Threshold autoregressive; Momentum-threshold autoregressive.

1. INTRODUCTION

As a small and open economy, Malaysia is significantly affected by external influences. The external influences include the exchange rate, world demand and the term of trade. In the aftermath of the Asian financial crisis, large concern on the impact of exchange rate on the real economy is quite obvious. In particular, the immediate impact of exchange rate shock on volume of exports and imports is very much concern by the authority as Malaysia heavily relies on imports and exports. In fact, Malaysia survival from the 1997 financial crisis was largely contributed by its positive balance of trade position. During the recession of 1997 and 1998, the country had a large trade surplus of US$4.0 billion in 1997 and US$17.7 billion in 1998. In November 2008, Malaysia recorded a trade surplus of RM11.49 billion, making it the 133rd consecutive month of trade surplus since November 1997.

The effects of these influences on Malaysian business cycle are often examined using a modeling approach. In the area of international trade, large number of studies widely used cointegration analysis to investigate the interdependence between variables. One of cointegration techniques applied is adopted from Engle and Granger (1987). A study by Arize (1994), for example, adopted this two-step cointegration test suggested by Engle and Granger (1987) to examine the long-run relation between real effective exchange rate and the trade balance in nine Asian economies. The approach is found to be an acceptable substitute for testing the Marshall-Lerner condition of stability. On similar issue, Hsing (2008) also adopted similar technique of cointegration to find evidence of a J-curve for the Dominican Republic, Costa Rica, El Salvador, Guatemala and Honduras. The study found evidence of a J-curve only for the Dominican Republic but not for others. Similar method also used by Asfaha and Huda (2002) to analyze cointegration between exchange rate misalignment and international trade competitiveness for South Africa and by Bahmani-Oskooee (2002) to investigate the impact of exchange rate volatility on the trade flows in Iran. In fact, many studies which related to trade or exchange rate were using this method in their analysis. Among all are Khan (2005), Rahman and Mishra (1992), Alse and Bahmani-Oskooee (1995), Wong and Tang (2007) and Bagchi et.al (2004).

This cointegration test of Engle and Granger (1987) assumes that the adjustment mechanism of the error correction term is symmetric, which indicates that the adjustment coefficients are similar regardless of positive or negative in the equilibrium error. For example, it is assumed that the adjustment speed of trade balance is the same no matter what type of exchange rate shocks occur. However, most of the research addressing the issue of equilibrium has not taken into account the asymmetric properties of adjustment process in the dependent variable. Asymmetry has been an important property in recent macroeconomic analysis, with a large number of studies providing evidence of the asymmetric adjustment of macroeconomic variables. In particular Utkulu et.al (2004), Holmes and Wang (2005), Ghoshray (2008), Yau and Nieh (2008), Ewing et.al (2006), Wang and Lin (2005), Chang (2008), Narayan (2007), Cook (2006), Heimonen (2006), Chen et.al (2005) and Shen et.al (2007). Thus, not taking into account recently established evidence of asymmetric adjustment of macroeconomic variables might lead to incorrect inferences. As noted by Balke and Fomby (1997), the movement toward the long-run equilibrium is not necessarily constant.

Thus, the present study finds it is important to analyze the long-run equilibrium relationship between real exchange rate and trade balance, imports and exports demand by cointegration tests assuming asymmetric adjustment. The rest of the paper is organized as follows: the next section provides theoretical framework of the study. Section 3 presents the empirical methods. Section 4 highlights the empirical findings and the analysis including the data preliminaries. Finally, section 5 concludes and draws policy recommendations from the major findings.

2. THEORETICAL FRAMEWORK

Theoretically, following the modeling introduced by Rose and Yellen (1989) and Rose (1990), a country's trade balance behaviour is built into a reduced form function directly depending on the real exchange rate and the real domestic and foreign incomes. In fact, this function began with a standard model specification for export and import demand:

$$X_t = \left(\frac{P}{P^*.E}\right)_t^{\eta}.\left(Y_t^*\right)^{\varepsilon} \quad (1)$$

$$M_t = \left(\frac{P^*.E}{P}\right)_t^{\gamma}.\left(Y_t\right)^{\pi} \quad (2)$$

where X and M are the volume of exports and imports, E is the nominal exchange rate and P, P^* and Y, Y^* denote the domestic and foreign price levels and incomes respectively; η and γ are the real exchange rate elasticities for exports and imports, respectively and ε and π are the income elasticities for exports and imports, respectively. Using logarithms, equations (1) and (2) could be written as:

$$\ln X_t = \eta\left[\ln P_t - \ln P_t^* - \ln E_t\right] + \varepsilon \ln Y_t^* \quad (3)$$

$$\ln M_t = \gamma\left[\ln P_t^* + \ln E_t - \ln P_t\right] + \pi \ln Y_t \quad (4)$$

where $\ln e_t = \left[\ln P_t^* + \ln E_t - \ln P_t\right]$ is the natural logarithm of real exchange rate. In common practice, trade balance (*TB*) is defined as the ratio between exports an d imports. Therefore, trade balance equation could be written as:

$$\ln TB_t = \pi \ln Y_t + \varepsilon \ln Y_t^* + \theta \ln e_t \quad (5)$$

where θ = - (η + γ). The coefficient of ln e_t indicates whether the Marshall-Lerner(ML) condition is fulfilled. Here, η and γ are assumed to be negative and ε and π are assumed to be positive so that ML holds whenever θ is positive indicating that a higher real exchange rate, that is, a real depreciation, appears to improve the trade balance over time.

Our major concern is focused on analyzing the long-run equilibrium relationship in imports demand, exports demand and trade balance by a cointegration test assuming asymmetric adjustment. We expect that it is possible that the adjustment speeds of exports demand, imports demand and trade balance are not the same when different types of exchange rate shocks occur.

3. EMPIRICAL APPROACH

Following Enders and Siklos (2001), the Engle-Granger two step cointegration test is expanding to incorporate an asymmetric error correction term. Given two series $\{y_t, x_t\}$, in the first step, the ordinary least squares (OLS) is used to estimate the long-run equilibrium relationship between y_t and x_t; thus:

$$y_t = \gamma_0 + \gamma_1 x_t + \varepsilon_t \quad (5)$$

where γ_0 and γ_1 are the estimated parameters and ε_t is a disturbance term. Possible cointegration between y_t and x_t is then examined via the order of integration of the residuals ε_t from (5) using a Dickey-Fuller test as below:

$$\Delta\hat{\varepsilon}_t = \rho\hat{\varepsilon}_{t-1} + \upsilon_t \qquad (6)$$

with the appropriate degree of augmentation employed via the inclusion of lagged values of the dependent variable. The null hypothesis of no cointegration ($H_0 : \rho = 0$) is then formally tested via comparison of the *t*-ratio of the adjustment parameter ρ and specifically generated nonstandard critical values. However, the EG approach is misspecified if the time series examined have an underlying asymmetric relationship (Enders and Siklos, 2001). Therefore, to test the stationarity of the disturbance term by incorporating the asymmetric adjustment, Enders and Siklos (2001) proposed the following model in the second step:

$$\Delta\varepsilon_t = I_t\rho_1\hat{\varepsilon}_{t-1} + (1-I_t)\rho_2\hat{\varepsilon}_{t-1} + \sum_{i=1}^{k}\delta_i\Delta\hat{\varepsilon}_{t-i} + \xi_t \qquad (7)$$

where ρ_1, ρ_2 and δ_I are coefficients; ξ_t is a white-noise disturbances; *k* is the number of lags; and I_t is an indicator function such that:

$$I_t = \begin{cases} 1 if \varepsilon_{t-1} \geq 0 \\ 0 if \varepsilon_{t-1} < 0 \end{cases} \qquad (8)$$

Tong (1983, 1990) showed that the least squares estimates of ρ_1 and ρ_2 have an asymptotic multivariate normal distribution. The cointegration model, comprises equations 5,7 and 8, is called the threshold autoregressive (TAR) cointegration model in Enders and Siklos (2001). In this model, it is important to note that the indicator function I_t depends on the level of ε_{t-1} in equation 8.

Enders and Siklos (2001) and Enders and Granger (1998) suggested an alternative threshold depending on the change in ε_{t-1} in the previous period. Therefore, the new indicator M_t is:

$$M_t = \begin{cases} 1 if \Delta\varepsilon_{t-1} \geq 0 \\ 0 if \Delta\varepsilon_{t-1} < 0 \end{cases} \qquad (9)$$

This model, which comprises of equation 5,7 and 9, is referred to as the momentum-threshold autoregressive (M-TAR) cointegration model. In the above models, the value of threshold (τ) is set equal to 0. In a case that τ is unknown; Enders and Siklos (2001) suggest use of a grid search procedure to derive a consistent estimate of threshold. In specific, considering TAR model, the residual series $\{\hat{\varepsilon}_t\}$ is arranged in ascending order as $\{\hat{\varepsilon}_1^0 < \hat{\varepsilon}_2^0 < .... < \hat{\varepsilon}_T^0\}$. After discarded the largest and smallest 15 percent of the $\{\hat{\varepsilon}_t\}$, the central 70 percent of observations of this sequence are then considered in turn as thresholds in (7) and (8) as each of them could be a possible threshold. The estimated threshold yielding the lowest residual sum of squares was deemed to be the appropriate estimate of the threshold. A similar approach could be done for MTAR model. Using the central 70 percent of observations of the sequence $\{\Delta\hat{\varepsilon}_1^0 < \Delta\hat{\varepsilon}_2^0 < .... < \Delta\hat{\varepsilon}_T^0\}$ considered as threshold values for (9), the value which could provide minimum residual sum of squares resulting from the estimation of (7) and (9) is then defined as the consistent threshold.

The asymmetric cointegration is then examined as follows. First, it is determined whether y_t and x_t are cointegrated in the TAR and M-TAR models. The test for this is carried out using F test for the null hypothesis of no cointegration, H_0: $\rho_1 = \rho_2 = 0$. The F statistics, however, has a non-standard distribution and is denoted as Φ by Enders and Siklos (2001). Second, in the presence of asymmetric cointegration, the null hypothesis H_0: $\rho_1 = \rho_2$ can be tested using the standard F-statistics. The evidence in support of asymmetric adjustment of the error correction term is indicated when both H_0: $\rho_1 = \rho_2 = 0$ and H_0: $\rho_1 = \rho_2$ are rejected. Adjustment is ρ_1 if y_{t-1} is above its long-run equilibrium value $(= \gamma_0 + \gamma_1 x_{t-1})$, but ρ_2 if y_{t-1} is below.

The asymmetric error-correction model also exists for y_t and x_t when they are formed in an asymmetric cointegrated relationship. That is:

$$\Delta y_t = \alpha_0 + \theta_{11} M_t \varepsilon_{t-1} + \theta_{12}(1 - M_t)\varepsilon_{t-1} + \sum_{i=1}^{k} \alpha_{1i} \Delta y_{t-i} + \sum_{i=1}^{k} \alpha_{2i} \Delta x_{t-i} + \xi_{1t} \tag{10}$$

and

$$\Delta x_t = \beta_0 + \theta_{21} M_t \varepsilon_{t-1} + \theta_{22}(1 - M_t)\varepsilon_{t-1} + \sum_{i=1}^{k} \beta_{1i} \Delta y_{t-i} + \sum_{i=1}^{k} \beta_{2i} \Delta x_{t-i} + \xi_{2t} \tag{11}$$

where θ_{11} and θ_{12} represent the speed of adjustment coefficients of Δy_t if y_{t-1} is above and below its long-run equilibrium, respectively, similarly, θ_{21} and θ_{22} represent the speed of adjustment coefficients of Δx_t of the two regimes, respectively, α_0 and β_0 are constant terms, α_{1i}, α_{2i}, β_{1i} and β_{2i} are coefficients of lagged change terms, and ξ_{1t} and ξ_{2t} are white-noise disturbances.

The Granger causality test could be applied to examine the lead-lag relationship between y_t and x_t. The null hypothesis that x_t does not lead y_t is H_0: $\alpha_{2i} = 0$, $i = 1,\ldots\ldots,k$ and the null hypothesis that y_t does not lead x_t is H_0: $\beta_{1i} = 0$, $i = 1,\ldots\ldots,k$.

4. EMPIRICAL RESULTS AND ANALYSIS

Data descriptions and unit root tests

All series examined in this study –volume of exports (X), volume of imports (M), trade balance (TB) and real effective exchange rate (REER) - are collected from the *IMF Statistics* and *Bank Negara Malaysia* (BNM) *Bulletin.* The data is monthly from M1: 1999 to M12: 2006. As for exchange rate, the indicator used is real effective exchange rate index with the base year of 2000. Both volumes of exports and imports are also in indices with 1999 as the base year and trade balance is simply the ratio of volume of exports to volume of imports. All these variables are transformed into natural logarithm and denoted with italic small letters.

These variables are first checked for their unit root properties using the standard augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root tests. While the ADF has non-stationary null hypothesis, the KPSS test states stationary as the null hypothesis. Results of these tests are displayed in Table 1. The results generally suggest that all variables are integrated of order one. In other words, the variables are non-stationary in level but stationary at first difference or I(1).

Table 1: Unit Root Tests

Variable	**ADF test statistic (with trend and intercept)**		**KPSS test statistic (with trend and intercept)**	
	Level	***First Difference***	***Level***	***First Difference***
tb	-3.239*	-11.806***	0.135*	0.034
x	-1.836	-12.191***	0.206**	0.073
m	-2.149	-11.506***	0.169**	0.068
reer	-1.578	-7.141***	0.171**	0.157**

Note: *** , ** and * denote significance at 1%, 5% and 10% level, respectively.

Long-run relations

In the present analysis, the following functions are considered for long-run relationship between exchange rate and trade variables:

Model 1: $tb_t = \alpha_0 + \alpha_1 reer_t + \varepsilon_t$ (12)

Model 2: $x_t = \beta_0 + \beta_1 reer_t + \varepsilon_t$ (13)

Model 3: $m_t = \sigma_0 + \sigma_1 reer_t + \varepsilon_t$ (14)

Model 1 establishes the link between real exchange rate and trade balance. The link between real exchange rate and exports demand and between real exchange rate and imports demand are established in Model 2 and Model 3, respectively. The long-run relations between real exchange rate and trade variables are displayed in Table 2.

Table 2: Long-run equations

Equation/ Model \ Variable	Dependent Variables		
	(1) *Ln Trade Balance (tb)*	(2) *Ln Exports (x)*	(3) *Ln Imports (m)*
constant	2.69 (2.74)***	17.47 (8.55)***	14.89 (6.22)***
Ln Real Effective Exchange Rate (reer)	-0.59 (-2.78)***	-2.74 (-6.18)***	-2.18 (-4.18)***

Included observation	96	96	96
Adjusted R^2	0.06	0.28	0.15
F-statistic	7.70***	38.23***	17.46***
Diagnostic test:			
Far			
Farch			
JBnormal			
Fhet			

Notes: 1. t-statistic in parentheses
2. *Far* is the F-statistic of Breusch-Godfrey Serial Correlation LM Test
Farch is the F-statistic of ARCH Test
JBnormal is the Jarque-Bera Statistic of Normality Test
Fhet is the F-statistic of White Heteroskedasticity Test
3. *** significant at 1% level
** significant at 5% leve
*significant at 10% level.

Prior to test the existence of asymmetric cointegration in the models, we conduct the traditional two-step cointegration test due to Engle and Granger (1987). Base on equation (6), Table 3 presents the results of these tests.

Table 3: Engle-Granger ADF cointegration tests

		Critical values		
Model	**t-statistic**	***1%***	***5%***	***10%***
1(*tb)*	-5.005	-4.07	-3.37	-3.03
2(*x)*	-1.659			
3(*m*)	-2.745			

The results of E-G cointegration tests reveal no long-run relation between real exchange rate and exports demand in model 2 and between real exchange rate and imports demand in model 3 as the null hypothesis of no cointegration is not rejected at 1% and 5% significant levels. However, there is long-run relation between real exchange rate and trade balance in models 1 since the null hypotheses of no cointegration is rejected at 1% and 5% levels of significance. Though there is no cointegration existed in model 2 and 3 base on symmetric E-G cointegration tests, there might be a possibility of uncovered asymmetric cointegrations in the models, which need to be explored further. For this purpose, further analysis using TAR and M-TAR models are conducted for all models 1, 2 and 3. The results from threshold cointegration analysis are reported in Table 4.

Table 4: Enders-Siklos asymmetric cointegration tests

	H_0: $\rho_1 = \rho_2 = 0$				H_0: $\rho_1 = \rho_2$	
	TAR: Φ	***k***	**M-TAR: Φ^***	***k***	**TAR: *F* test**	**M-TAR: *F* test**
Model 1(*tb*)	13.84***	1	16.42***	1	2.29	6.34**
Model 2(*x)*	1.85	1	2.04	1	0.95	1.31
Model 3(*m*)	7.46**	1	3.77	1	6.91 ***	0.09

Notes: The notation k is the lag periods of lagged difference term, which is decided by the minimum AIC. The symbols *, ** and *** indicate significance at the 10, 5 and 1 % levels, respectively. The critical values of Φ and Φ^* statistics are given in Enders and Siklos (2001). *F* indicates *F*-statistic for the null hypothesis of symmetric adjustment, $\rho_1 = \rho_2$.

From Table 4, using model 1, it is found that there exists asymmetric cointegration between balance of trade and real exchange rate when M-TAR model is conducted as the Φ^* statistic and F-statistic of Wald coefficents tests are significant at 1 percent and 5 percent levels, respectively. Using model 3, it is also found asymmetric cointegration between export volume and real exchange rate under TAR model as Φ statistic and F-statistic of Wald coefficents tests are significant at 1 percent and 5 percent levels, respectively.

Threshold error-correction models

Given the presence of asymmetric cointegrations between trade balance and real exchange rate and between import volume and real exchange rate, we estimate threshold and momentum-threshold error correction models to assess its dynamic in the short-run. We set the maximum lag order of first differenced variables to 12. Then we trim the lag order down if the last lag is found to be insignificant using 10% significant level. Table 5 and Table 6 present results respectively for M-TAR (trade balance model) and TAR (import model) models. Both models are diagnosed for robust evidence. Noted from the tables, the estimated models are free from problems of non-normality, autocorrelation, ARCH effects and heteroskedasticity as indicated by Jarque-Bera test for normality, Breusch-Godfrey LM test for serial correlation, Engle's test for ARCH effects and White Heteroskedasticity test.

Table 5: Momentum Threshold Autoregressive (M-TAR) Error Correction Model for trade balance

Equation / Ind. Variable	Dependent Variable (M-TAR) Δtb
constant	-0.001
$M_t \varepsilon_{t-1}$	-0.589***
$(1-M_t)\ \varepsilon_{t-1}$	-0.442***
Δtb_{t-1}	-0.117
Δtb_{t-2}	0.250*
Δtb_{t-3}	0.217*
Δtb_{t-4}	0.141
Δtb_{t-5}	0.059
Δtb_{t-6}	0.130
Δtb_{t-7}	0.207**
$\Delta reer_{t-1}$	-0.954
$\Delta reer_{t-2}$	-0.042
$\Delta reer_{t-3}$	-1.063
$\Delta reer_{t-4}$	-0.071
$\Delta reer_{t-5}$	-0.102
$\Delta reer_{t-6}$	-0.161
$\Delta reer_{t-7}$	-0.507
Adjusted R^2	0.269
F-statistic	2..996***

Diagnostic test:	
Far	1.039
Farch	1.324
JBnormal	2.198
Fhet	1.223

Notes: 1. *Far* is the F-statistic of Breusch-Godfrey Serial Correlation LM Test
Farch is the F-statistic of ARCH Test
JBnormal is the Jarque-Bera Statistic of Normality Test
Fhet is the F-statistic of White Heteroskedasticity Test
2. *** , ** and * denote significance at 1%, 5% and 10% level, respectively.

Table 6: Threshold Autoregressive (TAR) Error Correction Model for import demand

Ind. Variable \ Equation	Dependent Variable (TAR) Δm
constant	-0.007
$I_t \varepsilon_{t-1}$	0.003
$(1-I_t)\ \varepsilon_{t-1}$	-0.326*
Δm_{t-1}	-0.298**
Δm_{t-2}	-0.024
Δm_{t-3}	0.105
Δm_{t-4}	-0.029
Δm_{t-5}	-0.052
Δm_{t-6}	0.013
Δm_{t-7}	-0.086
Δm_{t-8}	-0.109
Δm_{t-9}	-0.023
Δm_{t-10}	-0.098
Δm_{t-11}	-0.128
Δm_{t-12}	0.352***
$\Delta reer_{t-1}$	1.343
$\Delta reer_{t-2}$	-0.701
$\Delta reer_{t-3}$	0.808
$\Delta reer_{t-4}$	-0.505
$\Delta reer_{t-5}$	0.184
$\Delta reer_{t-6}$	0.844
$\Delta reer_{t-7}$	-1.336
$\Delta reer_{t-8}$	0.566
$\Delta reer_{t-9}$	0.363
$\Delta reer_{t-10}$	-1.107
$\Delta reer_{t-11}$	-1.411
$\Delta reer_{t-12}$	1.244
Adjusted R^2	0.369
F-statistic	2.852***
Diagnostic test:	
Far	0.854
Farch	0.731
JBnormal	3.919
Fhet	1.262

Notes: 1. *Far* is the F-statistic of Breusch-Godfrey Serial Correlation LM Test
Farch is the F-statistic of ARCH Test
JBnormal is the Jarque-Bera Statistic of Normality Test
Fhet is the F-statistic of White Heteroskedasticity Test
2. *** , ** and * denote significance at 1%, 5% and 10% level, respectively.

From the estimation of M-TAR error-correction trade balance model, it can therefore be concluded that there exists a long-run cointegrating relationship between real exchange rate and trade balance with the underlying adjustment process being highly asymmetric. In specific, the value of the adjustment parameters indicate that when real exchange rate and trade balance temporarily depart from their underlying equilibrium relationship, adjustment back to equilibrium is more rapid following relative increase in trade balance (above long-run value) compared to relative decrease in trade balance (below long-run value). This could be illustrated as follows:

$$\Delta tb_t = K - 0.589\left[tb_{t-1} - 2.69 + 0.59 reer_{t-1}\right], \qquad \text{for } \hat{\varepsilon}_{t-1} > 0 \qquad (15)$$

$$\Delta tb_t = K - 0.442\left[tb_{t-1} - 2.69 + 0.59 reer_{t-1}\right], \qquad \text{for } \hat{\varepsilon}_{t-1} < 0 \qquad (16)$$

where *K* represents other terms (i.e. constant and lagged changes in imports and real exchange rate) in equation 10. The M-TAR specification showed that reversion to an underlying equilibrium relationship is faster, with 59% speed of adjustment, when temporary departures from it are caused by relative increases in trade balance, or equivalently, decreases in real exchange rate. However, the reversion to the underlying equilibrium is only with 44% speed of adjustment when the temporary departures from it are caused by relative decreases in trade balance, or equivalently, increases in real exchange rate.

The inferences from the tests reflect the evidence of persistence of trade balance deficit in the case of Malaysia as the trade balance adjustment to its long-run value is slower when it faces deficit than when it faces surplus. The concern is that a long-lasting trade deficit can lead to foreign debt, on which the country has to pay interests. If the debt is judged as unsustainable, a currency crisis is afraid could be erupted. Historically, Malaysia did face decreases in world commodity prices, a current account deficit and an overvalued real exchange rate in the early 1980s. However, the country had a much more successful adjustment and embarked on a decade of rapid growth. Despite declining of commodity and oil prices in 1981 and the term of trade reversals which cost the country real income declined dramatically in 1982, the government maintained its fiscal expansion, relying on foreign borrowing to finance growing government deficits. In fact, starting in 1984, the government embarked an adjustment program which cut government spending to reduce the deficit and depreciated the nominal exchange rate and reduced external borrowing to restore external competitiveness. Combined with lower domestic inflation, the policies led to real depreciation between 1985 and 1987 which return the current account into surplus. Since the present study finds new evidence of persistence trade deficit within 1990 until 2006 (more or less the present period) probably due to policies to defend an overvalued exchange rate by protectionist trade policies or capital controls, it is expected that similar adjustment program could be implemented to restore growth of the country despite a series of crises encountered.

Looking at TAR error-correction import demand model, the model suggests quick adjustment of import demand once it is below long-run value. The model provides no evidence for import demand adjustment when it is above long-run value. An illustration for this, we have:

$$\Delta m_t = K - 0.326[m_{t-1} - 14.89 + 2.18reer_{t-1}], \qquad \text{for } \hat{\varepsilon}_{t-1} < 0 \qquad (17)$$

where K represents other terms (i.e. constant and lagged changes in imports and real exchange rate). The estimated error –correction coefficient suggests that 32% of last-period deviation of imports from its long-run value will be corrected by imports adjustment. In particular, the values of the adjustment parameter indicate that when real exchange rate and imports temporarily depart from their underlying equilibrium relationship, adjustment back to equilibrium is more rapid and significant following a relative decrease in imports or equivalently, an increase in real exchange rate. On the other hand, the adjustment of imports is found to be insignificant when it is above its long-run value.

This indicates that the shock of exchange rate on import demand is likely to be temporary in nature. In specific, increase in real exchange rate only reduces imports temporarily and therefore non-persistence while the impact of depreciation is found to be insignificant. Again, this reflects the weaknesses of overvalued exchange rates. Worldwide experience has shown that defending the exchange rate has no medium-run benefits and it hurts the economy and growth. In facts, an overvalued exchange rate is often the root cause of protection and the country will be unable to return to the more liberal trade policies that allow growth and integration into the world trading community without exchange rate adjustment (Shatz and Tarr, 2000)

5. CONCLUSION

The effects of exchange rate shock on trade balance, imports and exports are often examined using a modeling approach. In the area of international trade, large number of studies widely used cointegration analysis to investigate the interdependence between variables. One of cointegration techniques applied is adopted from Engle and Granger (1987). This cointegration test of Engle and Granger (1987) assumes that the adjustment mechanism of the error correction term is symmetric, which indicates that the adjustment coefficients are similar regardless of positive or negative in the equilibrium error. However, asymmetry has now been an important property in macroeconomic analysis, with a large number of studies providing evidence of the asymmetric adjustment of macroeconomic variables. The present study attempts to analyze the long-run equilibrium relationship between real exchange rate and trade balance, imports and exports demand by cointegration tests assuming asymmetric adjustment.

By adopting Enders-Siklos asymmetric cointegration tests, it is found that there exists asymmetric cointegration between balance of trade and real exchange rate when M-TAR model is conducted and the study also found asymmetric cointegration between export volume and real exchange rate under TAR model.

From the estimation of M-TAR error-correction trade balance model, it can be concluded that there exists a long-run cointegrating relationship between real exchange rate and trade balance with the underlying adjustment process being highly asymmetric. In specific, the value of the adjustment parameters indicate that when real exchange rate and trade balance temporarily depart from their underlying equilibrium relationship, adjustment back to equilibrium is more rapid following relative increase in trade balance (above long-run value) compared to relative decrease in trade balance (below long-run value). As for TAR error-correction import demand model, the model suggests quick adjustment of import demand once it is below long-run value. The model provides no evidence for import demand adjustment when it is above long-run value. The results reflect the evidence of persistence of trade balance deficit in the case of Malaysia as the trade balance adjustment to its long-run value is slower when it faces deficit than when it faces surplus. This is probably due to policies to defend an overvalued exchange rate by protectionist trade policies or capital controls. Moreover, the shock of exchange rate on import demand is likely to be temporary in nature, in which, increase in real exchange rate only reduces imports temporarily and therefore non-persistence while the impact of depreciation is found to be insignificant. Similarly, this reflects the weaknesses of overvalued exchange rates. To avoid negative implications of the overvaluation of exchange rate, it is recommended that an adjustment program be implemented to restore growth of the country as what had been done previously and successfully in 1980s.

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