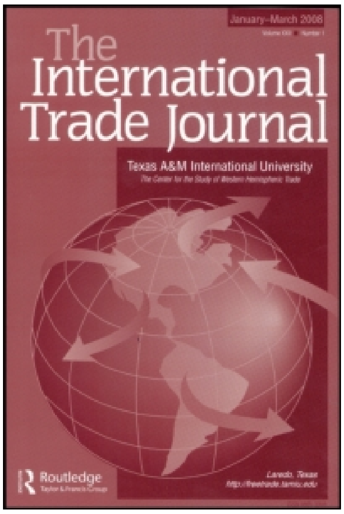

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The Effects of Real Exchange Rate on Trade Balance and Domestic Output: A Case of Malaysia

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THE EFFECTS OF REAL EXCHANGE RATE ON TRADE BALANCE AND DOMESTIC OUTPUT: A Case of Malaysia

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The main objective of this study is to determine the effects of real exchange rate changes on the real Malaysian trade balance and the domestic output during the pegged exchange rate regime, 1977:1–1998:2, using quarterly data. The cointegration results suggest that a real ringgit exchange rate depreciation improves the Malaysian balance of trade in the long run. The impulse response analysis suggests that the effects of a depreciation of ringgit on the trade balance and domestic output are quite similar. A devaluation will initially improve the trade balance and domestic output, after which the trade balance starts to deteriorate and then the recession sets in, but subsequently both the trade balance and domestic output improve.

KEYWORDS *trade balance, real exchange rate, domestic output, Malaysia*

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I. INTRODUCTION

In recent years there have been a number of studies to determine the effects of exchange rate changes on the trade balance. In particular, Rose (1990) examines the empirical impact of real exchange rates on the trade balances of several developing countries using the three-stage least squares and he finds that there is little evidence to show that their trade balances are significantly affected by the real exchange rates. Another study by Rose (1991) estimates directly the responsiveness of the trade balances of five OECD countries to real exchange rates, in the post Bretton Woods era, using a number of techniques and he concludes that there is little statistical evidence to support the view that the real exchange rate affects the trade balance.

But the results of the more recent studies, which are based on the cointegration technique and the VECM, have found that the real exchange rate is an important determinant of trade balance in both the developed and developing countries. Bahmani-Oskooee (2001) examines the long-run relationship between the trade balance and the real exchange rate of 11 Middle Eastern countries using the co-integration technique. He finds that the trade balance and the real exchange rate are co-integrated and he concludes that devaluation could improve the trade balance in the long-run. Kale (2001) in his study of Turkey's trade balance finds that a real depreciation causes a delayed J-curve effect while Kapoor and Ramakrishnan (1999) conduct a study to analyze the effects of exchange rate on the Japan's trade balance during the floating regime (1975:1 – 1996:4) by employing the error-correction model. The results indicate that there exist the J-curve effect.

Gomes and Paz (2005) study the effect of devaluation on the Brazilian trade balance. They find that devaluation affects the trade balance and there exits the J-curve phenomenon. De Silva and Zu (2004) carry out an empirical study to analyze the impact of devaluation of the Sri Lankan currency (rupee) on Sri Lankan trade balance and gross domestic product and they find that there has been a contractionary impact of devaluation on the Sri Lankan output. There are not many empirical studies about the effects of exchange rate on the trade balance in Malaysia.

Wilson (2001) examines the relationships between the bilateral merchandise trade balance and exchange rate among Malaysia, South Korea, and Singapore against the United States and Japan. He finds no evidence of the J-curve effect, except South Korea's trade with the United States. A study by Baharumshah (2001) indicates that the real exchange rate, domestic income, and foreign income are important determinants of Malaysian bilateral trade balance. Although the effects of devaluation last for 8 to 9 quarters, he finds no J-curve effect.

The main objective of this article is to examine the effects of real exchange rate changes on Malaysian trade balance and domestic output. Specifically, the objectives are: to determine whether there is a long-run relationship among the trade balance, real exchange rate, real domestic income and real foreign income. Then the dynamic relationship between trade balance and real exchange rate is examined to see whether there exists the J-curve effect. And finally the direction of the causal relationships among the trade balance, exchange rate, and incomes are also examined. Thus, the article is organized as follows. It begins with a discussion on the empirical issues of exchange rate and trade balance, followed by the formulation of the model to be estimated, methodology, empirical results and the conclusion.

II. THE MODEL

The trade balance equation is derived from the export and import demand equations specified respectively as

$$(1) \qquad X = A_0\, q^{\alpha}\, Y_f^{\beta}$$

$$(2) \qquad M = B_0\, q^{\delta}\, Y_d^{\gamma}$$

where $q = e\ (P_f / P_d)$ is the real exchange rate, X is the quantity of exports, A_0 is the initial quantity of exports, P_d is the domestic price of exports in domestic currency, P_f is the foreign price of imports in foreign currency, and e is the nominal exchange rate expressed in domestic currency per unit of foreign currency. The parameters α and β are the elasticities of export demand with respect to relative price of exports, q, and foreign income respectively. M is the quantity of imports, B_0 is the initial quantity of imports, Y_d is the domestic income, δ and γ are the elasticities of import demand with respect to real price of imports, q, and domestic income, respectively.

Now define the real trade balance, in log form, LTB as

$$\text{(3)} \qquad LTB = LX - Lq - LM$$

where L is the natural logarithm. Substituting equations (1) and (2) into the trade balance equation (3), simplifying and rearranging, we obtain the reduced form trade balance equation as

$$\text{(4)} \qquad \begin{aligned} LTB = {} & \log(A_0) - \log(B_0) + (\alpha - \delta - 1)\, Lq \\ & + \beta L Y_f - \gamma LY_d \end{aligned}$$

or

$$\text{(5)} \qquad LTB = \lambda_0 + \theta Lq + \beta LY_f - \gamma LY_d$$

where $\lambda_0 = \log(A_0)$ - $\log(B_0)$ and $\theta = (\alpha$ - $\delta - 1)$. Equation (5) states that the real trade balance depends on the real exchange rate, the real domestic income, and the real foreign income. Rhomberg (1976) and Lipschitz and Sumdrajan (1980) argue that if we are estimating a country's trade balance with the rest of the world, the appropriate real exchange rate is the real effective exchange rate because it takes into account many exchange rates and therefore reduces the risk of errorneous generalizations that result from changes that is peculiar only to a specific currency.

Therefore, in this study, we shall use the real effective exchange rate to represent the real exchange rate, q.

For empirical analysis, equation (5) is rewritten as

$$(6) \qquad \mathrm{LBM_t} = \lambda_0 + \beta\ \mathrm{LYF_t} + \theta\ \mathrm{LREER_t} + \gamma \mathrm{LYM_t} + u_t$$

where LBM is the log of trade balance of Malaysia with the rest of the world, LYF is the log of foreign real income, LYM is the log of domestic real income, and LREER is the log of real effective exchange rate expressed in domestic currency per unit of foreign currency and u_t is a disturbance term. The expected signs of the coefficient of the domestic income could be negative or positive. First, as domestic income rises, Malaysia imports more goods and services causing the trade balance to deteriorate, thus $\gamma < 0$.

However, if the increase in the domestic income is due to an increase in the production of and domestic demand for import-substitute goods, imports may actually decline, yielding a positive sign for γ. An increase in foreign income will lead to foreigners to import more goods from abroad giving β a positive sign. Thus, an increase in foreign income will increase the demand for Malaysian exports which tends to improve the trade balance. The effect of real effective exchange rate, REER, on trade balance could be positive or negative. If θ is positive, then the Marshall-Lerner condition is satisfied and therefore a devaluation of domestic currency is expected to encourage the demand for exports and discourage imports and thus improving the trade balance. If θ is negative then the Marshall-Lerner condition is not satisfied, therefore devaluation worsens the balance of trade.

Sources of Data

This study uses quarterly data from 1977:1–1998:2 as we want to focus on the period of Malaysia's pegged exchange rate regime. The data are then extended to 2001:4 to include data during the fixed exchange rate regime. Malaysia fixed its currency (RM=ringgit

Malaysia) to the US dollar at RM 3.80 to the one US dollar beginning in September, 1998. The variables *TB*, *REER*, *YM*, and *YF* denote Malaysia's real balance of trade on merchandise exports and imports, real effective exchange rate defined as domestic currency per unit of foreign currency, real Malaysian income, and real foreign income respectively. Malaysia's and foreign incomes are represented by their respective industrial production indices. The study uses the method suggested by Bahmani (2001) to calculate the real effective exchange rate. The 5 major trading partners used to calculate the real exchange rate are: the United States, the United Kingdom, Germany, Japan, and Singapore.

III. ESTIMATION METHODS

In the first stage, we carry out the unit root tests for non-stationarity using the Augmented Dickey-Fuller test (Dickey & Fuller 1979). Since the technique is well documented in the literature we shall not discuss here. If the series are integrated of order one [1(1)] and therefore they are non-stationary, we then carry out the multivariate cointegration procedure suggested by Johansen (1991) and Johansen and Juselius (1990) to examine the existence of long-run relationships among the variables in the model. The method uses the maximum likelihood estimation procedure to determine the existence of cointegrating vectors in a VAR system. The likelihood ratio test is used to find out the number of cointegrating vectors. We then estimate two models, Model I and Model II. Model I is the pegged exchange regime of 1977:1 – 1998:2 period while Model II includes observations from the pegged and fixed exchange rate regimes of 1977:1 – 2001:4 period.

Model I: Pegged Regime Period (1978:1–1998:2)

Following Engle and Granger (1987), the trade balance equation (6) can be written as a vector error-correction model (VECM):

$$
\begin{aligned}
\Delta \mathrm{Z_t} = {} & \beta_{0\mathrm{i}} + \lambda_{\mathrm{i}}\,\mathrm{ECT_{t-1}} + \sum_{\mathrm{j=1}}^{\mathrm{k}} \beta_{\mathrm{ji}}\,\Delta\,\mathrm{LBM_{t-j}} \\
(6) \qquad & + \sum_{\mathrm{j=1}}^{\mathrm{k}} \beta_{\mathrm{ji}}\,\Delta\,\mathrm{LYF_{t-j}} + \sum_{\mathrm{j=1}}^{\mathrm{k}} \gamma_{\mathrm{ji}}\,\Delta \mathrm{LYM_{t-j}} \\
& + \sum_{\mathrm{j=1}}^{\mathrm{k}} \theta_{\mathrm{ji}}\,\Delta \mathrm{LREER_{t-j}} + \sum_{\mathrm{i=1}}^{\mathrm{n}} \varphi_{1\mathrm{j}}\,\mathrm{D_{1i}} + \varepsilon_{1\mathrm{t}}
\end{aligned}
$$

where Z = (LBM, LYF, LYM, LREER) is the first-difference operator, k represents the number of lags of the explanatory variables, and ECT is the error-correction term generated from the Johansen multivariable process. Dummy variables, D, are added to the model to capture the seasonal effect (quarters) where $D = 1$ for the respective quarter and $D = 0$ otherwise. The coefficients of the regressors indicate the short-run effects while the coefficient of the error correction term captures the short-run effects of the long-run dynamics. When the variables are cointegrated, in the short run the deviations from this long-run equilibrium will feed back in the changes of the dependent variable forcing the movement of the variables towards the long-run equilibrium. Thus, the coefficient of the lagged error-correction term is a short-run adjustment coefficient representing the proportion by which the long-run disequilibrium in the dependent variable is being corrected toward the equilibrium level in each period.

Model II: Pegged and Fixed Exchange Rate Regimes (1977:1–2001:4)

In Model II, we extend the study period to include the fixed exchange rate regime as well. It is similar to Model I, except that we also include the dummy variables to take into account the effects of the two different regimes and the financial crisis in 1997–1998 period. Writing more compactly, the VECM now becomes

$$
\begin{aligned}
\Delta Z_t = {} & \beta_{0i} + \lambda_i ECT_{t-1} + \sum_{j=1}^{k} \beta_{ji} \Delta LBM_{t-j} \\
& + \sum_{j=1}^{k} \beta_{ji} \Delta LYF_{t-j} + \sum_{j=1}^{k} \gamma_{ji} \Delta LYM_{t-j} \\
& + \sum_{j=1}^{k} \theta_{ji} \Delta LREER_{t-j} \\
& + \sum_{i=1}^{n} \varphi_{1j} D_{1i} + \phi_1 DER + \phi_2 DCRISIS + \varepsilon_{it}
\end{aligned} \tag{7}
$$

where Z = (LBM, LYF, LYM, LREER)′, DER is the regime dummy which takes the value 1 if it is in the pegged regime and 0 otherwise, DCRISIS is the dummy for the financial crisis taking the value 1 during 1997-1998 period and 0 otherwise.

IV. RESULTS

Model 1: Pegged Regime Period (1977:1 – 1998:2)

The results of Augmented Dickey-Fuller tests using lag length k = 4 as suggested by the Akaike information criterion, given in Table 1, suggest that the series are integrated of order one [1(1)] and therefore non-stationary.

Table 1
Results of ADF Tests for Unit Roots

Variable Difference	Level		First Difference	
	Model 1	Model II	Model I	Model II
LBM	−2.2686	−0.7412	−4. 5008	−12.6031
LYF	−3.2659	−1.2774	−5.8397	−11.6953
LYM	−0.8295	−1.2807	−13.9851	−10.1809
LREER	−1.2043	−2.7822	−5.5037	−11.2818

Note: Significant at 1%: Critical value = −3.49

Table 2
Johansen's Test for the Number of Cointegrating Vectors (VAR with 5 lags)

	Test Statistics			
	Trace		Maximal Eigen value	
Null	Statistic	5% C.V.	Statistic	5% C.V.
Sample: 1977:1 – 1998:2				
r = 0	73.8585 **	54.64	42.5210**	30.33
r ≤ 1	31.3374	34.55	20.3339	23.78
r ≤ 2	11.0035	18.17	8.3437	16.87
r ≤ 3	2.6598	3.74	2.6598	3.74
Co-integration equation: LBM = 1.8951 LREER + 0.3032 LYM + 1.90906 LYF				
(0.6542)** (0.1502)* (0.4292)**				
Sample: 1977:1 – 2001:4				
r = 0	78.058 **	55.24	40.244**	30.81
r ≤ 1	27.814	35.01	18.138	24.25
r ≤ 2	9.67	18.39	7.913	17.14
r ≤ 3	1.764	1.764	2.6598	3.81
Co-integration equation: LBM = 3.1455 LREER + 1.4750 LYM + 4.1053 LYF				
(0.4533)** (0.2730)** (0.8418)**				

Notes: significant at 5 % level, C.V.= critical value.
**significant at 1% level.
The values in the parentheses are the standard errors

We therefore move to the second stage to test for cointegration. The results of the cointegration tests are presented in Table 2. The number of lags is 5 as suggested by Akaike information criterion. Both the trace and maximum eigen statistics indicate a unique long-run relationship among the variables where the null hypothesis of no cointegration at r = 0 is rejected at the one% level. We shall use this cointegration relationship to analyze the long-run and short-run behavior of the trade balance and the domestic output.

The results of the estimated long-run trade balance, in Table 2, when normalized by the coefficient of trade balance indicate that the real exchange rate, the domestic and foreign incomes have the correct positive signs and could significantly explain the variations in the trade balance at least at the 5% level. The positive sign of the coefficient of exchange rate suggests that the Marshall-Lerner condition is satisfied and therefore devaluation should be able to improve the trade balance in the long-run. Thus, the balance of trade improves about 1.9% in the long run in response to a 1% real depreciation. Moreover, a 1% rise in Malaysian income leads to about 0.30% improvement in the trade balance in the long-run while a 1% increase in the world foreign income improves the trade balance by 1.9% indicating that both are important determinants of Malaysian trade balance.

Model 2 (1977:1 – 2001:4)

The results of the cointegration tests of Model II are quite similar to Model I (Table 2). Both the trace statistics and the maximum Eigen statistics are significant at the 1% level, suggesting that all the variables are cointegrated. The estimated long-run trade balance indicate that the real exchange rate, the domestic and foreign incomes have the correct positive signs and could significantly explain the variations in the trade balance at least at 5% level but all the long-run elasticities are higher than those estimated in Model I. In particular, the coefficient of exchange rate is positive suggesting that the Marshall-Lerner condition is satisfied and therefore devaluation should be able to improve the trade balance in the long-run. The balance of trade improves about 3.1% in the long run in response to a 1% real depreciation.

V. SHORT-RUN DYNAMICS

Model I

The short-run dynamic behavior of the trade balance is examined by estimating the vector error-correction model (VECM). Five lags are needed to achieve white noise in the error term. The results of VECM showing the short-run dynamics of the trade balance equation and the diagnostic tests are given in Table 3.

Table 3
VECM Results of Model I (Dependent Variable: ΔLBM)

		Coefficient Estimates of				
Lags	ECT*	ΔLBM*	ΔLREER*	ΔLYM*	ΔLYF*	C[a]
1	−0.372	−0.148	−0.579	−0.162	0.301	−0.021
	(−4.65)	(1.29)	(1.61)	(1.97)	(1.28)	(1.98)
2		0.112	−0.710	−0.073	0.449	
		(0.97)	(2.10)	(2.66)	(2.08)	
3		0.188	−0.595	−0.374	0.404	
		(1.69)	(1.73)	(0.37)	(1.81)	
4		0.2016	−1.268	0.143	0.512	
		(1.64)	(3.53)	(1.43)	(2.51)	
5		−0.138	−1.153	0.118	0.567	
		(1.15)	(3.16)	(1.30)	(2.83)	
		D1	D2	D3	D4	
		0.041	−0.317	−0.036	0.412	
		(2.84)	(1.37)	(2.67)	(2.51)	

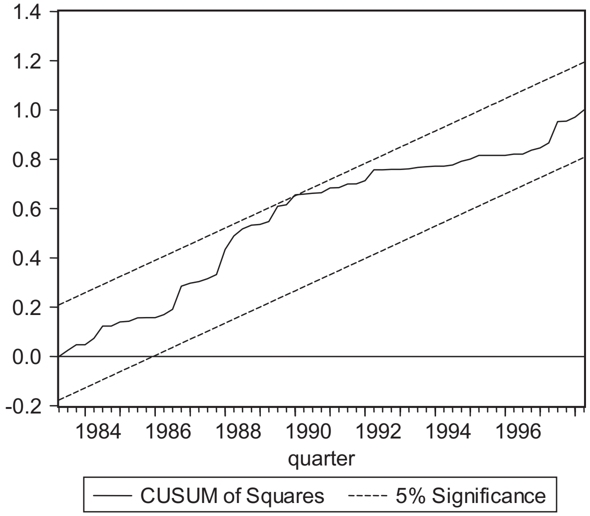
R^2 = 0.4935, Normality: JB = 2.7178(0.2822), heteroscedasticity: χ^2 (450) = 442.5564-(0.5899)
Note: * The values in parentheses are t-statistics

The diagnostic tests indicate that the VECM is adequately specified. The Jarque-Bera statistic (JB) suggests that the residuals are normally distributed, the Breusch-Godfrey LM statistics indicate that there is no autocorrelation in the residuals up to 10 lags, while the White heteroscedasticity statistic is also insignificant. The CUSUM square test indicates that the model is stable as shown in Figure 1.

The VECM results in Table 3 suggest that the real exchange rate is an important determinant of trade balance in the short-run where it is significant at least at 5% level in the second, fourth and fifth quarters. The coefficients of the exchange rate tend to suggest that a depreciation of ringgit immediately worsens the trade balance.

In order to investigate the dynamic effect of exchange rate on trade balance when all the variables in the trade balance equation

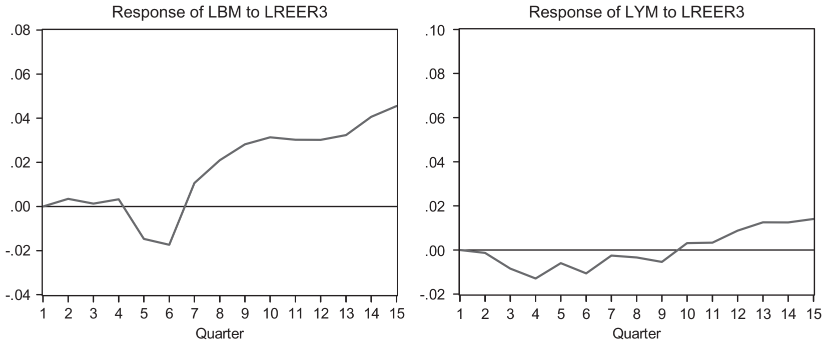
Figure 1
Stability Test (1997:1–1998:2)



change, an impulse response analysis is carried out. It is found that, initially, a depreciation of ringgit improves the trade balance for four quarters after which the trade balance starts to deteriorate reaching its trough in the sixth quarter and subsequently it begins to improve. By the seventh quarter the trade balance has generated trade surplus. This indicates that the effect of exchange rate on the trade balance exhibits a delayed J-curve phenomenon as shown in Figure 2. This finding is similar to the case of Turkey, Kale (2001).

The impulse response analysis of real exchange rate on domestic income indicates that a depreciation is recessionary lasting for about two years but the domestic economy begins to improve in the ninth quarter which is similar to the finding by De Silva and Zu (2004) in the case of Sri Lanka. The adjustment coefficient is negative, as expected, and significant at 1% level. The adjustment to the equilibrium level is quite rapid when about 37% is completed in the first quarter.

Figure 2
Response to Cholesky One S.D. Innovations



The Granger causality tests (Granger 1980) are carried out to examine the directions of the relationship among trade balance, real exchange rate, the domestic income and foreign income in the short-run. The results given in Table 4 indicate that the variations in trade balance are caused by the changes in the exchange rate, the domestic and foreign incomes and the direction of causation is uni-directional.

Model II

The results of the short-run dynamics of Model II are not as good as that of Model I as many of the lags are insignificant (Table 5). Since the seasonal dummies (quarters) are not significant, they are dropped from the model in final estimation.

One possible reason is that when we extend the estimation period to include the fixed exchange rate regime, the model becomes unstable as suggested by CUSUM squares test for stability as depicted in Figure 3. We will therefore not discuss these VECM results in detail.

The results of impulse response analysis suggest that a depreciation of rinnggit will immediately improve the balance of trade as shown in Figure 4 and it does not exhibit the

Table 4
Granger Causality Tests (Model I)

	ΔLBM	ΔREER*	ΔLYM*	ΔLYF*	ECT**
ΔLBM	–	16.67	6.04	10.93	−.3721
		(0.005)	(0.030)	(0.052)	(−4.65)
ΔREER	2.15	–	0.41	4.51	−0.027
	(0.82)		(0.99)	(0.47)	(0.69)
ΔLYM	3.69	1.44		1.20	−0.074
	(0.59)	(.99)		(0.94)	(0.64)
ΔLYF	6.24	4.47	0.71	–	−0.043
	(0.28)	(0.48)	(0.98)		(0.78)

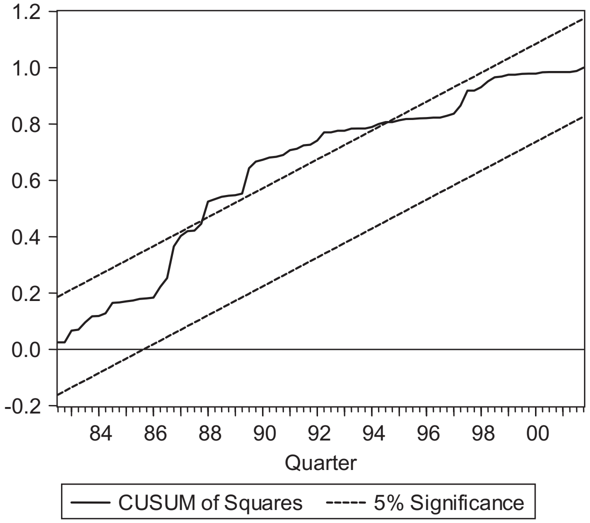
*F-statistic, the values in parentheses are the probabilities,
**The values in parentheses are the t-statistics.

Table 5
VECM Results of Model II (Dependent Variable: ΔLBM)

	Coefficient Estimates of					
Lags	ECT*	ΔLBM*	ΔLREER*	ΔLYM*	ΔLYF*	C*
1	−0.0278	−0.279	−0.239	−0.011	−0.246	0.046
	(−2.95)	(-2.56)	(1.61)	(1.77)	(1.34)	(0.45)
2		−0.056	−0.123	− 0.062	−0.087	
		(0.97)	(-1.00)	(1.66)	(1.46)	
3		0.188	−2.61	−0.046	0.39	
		(−0.52)	(−1.21)	(−1.49)	(1.69)	
4		0.162	−0.124	−0.062	0.67	
		(1.51)	(0.59)	(1.693)	(1.36)	
5		−0.164	(0.025	0.077	0.80	
		(−1.57)	(0.122)	(0.95)	(1.83)	
		DER	DCRISIS			
		0.101	−0.136			
		(2.82)	(−3.67)			

Note: $R^2 = 0.3791$, Normality: JB = 4.715(0.0946), heteroscedasticity: χ^2 (440) - = 416.2459(0.77861)
* The values in parentheses are t-statistics.
DER is the dummy for exchange rate regime: 1 if pegged regime and 0 otherwise, DCRISIS is the dummy for financial crisis in 1997–1998: 1 during crisis and 0 otherwise. Since seasonal dummies are insignificant, they are dropped from estimation.

Figure 3
Stability Test (1977:1–2001:4)

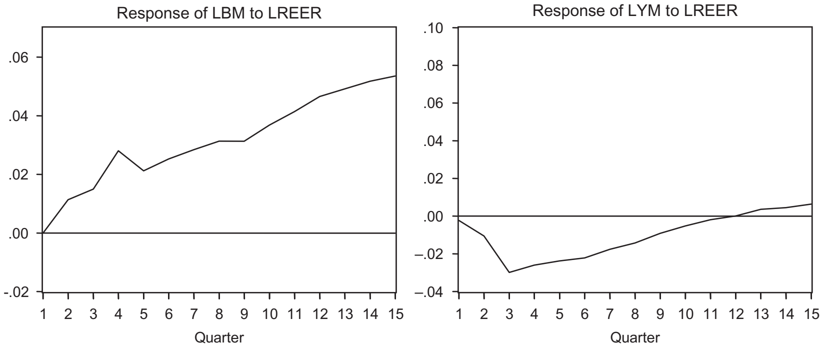


J-curve effect. But similar to Model I, depreciation immediately causes recession reaching its trough in the third quarter after which it slowly improves and the domestic economy recovers after the 12th quarter. But the Granger causality test fails in the case of Model II which suggests that there does not exist the short-run causality among the trade balance, exchange rate, and incomes and therefore we will not report the results here.

VI. CONCLUSION

This study examines the effects of real exchange rate, domestic and foreign incomes on Malaysia's trade balance during the pegged exchange rate regime (1977:1 – 1998:2) and the extended model from 1977:1 to 2001:4 to include the period of fixed exchange rate regime. The cointegration results show that, in both cases, a real depreciation leads to an

Figure 4
Response to Cholesky One S.D. Innovations



improvement in the Malaysian trade balance in the long run. An impulse response analysis of the pegged regime indicates that a one standard deviation innovations in the exchange rate results in a small improvement in the trade balance immediately after a depreciation; then the trade balance worsens and finally improves substantially, suggesting the existence of a delayed J-curve effect. The effect of devaluation is recessionary in the intermediate run but a real exchange rate depreciation improves both the trade balance and economic growth in the long-run.

The results of the short-run dynamic analysis of Model II are quite different from that of Model I. Specifically, the trade balance improves immediately after depreciation and it does not exhibit the J-curve effect. But similar to the finding in the case of pegged regime, a depreciation immediately results in recession but subsequently it improves. A policy implication that can be drawn from this study is that a depreciation improves trade balance in the long-run but it is recessionary in the short-run. Thus when Malaysian ringgit depreciates, policy makers may have to implement appropriate monetary and fiscal policy to minimize the recessionary impact stemming from depreciation.

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