

# The Long-run Impact of Bilateral Real Exchange Rate Volatility on Malaysia's Bilateral Trade Balance with its Major Trading Partners

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## ABSTRACT

*The objective of this paper is to analyse the long-run impact of bilateral real exchange rate volatility on Malaysia's bilateral trade balance with its major trading partners, comprising the United States, Singapore, Japan, United Kingdom, and Republic of Korea over the monthly period 1990:1 to 2002:12. The long-run impact will be analysed using the cointegration analysis and a vector error correction model (VECM) framework which treats all variables in the model as potentially endogenous. In this study, the GARCH model is employed to measure the bilateral exchange rate volatility. Our findings revealed that there is a positive long-run impact of exchange rate volatility on the trade balance of Malaysia with the United States, a negative long-run impact on the trade balance of Malaysia with Singapore and no impact on the trade balance of Malaysia with the other three countries.*

**Keywords:** *exchange rate, bilateral exchange rate, exchange rate volatility, international trade, trade balance, cointegration, long-run impact*

## **Introduction**

The effect of foreign exchange rate volatility on international trade is often discussed in the literature. While most economists believe that exchange rate volatility has a negative effect on international trade, others suggest the opposite. Indeed, theoretical and empirical studies often yield conflicting results on foreign exchange rate volatility and international trade relationships.

Most of the studies relating to the relationship of foreign exchange rate volatility and international trade focus on the exports and/or imports scenarios. Some examples are Akhtar and Hilton (1984), Cushman (1988), Gagnon (1993), McKenzie and Brooks (1997), Pattichis, Cheong, Mehari and Williams (2004). As far as we know, very few studies have investigated the relationship between foreign exchange rate volatility and trade balance. But there are such studies done and some examples are Bahmani-Oskooee (1991), Baharumshah (2000), Bahmani-Oskooee and Mirzai (2000) and Onafowora (2003).

The primary purpose of this paper is to analyse the long-run impact of bilateral real exchange rate volatility on Malaysia's bilateral trade balance with its major trading partners, comprising the United States, Singapore, Japan, United Kingdom, and Republic of Korea over the monthly period 1990:1 to 2002:12. The long-run impact will be analysed using the cointegration analysis and a vector error correction model (VECM) framework which treats all variables in the model as potentially endogenous.

## **Literature Review**

Theoretical models on this subject generally predict a negative relationship between exchange rate volatility and the level of international trade. Amongst others, Ethier (1973), Hooper and Kohlhagen (1978), Cushman (1986) and Pereg and Steinherr (1989) argued that exchange rate volatility may reduce trade flows. Franke (1991), Sercu and Vanhulle (1992) and Viaene and de Vries (1992) however, contend that exchange rate uncertainty positively affects international trade. These conflicting theoretical models, aimed at examining the effect of foreign exchange rate variability on international trade levels, conclude that the postulated impact may be positive or negative depending on the assumptions employed. These assumptions could be related to factors such as traders'

attitude towards risk, presence or absence of hedging facilities, profit opportunities, diversifiable risk, and nature of the trader and model specification.

The empirical evidence is also mixed. Klein (1990), Asseery and Peel (1991) and McKenzie and Brooks (1997) find some positive evidences in the relationship between exchange rate variability and trade flows. Meanwhile, Kenen and Rodrik (1986), Koray and Lastrapes (1989), Chowdhury (1993) and Arize, Osang and Slottje (2000) argue that exchange rate variability negatively affects international trade flows. However, Kroner and Lastrapes (1993) discover both positive and negative effects of foreign exchange rate on trade levels, while McKenzie (1998) and Aristotelous (2001) find insignificant relationships between exchange rate volatility and trade flows.

## **Methodology and Data**

### **A. Empirical model and data description**

Conventional theory suggests that trade balance is determined by macro-variables. However, recent studies suggest that trade balance could have a direct or indirect effect on the macroeconomics variables. In our study, the trade balance is modelled by considering the model employed by Bahmani-Oskooee (1991) and Rose (1991) because of its ability to capture the effect on macro-variables on trade balance.

Accordingly, we specify the bilateral trade balance as a function of domestic income, foreign income, relative price levels and exchange rate volatility. The reduced form of the equation is given as follows:

$$tb_t = \beta_0 + \beta_1 w_t + \beta_2 w_t^* + \beta_3 p_t + \beta_4 \sigma_t + \varepsilon_t \quad (1)$$

where  $tb$  is the bilateral trade balance,  $w$  is Malaysian income,  $w^*$  is foreign income,  $p$  is the relative price levels,  $\sigma$  is the bilateral exchange rate volatility and  $\varepsilon$  is the disturbance term. Lower case letters are used to denote the logarithmic form of the series.

The trade balance is usually measured as the difference between the value of total exports and total imports. In this study, we measure the trade balance according to Bahmani-Oskooee's (1991) model. Bahmani-Oskooee (1991) measured trade balance as the ratio of the bilateral exports value (X) to the bilateral imports value (M). According to

Bahmani-Oskooee, measuring the trade balance using the ratio offers a number of advantages. The first advantage is that the ratio is insensitive to the units of measurement of the bilateral exports and imports value. Secondly, it is also insensitive to whether the bilateral exports and imports are in real or nominal terms. This X/M ratio, or its inverse, has been used in many empirical investigations of the trade balance-exchange rate relationships, (e.g. Guptor-Kapoor and Ramakrishnan (1999), Bahmani-Oskooee and Brooks (1999) and Boyd, Caporale and Ron (2001).

The relative competitiveness price level is measured by the ratio of Malaysian consumer price index (CPI) to the trading partners' CPI and is a measure of a country's international competitiveness. The industrial production index is used as a proxy for the income of Malaysia and foreign countries, since the monthly gross domestic products (GDP) is not available. Although the industrial production index is a more restrictive measure (looking only at the level of manufacturing), it should reflect the overall trend in the GDP. As for the measures of exchange rate volatility as proxies for exchange rate risk, we employed Bollerslev's (1986) generalized autoregressive conditional heteroskedasticity (GARCH) models.

Economics theory suggests that the volume of imports to a domestic country ought to increase as the income and purchasing power of the domestic economy rises, and ought to decrease as the income and purchasing power of the domestic economy falls. Thus, we expect  $\beta_1$  to be negative. However, if the income and purchasing power of the trading partners' rises, then the volume of exports to the foreign partners ought to increase and decrease if the income and purchasing power of the trading partners falls. Therefore, we can expect  $\beta_2$  to be positive. However, if the rise in income in the countries is due to an increase in the production of import substitutes, then imports of both countries may decline as income increases, in which case  $\beta_1$  will be positive and  $\beta_2$  will be negative. As for the relative prices, an increase means that domestic products are more expensive relative to the products in the foreign country. This scenario will generate demand for a fall in exports. Thus,  $\beta_3$  is expected to be negative. However, as we have seen the theoretical effect of bilateral exchange rate volatility on the bilateral trade balance is ambiguous. It depends on assumptions. For example, it could be positive if we assumed that exporters are risk averse that would increase export in order to avoid any decline in profits caused by an increase in exchange rate volatility. The trade balance could be negative if we assumed exporters to be risk averse, who would increase the price in order to

reduce the risk, and importers who could reduce their exchange rate risk due to the availability of hedging facilities. Therefore, the sign on  $\beta_4$  could be negative or positive and needs to be estimated.

For the econometric analysis, we use monthly data covering the period 1990:1 to 2002:12 drawn from the IMF, International Financial Statistics and Department of Statistics, Malaysia for the bilateral trade balance with the trading partners.

In this study, we choose five countries as the trading partners of Malaysia: the United States, Singapore, Japan, the United Kingdom and the Republic of Korea. The countries are chosen based on their ranking in the top 10 exports to and imports from Malaysia during the period 1990 through to 2002. The criteria are that each country must be among the top 10 in both exports to and imports from Malaysia.

#### B. Volatility index

There is no definite answer as to which is the best proxy for exchange rate volatility in the study of exchange rate volatility and trade balance. In this study, we generate the bilateral real exchange rate series of exchange rate volatilities. The bilateral real exchange rate is calculated by multiplying nominal bilateral exchange rate by the relative price given as:

$$R_t = E_t(P_t^* / P_t) \quad (2)$$

where  $R_t$  is the real exchange rate at period  $t$ ,  $E_t$  is the nominal exchange rate at period (ringgit price of one unit of foreign currency), is the CPI of foreign country at period and is the CPI of Malaysia at period.

The nominal exchange rate of ringgit against US dollar is directly obtained from the International Financial Statistics but the other nominal exchange rates are obtained by exploiting triangular arbitrage between the ringgit exchange rate against the US dollar, and the foreign currencies against the US dollar. An increase in real and nominal exchange rate implies a depreciation of the Malaysian ringgit against the foreign currencies.

#### C. Volatility measurements

Various measurements have been used to capture exchange rate uncertainty. For this study, we employ Bollerslev (1986) GARCH models

to measure the exchange rate volatility. The underlying model is a GARCH (1,1) specification:

$$Y_t = X_t' \theta + \varepsilon_t \quad (3)$$

$$\sigma_t^2 = \alpha + \beta \varepsilon_{t-1}^2 + \gamma \sigma_{t-1}^2 \quad (4)$$

in which the mean equation given in Equation (3) is written as a function of exogenous variables with an error term. The conditional variance equation, Equation (4), is a function of three terms: (1) the mean  $\alpha$  ; (2) the news about volatility from the previous period measured as the lag of the square residual from the mean equation  $\varepsilon_{t-1}^2$  (the ARCH term); and (3) the last periods forecast error variance  $\sigma_{t-1}^2$  (the GARCH term).

However, before applying the GARCH estimation procedure, we first test for the stationarity of the real exchange rates, as well as for the presence of ARCH effects in the real exchange rate process. We found that the real exchange rates are not stationary. Therefore, the first difference of the log of the real exchange rate (to correct for non-stationarity) is used in our estimation of the volatility. In addition, we add a dummy variable to capture the effects of the July 1997 Asia financial crisis and the September 1998 shift in the exchange rate policy.

Thus, our GARCH (1,1) specification model is as follows:

$$\Delta er_t = a_0 + a_1 dummy_t + \varepsilon_t, \text{ where } \varepsilon_t \sim N(0, \sigma^2) \quad (5)$$

$$\sigma_t^2 = \alpha + \beta \varepsilon_{t-1}^2 + \gamma \sigma_{t-1}^2 + \delta dummy_t + \mu_t \quad (6)$$

where  $\mu_t$  is a white noise process with mean zero and variance  $\sigma_\mu^2$ . When we run Equation (5) and (6), we found that none of the dummy variables were significant, therefore we dropped the dummy variables from our equation of the GARCH model. The results of the GARCH (1,1) are reported in Table 1. We test the adequacy of these GARCH results for no remaining ARCH effects and the results successfully indicate that all the ARCH effects have been accounted for. We found that for all exchange rates volatility (except for ringgit/Singapore dollar volatility) is specified as GARCH (1,1) model. The ringgit/Singapore dollar volatility is specified as GARCH (0,1) model.

D. Empirical implementation

In line with recent developments in econometric methodology, we first investigate the time series properties of the data. If the series do not follow the same order of integration, then there can be no meaningful relationship among them. We utilize the Augmented Dickey-Fuller (ADF) test for detecting unit roots in the data. In order to establish if a long-run equilibrium relationship exists among the variables in Equation (1), we employ the Johansen (1988) and Johansen and Juselius (1990) approach, since it is regarded as superior to the regression based on the Engle and Granger procedure. The Johansen-Juselius method sets out the maximum likelihood procedure for the estimation and determining the presence of cointegrating vectors in a Vector Autoregression (VAR) system.

We test for the existence of cointegration using two tests proposed by Johansen: the Trace test and the Maximum eigenvalue test. However, it has been pointed out by, for example Cheung and Lai (1993) and Reimers (1992), that these statistics may be subject to size distortion depending on the chosen DGP and sample size. To correct for such possibility, Reimers (1992) suggests scaling the test statistics down, while Cheung and Lai (1993) suggest scaling the Johansen critical values up. In this study, we follow Reimers' (1992) approach and the small sample corrected formulas are:

$$TR = (T - np) \sum_{i=r+1}^N \ln(1 - \hat{\lambda}_i) \quad (7)$$

$$LR = (T - np) \ln(1 - \lambda_{r+1}) \quad (8)$$

Table 1. Regression estimates for the GARCH modelling

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$\Delta ex_t = a_0 + \varepsilon_t$ , where  $\varepsilon_t \sim N(0, \sigma^2)$ ,

$\sigma_t^2 = \alpha + \beta \varepsilon_{t-1}^2 + \gamma \sigma_{t-1}^2 + \mu_t$

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Sample	RM/US\$	RM/S\$	RM/¥	RM/£	RM/Won
Variance Equation					
Constant, $\alpha$	0.00002 (3.874)	0.0001 (3.492)	0.0002 (2.646)	0.0003 (2.419)	0.00008 (3.528)

ARCH, $\beta$	0.706 (5.531)	0.964 (5.600)	0.177 (3.120)	0.337 (2.698)	0.584 (4.710)
GARCH, $\gamma$	0.457 (9.725)	(0.044) (0.458)*	0.704 (9.356)	0.433 (2.499)	0.440 (5.481)
Process	GARCH (1,1)	GARCH (0,1)	GARCH (1,1)	GARCH (1,1)	GARCH (1,1)

Notes: The values in parenthesis are z-statistic. The \* indicates that it is not significant.

## Empirical Analysis and Results

### A. Time series properties

Before estimating the cointegration parameters, the order of integration of each series should be examined. For each series, we examine the time series properties of the variables using the ADF test. We conducted both the intercept and intercept and trend assumptions in carrying out the unit root tests and the results confirm that all the series are non-stationary in their level but stationary in their first difference. The results of the unit roots test are reported in Table 2.

Table 2. ADF Unit Roots Test

	Intercept	Intercept & Trend	Order of Integration
Income:			
Malaysia	-1.705(-6.038*)	-2.462(-6.177*)	I(1)
US	-0.869(-3.495*)	-1.314(-3.507*)	I(1)
Singapore	-1.214(-7.489*)	-3.967**(-7.472*)	I(1)
Japan	-2.510(-4.169*)	-2.550(-4.151*)	I(1)
UK	-1.005(-4.546*)	-0.636(-4.556*)	I(1)
Korea	-0.400(-6.830*)	-2.237(-6.807*)	I(1)
Malaysia Trade Balance with:			
US	-2.346(-9.825*)	-3.615**(-9.792*)	I(1)
Singapore	-3.253**(-8.813*)	-4.459*(-8.829*)	I(0)
Japan	-0.900(-6.754*)	-2.052(-6.838*)	I(1)
UK	-2.239(-6.574*)	-1.962(-6.614*)	I(1)
Korea	-2.071(-8.234*)	-1.920(-8.354*)	I(1)

*The Long-run Impact of Bilateral Real Exchange Rate Volatility*

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Malaysia Relative Price with:			
US	-1.241(-5.679*)	-1.472(-5.735*)	I(1)
Singapore	-0.221(-5.127*)	-2.692(-5.105*)	I(1)
Japan	-0.091(-6.321*)	-3.645**(-6.304*)	I(1)
UK	-1.502(-6.516*)	-2.498(-6.481*)	I(1)
Korea	-2.093(-6.888*)	-3.282(-6.979*)	I(1)
GARCH Real Exchange Rate Volatility			
RM/US\$	-3.367**(-7.970*)	-3.362(-7.946*)	I(0)
RM/S\$	-3.644*(9.254*)	-3.642**(-9.225*)	I(0)
RM/Yen	-3.017**(-7.138*)	-3.007(-7.123*)	I(0)
RM/£	-3.630*(-7.805*)	-3.618**(-7.783*)	I(0)
RM/Won	-3.424**(-5.858*)	-3.436(-5.841*)	I(0)

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Notes:

The Null hypothesis is that the series is I(1).

The ADF test for the first difference of each variable is shown in parenthesis.

\* (\*\*) indicates rejection is significant at statistic level at 1% (5%).

The critical values for rejection are -3.47(-2.88) at a significant level of 1%(5%) for intercept term.

The critical values for rejection are -4.02(-3.44) at a significant level of 1%(5%) for intercept and trend term.

These values are provided by the Eviews output based on MacKinnon (1996).

## B. Long-run relationships

It is well known that the results of the Johansen-Juselius procedure are sensitive to lag length. Prior to testing for the cointegration we need to determine the number of lags in each cointegration equation, and to choose the one that seems most plausible for the data in hand. The optimal lag length on each of the VAR/VECM model was sequentially determined by an information criterion, such as AIC or SC, subject to that choice passing a test for the absence of serial correlation (e.g. the Lagrange-Multiplier test). Based on the AIC criterion (and passing the test of serial correlation), the results indicate that the optimum lag length is four for the UK, five for the US and Korea, six for Singapore and seven for Japan.

In Table 3, we present our cointegration results and associated statistics. On the basis of a standard set of significance variables (that is, the values unadjusted for small sample bias), there is strong evidence of cointegration for all five countries. The results provide empirical support for the existence of a long-run cointegrating relationship between the

variables. Given that our sample size is relatively small, we also adjusted the Trace and Maximum eigenvalue statistics using Reimers's (1992) small sample correction (see Equation (7) and (8) above), reported in the columns labelled  $T - np$ . With these adjusted statistics, the results indicate that there is a single unique significant vector for all countries and we therefore proceed on this basis. Since we have one cointegrating vector in our model for all the countries, an economic interpretation of the results can be obtained by normalizing the cointegrating vector on the trade balance. In Table 4 we report the estimated coefficients of the cointegrating vector and the error correction adjustment.

The exchange rate volatility coefficients appear with a positive sign in the trade balance of Malaysia with the US, UK and Korea and a negative sign for Malaysia with Singapore and Japan. The results are statistically significant for Malaysia-US and Malaysia-Singapore models, while statistically insignificant for Malaysia-UK, Malaysia-Japan and Malaysia-Korea models. Based on these results, we found that the impact of exchange rate volatility on trade balance in this study is ambiguous. This is in line with theories which say the impact of exchange rate volatility on trade balance is not certain and depends on the nature of the assumptions made.

The effects of exchange rate volatility on Malaysia's trade balance with the five trading partners vary across these partners could be due to the compositions of Malaysia's exports and imports with them. Malaysian exports are due primarily to manufacturing sectors and in which more than 60% consists of electrical and electronic products. For the whole of the 1990s, the United States emerged as the largest importer of Malaysian electrical and electronic products, having about one third of the total export shares. Thus, even though the exchange rate is highly volatile, Malaysia's trade balance is not decreasing with the United States because of the long-run institutional relationships evident in electronics.

The negative impact of exchange rate volatility on Malaysia's trade balance with Singapore could be due to the fact that Singapore's imports were mainly for re-exporting to Malaysia in the form of finished products. Thus, when exchange rate is highly volatile, Malaysian exporters would increase the exports price in order to avoid any decline in profits caused by an increase in exchange rate volatility. As a result of the increase in the price, exports to Singapore would fall and the trade balance with Singapore would deteriorate. The insignificant impact on Malaysia's trade balance with the UK, Japan and Korea shows that exchange rate

Table 3. Cointegration test results: Measurement of real exchange rate volatility: GARCH

	US		Singapore		Japan		UK		Korea	
	T	T-1p	T	T-1p	T	T-1p	T	T-1p	T	T-1p
TR none	101.92*	84.93*	101.14*	80.78*	116.31*	88.80*	116.56*	97.13*	117.94*	98.28*
TR at most 1	64.70*	53.92	66.06*	52.76	59.38*	45.34	64.74*	53.96	64.29*	53.58
TR at most 2	37.68*	31.40	38.28*	30.57	34.62	26.43	36.71*	30.59	35.69*	29.74
TR at most 3	19.02	15.85	21.64*	17.29	18.50	14.13	17.54	14.61	16.13	13.44
TR at most 4	6.22	5.18	8.16	6.51	5.63	4.30	3.71	3.09	3.88	3.24
LR none	37.22*	31.01	35.08*	28.02	37.31*	28.49	51.81*	43.18*	53.65*	44.70*
LR at most 1	27.02	22.52	27.78	22.19	24.76	18.91	28.04	23.37	28.61*	23.84
LR at most 2	18.66	15.55	16.63	13.28	16.12	12.30	19.17	15.97	19.56	16.30
LR at most 3	12.81	10.67	13.49	10.77	12.87	9.93	13.83	11.53	12.25	10.20
LR at most 4	6.22	5.18	8.15	6.51	5.63	4.30	3.71	3.09	3.88	3.24
E1	0.22		0.21		0.22		0.29		0.30	
E2	0.16		0.17		0.15		0.17		0.17	
E3	0.12		0.11		0.10		0.12		0.12	
E4	0.08		0.08		0.08		0.09		0.08	
E5	0.04		0.05		0.03		0.02		0.03	

Notes: The entries in the rows labelled TR none to TR at most 4 and LR none to LR at most 4 are the estimates of the Trace test and Maximum eigenvalue test, respectively. The entries in the rows labelled E1 to E5 are the eigenvalues for each cointegrating vector

volatility is not an important factor in determining trade with these three countries.

The results concerning the long-run relationship between the trade balance and domestic income show statistically significant positive relationship in the trade balance with the US and the UK, significant negative relationship with Japan and Korea and insignificantly negative relationship with Singapore. Theoretically, the results of the coefficients of the domestic income are expected to be negative if the increase in the domestic income was an increase in the real income, and would be positive if the increase in the domestic income was due to an increase in the production activity of import substitutes.

In this study, we could conclude that the increase in Malaysian income during the study periods was due to an increase in real income, rather than an increase in import substitutes because during those periods Malaysia was embarking upon a more advanced stage of industrialisation. So, the negative sign of the Malaysian domestic income coefficients in the trade balance with Singapore, Japan and Korea revealed that Malaysia was importing largely from these countries. Moreover, during these periods the Malaysian government had launched a 'look to East' policy as a way to boycott Western products. Apart from that, the goods from these Asian countries are much cheaper compared to the Western goods in terms of ringgit values. This explains why the domestic income coefficients in the trade balance with the US and the UK are positive. It showed that Malaysia is importing less from these two countries.

We found the results for the long-run relationship between the trade balance and foreign income of all the models to be significantly positive except in the Malaysia-US model. The estimated coefficients are expected to be positive if the increase in the foreign partners' income were assumed to be due to an increase in real income and negative if the increases were assumed to be the results of the increase in the production of import substitutes. Based on the results, we could conclude that an increase in the income of Malaysia's trading partners (i.e. Singapore, Japan, the United Kingdom and Korea) was due to an increase in real income. But in the United States, the increase in the income could be due to an increase in imports substitutes.

Theoretical models stated that the trade balance should show a negative long-run relationship with relative price, since an increase in the domestic price would make exports to fall. However, the results in this study seem to be contradictory in most cases. The coefficients of the relative price have a positive sign for Malaysia's relationships with

Table 4. Estimated Cointegration Coefficients and Error Correction Adjustment: GARCH Volatility.

Trade Partner	$w$	$w^*$	$p$	$\sigma$	$\alpha_{tb}$	$\alpha_w$	$\alpha_{w^*}$	$\alpha_p$	$\alpha_\sigma$
US	6.30 (1.60) [3.93]	-20.08 (4.70) [4.27]	43.32 (12.18) [3.56]	140.54 (33.91) [4.14]	-0.05 (0.02) [-2.06]	0.01 (0.01) [1.54]	-0.001 (0.001) [-1.71]	-0.002 (0.001) [-2.74]	0.002 (0.001) [3.57]
Singapore	-3.01 (1.55) [-1.94]	4.30 (2.10) [2.05]	-4.30 (3.80) [-1.13]	-251.01 (86.55) [-2.90]	-0.001 (0.02) [-0.04]	-0.02 (0.01) [-2.95]	0.03 (0.02) [1.68]	-0.0001 (0.001) [-0.15]	-0.001 (0.0004) [-1.81]
Japan	-2.34 (0.19) [-11.9]	2.39 (0.33) [7.36]	8.17 (0.57) [14.27]	-9.85 (9.21) [-1.07]	-0.23 (0.11) [-2.14]	-0.25 (0.06) [-4.40]	0.02 (0.02) [0.81]	0.01 (0.01) [1.62]	0.003 (0.001) [2.22]
UK	3.22 (1.07) [3.02]	18.54 (6.93) [2.68]	-62.41 (14.43) [-4.32]	124.64 (90.35) [1.38]	0.02 (0.01) [1.19]	0.02 (0.004) [6.66]	0.001 (0.001) [1.90]	-0.0004 (0.001) [-0.96]	-0.0001 (0.0002) [-0.60]
Korea	-3.47 (1.38) [-2.50]	5.42 (1.20) [4.53]	19.67 (5.95) [3.30]	5.57 (13.02) [0.43]	0.05 (0.04) [1.27]	-0.03 (0.01) [-4.05]	-0.03 (0.01) [-4.48]	0.005 (0.001) [4.66]	0.001 (0.001) [1.54]

Notes:  $tb$  = trade balance,  $w$  = domestic income,  $w^*$  = foreign income,  $p$  = relative price,  $\sigma$  = volatility.

Standard errors are in brackets and t-statistics are in parentheses.

the US, Japan and Korea, while a negative sign for the relationships with Singapore and the UK. All the coefficients are statistically significant except for the case of Malaysia with Singapore. The positive sign in the trade balance model of Malaysia with the US, Japan and Korea could be due to the fact that domestic products are considered to be superior products or basic necessities for these foreign countries. That is why, even though the price of the domestic products increases exports increases. As for the trade balance model of Malaysia and the UK, the results are consistent with the theories. The negative sign means that the UK imports lesser products from Malaysia when Malaysian products increase in price.

## Summary and Conclusion

In this study, our primary objective is to assess the long-run impact of bilateral exchange rate volatility on Malaysia's bilateral trade balance. The responsiveness of trade balance to exchange rate volatility is a crucial

issue in trade or exchange rate policies. In order to establish the relationship, we focus on five trading partners that Malaysia has the most trade with (i.e. the United States, Singapore, Japan, the United Kingdom and the Republic of Korea) and have applied the GARCH model for exchange rate volatility. The Johansen cointegration test reveals that all five variables: trade balance, domestic income, foreign income, relative price and exchange rate volatility in the trade balance function have a tendency to move together in the long-run.

Overall, the results indicate that exchange rate volatility did have a statistically significant impact on Malaysia's trade balance with the United States and Singapore and no impact at all on its trade balance with the UK, Japan and the Republic of Korea. The results show that exchange rate volatility has a positive and negative impact on Malaysia's trade balance with the United States and Singapore, respectively. These imply that the effects of exchange rate volatility on trade balance would be different across trading partners, and depend on assumptions in the behaviour of the traders and the hedging mechanisms available to them. Therefore, we could conclude that, this study revealed that there is a positive long-run impact of exchange rate volatility on the trade balance of Malaysia with the United States, a negative long-run impact on the trade balance of Malaysia with Singapore and no impact on the trade balance of Malaysia with the other three countries.

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*The Long-run Impact of Bilateral Real Exchange Rate Volatility*

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