International Journal of Business and Society, Vol. 20 No 2, 2019, 605-626

VOLATILITY AND BILATERAL EXPORTS IN MALAYSIA

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ABSTRACT

This study examines the impact of volatility, namely exchange rate volatility and oil price volatility on Malaysia's bilateral total exports and on sub-categories of Malaysia's bilateral total exports by standard international trade code (SITC) with China, Singapore, Japan, Korea and the United States (US). Exchange rate volatility and oil price volatility are estimated by a stochastic volatility model. The autoregressive distributed lag (ARDL) models are used to examine the impact of exchange rate volatility and oil price volatility on Malaysia's bilateral exports. Exchange rate volatility and oil price volatility in many cases are found to have some significant impact on Malaysia's bilateral exports and sub-categories of Malaysia's bilateral total exports in the short run and long run. Moreover, exchange rate volatility is found to have relatively more significant impact than oil price volatility on Malaysia's bilateral exports and sub-categories of Malaysia's bilateral total exports in the short run and long run. The impact of exchange rate volatility and oil price volatility on bilateral exports can be negative or positive and can be different for sub-categories of bilateral exports. Positive or negative exchange rate volatility or oil price volatility tends to have positive or negative impact on bilateral exports. Generally, volatility can influence Malaysia's bilateral exports.

Keywords: Exchange rate volatility; oil price volatility; Stochastic volatility; Autoregressive distributed lag; Bilateral exports; Malaysia

Received: 8 June 2018
Accepted: 12 January 2019

1. INTRODUCTION

Volatility implies uncertainty and risk, which can adversely influence exports. Volatility can be due to exchange rate and other factor such as oil price. Generally, exchange rate is volatile for countries adopt a flexible or managed exchange system after the breakdown of the Bretton Woods system in 1973. A risk averse exporter would reduce exports with increase in exchange rate volatility. Thus, exchange rate volatility discourages exports (Asteriou, Masatci and Pılbeam, 2016; Chi and Cheng, 2016; Bahmani-Oskooee and Aftab, 2017). Conversely, a few study reports that exchange rate volatility has a positive impact on exports (De Grauwe, 1988). Several studies report that there is no significant impact of exchange rate volatility on exports (Bahmani-Oskooee, Iqbal and Salam, 2016). This may due to amongst other inelasticity of export demand or incomplete exchange rate pass-through. The impact of exchange rate volatility on exports is actively researched (Aftab, et al. 2016; Pino, Tas and Sharma, 2016; Soleymani, Chua and Hamat, 2017).

Oil is an important source of energy in economy. The world oil price highly fluctuated in the 2010s. The fluctuation of the world oil price has adversely impact on the real and financial sectors in

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economy (Riggi and Venditti, 2015; Diaz, Molero and De Gracia, 2016). Therefore, export would be adversely affected when the real and financial sectors in economy had been adversely affected. Oil price shock can reduce export duration. Wang, Zhu and Wang (2017) find that oil price shock has significantly negative impact on China's export duration. Oil price shock reduces export duration in non-energy intensive industries more than in energy intensive industries. Moreover, oil price shock influences non-processing firms more than processing firms. There are many studies reported the negative impact of oil price shock on stock returns (Singhal and Ghosh, 2016) or the impact of oil price shock and oil price volatility on stock returns (Luo and Qin 2017). The impact of oil price shock on economy can be asymmetric, that is, an increase in oil price shock has a more significant impact on economy than a decrease in oil price shock on economy (Bastianin, Conti and Manera, 2016).

Singapore is the main importer of Malaysia's exports. In 2015, exports of Malaysia to Singapore were about 13.9 per cent of total exports. This was followed by China (13.1%), the United States (US) (9.5%) and Japan (9.4%). Malaysia exported a small percentage of its total exports to Korea (3.2%). The total exports of Malaysia to Singapore, China, the US, Japan and Korea were about 49.1 per cent in 2015 (Ministry of Finance Malaysia, 2015, 2016). In 2015, the main exports of Malaysia to Singapore were SITC 7, SITC 3 and SITC 8, which were Malaysian ringgit (RM) 50,556.4 million, RM22,309.9 million and RM11,887.5 million or about 46.6 per cent, about 20.6 per cent and about 11.0 per cent of exports Malaysia to Singapore, respectively. The main exports of Malaysia to China were SITC 7, SITC 3 and SITC 5, which were RM46,595.0 million, RM14,640.6 million and RM10,817.9 million or about 45.9 per cent, about 14.4 per cent and about 10.7 per cent of exports Malaysia to China, respectively. The main exports of Malaysia to the US were SITC 7, SITC 8 and SITC 6, which were RM45,976.4 million, RM17,146.8 million and RM3,698.7 million or about 62.4 per cent, about 23.3 per cent and about 5.0 per cent of exports Malaysia to the US, respectively. The main exports of Malaysia to Japan were SITC 3, SITC 7 and SITC 6, which were RM32,387.2 million, RM20,309.1 million and RM6,289.5 million or about 43.9 per cent, about 27.5 per cent and about 8.5 per cent of exports Malaysia to Japan, respectively (Ministry of Finance Malaysia, 2015, 2016).The main exports of Malaysia to Korea were SITC 3, SITC 7 and SITC 6, which were RM8,634.6 million, RM6,971.6 million and RM4,065.5 million or about 34.2 per cent, about 27.6 per cent and about 16.1 per cent of exports Malaysia to Korea, respectively (Ministry of Finance Malaysia, 2015, 2016). In 2015, exports of SITC 7, SITC 8, SITC 6 and SITC 3 were the main exports of Malaysia. The main components of exports of SITC 7 are thermionic valves and tubes, photocells and parts thereof, automatic data processing machines and units thereof and telecommunications equipment. The main components of exports of SITC 8 are measuring, checking, analysing and controlling instruments and apparatus. The main components of exports of SITC 6 are mineral manufactures. The main components of exports of SITC 3 are natural gas, whether or not liquefied, petroleum products, refined and petroleum oils, crude and crude oils obtained from bituminous minerals.

This study examines the impact of exchange rate volatility and oil price volatility on Malaysia's bilateral total exports and sub-categories of Malaysia's bilateral total exports by standard international trade code (SITC) from 0 to 9 with China, Singapore, Japan, Korea and the US. SITC is a widely used classification of exports and imports maintained by the United Nation (United Nations, 2006). This study provides some evidence of the impact of exchange rate volatility and as well as oil price volatility on bilateral total exports and also sub-categories of bilateral total exports. Oil price was volatile especially in the recent period (Herrera, Hu and Pastor, 2018). The impact of exchange rate volatility and oil price volatility on bilateral total exports and sub-categories of bilateral total exports can be different due to different degree of sensitivity of bilateral exports and industries to volatility. Moreover, there are not many studies examined the impact of oil price volatility on bilateral exports. Exchange rate volatility and oil price volatility are estimated by a stochastic volatility model, which is selected from a group of stochastic volatility models (Chan and Hsiao, 2014; Chan and Grant, 2016). The stochastic volatility models are demonstrated to be good models in estimating volatility. The measurement of volatility can be a matter of the significant impact of exchange rate volatility and oil price volatility on bilateral exports (Chi and Cheng, 2016). There are not many studies examined the impact of exchange rate volatility on exports using a stochastic volatility model. The asymmetric autoregressive distributed lag (ARDL) approach is used to investigate the positive and negative impact of exchange rate volatility and oil price volatility on bilateral exports (Choudhry and Hassan, 2015).

2. LITERATURE REVIEW

Exchange rate volatility is found to have negative significant impact on exports. However, the impact of exchange rate volatility varies across categories of exports. Aftab, et al. (2016) examine the impact of exchange rate volatility on Malaysia's bilateral trade with European Union using industry level monthly data for the period from January, 2000 to December 2013. The results of the ARDL approach show that exchange rate volatility is found to have significant impact on many imports and exports in the short run and a few imports and exports of Malaysia's bilateral trade is found to have significant impact in the long run. Furthermore, the global financial crisis, 2007-2008 is found to have significant impact on Malaysia's bilateral trade with European Union. Bahmani-Oskooee and Aftab (2017) investigate the asymmetric impact of exchange rate volatility on 54 Malaysia's bilateral exports to the US and 63 Malaysia's bilateral imports from the US using the ARDL approach. The study reports that the asymmetric impact of exchange rate volatility is found to be significant for about 1/3 of the bilateral imports and exports between the US and Malaysia. Soleymani, Chua and Hamat (2017) find that real exchange rate volatility has a significant negative impact on 15 export and four import models in the short run and long run. The impact of four countries 'currencies of Association of South East Asian (ASEAN), namely Indonesia, Malaysia, Singapore and Thailand against yuan exchange rate volatility respectively dominates the effect of the third country exchange rate volatility on four countries of ASEAN's trade.

The impact of exchange rate volatility on export varies across countries. Chi and Cheng (2016) examine the impact of exchange rate volatility on Australia's maritime export volume with its Asian trading partners, namely China, Japan, Republic of Korea, Taiwan, India, Indonesia and Malaysia respectively using quarterly data for the period from quarter 1, 2000 to quarter 2, 2013. Two measures of exchange rate volatility are used, namely the generalized autoregressive conditional heteroskedasticity (GARCH) (1,1) models and mean adjusted relative change measures. Exchange rate volatility is found to have a significant negative impact on maritime export volume in the long run but the impact is found to vary across country pairs. Moreover, different measure of exchange rate volatility can produce different impact. Pino, Tas and Sharma (2016) show that exchange rate volatility is found to have a significant impact on exports in the short run and long run. The negative impact of exchange rate volatility is dominated for all countries examined, except for Singapore. However, the impact of exchange rate volatility varies across countries in the short run. The conclusions are about the same to different measurements of exchange rate volatility.

The impact of exchange rate volatility can be different across measurements of exchange rate volatility. Wang and Zhu (2016) inspect the impact of Reminbi (RMB) exchange rate on trade in China using the spatial panel model and Markov Chain Monte Carlo estimation method for the period from quarter 1, 1993 to quarter 3, 2013. The results reveal that the RMB against the US dollar exchange rate is widely used in trade settlement has more significant impact on Chinese export. One per cent appreciation of the RMB against the US dollar exchange rate will lead to about 1.532 per cent decline in Chinese export. Conversely, one per cent appreciation of the RMB against the nominal effective exchange rate will lead to about 0.42 per cent decline in Chinese export. One per cent increases in the RMB against the US dollar exchange rate volatility will lead to about 0.579 per cent decline in Chinese export. China should improve the foreign exchange derivatives market to reduce the adverse impact of exchange rate volatility.

There are studies found insignificant impact of exchange rate volatility on exports. Bahmani-Oskooee, Iqbal and Salam (2016) study the impact of exchange rate volatility on 44 Pakistani export industries to Japan and 60 Pakistani import industries from Japan using the ARDL approach for annual data from 1980 to 2014. The results show that exchange rate volatility is mainly found not to have significant impact on trade between Pakistan and Japan in the short run and long run. Bouoiyour and Selmi (2016) survey literature of exchange rate volatility on trade using the meta-regression analysis on 41 studies. The results show exchange rate volatility impact to have a significant impact on trade after correction of publication bias, that is, the result is heterogeneity with respect to model specifications, samples, time horizons and countries' characteristics.

The impact of exchange rate volatility on exports is actively researched. The ARDL approach is widely used in the estimation. The measurement of exchange rate volatility is mostly non-stochastic such as estimated by an ARCH model or a moving-average standard deviation measure. The aggregated data and bilateral data are used to examine the impact of exchange rate volatility on exports. Generally, exchange rate volatility is found to have a significant impact on export. However, the impact of exchange rate volatility can be varied across categories of exports, across countries and across measurements of exchange rate volatility. There are several studies found insignificant impact of exchange rate volatility on exports.

3. DATA AND METHODOLOGY

Bilateral total exports ($x_{t,t}$) is the sum of export values of SITC from 0 to 9 divided by total exports price index (2005 = 100). Bilateral exports of SITC from 0 to 9 ($x_{i,t}$, $i = 0, \ldots, 9$) are export values of SITC from 0 to 9 divided by export price indexes (2005 = 100) of SITC from 0 to 9, respectively. SITC 0 is food and live animals. SITC 1 is beverages and tobacco. SITC 2 is crude materials, inedible, except fuels. SITC 3 is mineral fuels, lubricants and related materials. SITC 4 is animal and vegetable oils, fats and waxes. SITC 5 is chemicals and related products. SITC 6 is manufactured goods classified by material. SITC 7 is machinery and transport equipment. SITC 8 is miscellaneous manufactured articles. SITC 9 is commodities and transactions not classified elsewhere in SITC. Exchange rate is the Malaysian ringgit (RM) against foreign currency multiplied by relative consumer price index (CPI, 2005 = 100) of Malaysia over CPI (2005 = 100) of foreign country. Exchange rate volatility (v_t) or oil price volatility (o_t) is exchange rate (e_t) or oil price (*3 spot price index*, 2005 = 100) is estimated by a stochastic volatility model. Foreign demand (y_t) is expressed by industrial production index (2005 = 100) or manufacturing production index of foreign country, except China, which foreign demand is expressed by industrial value-added of China (2005 = 100). Total exports, export values of SITC from 0 to 9, export price indexes and export values of the trading partner of Malaysia were obtained from *Malaysia External Trade Statistics System*, Department of Statistics Malaysia. Industrial value-added of China was obtained from the website of National Bureau of Statistics of China. Exchange rates were obtained from *Monthly Statistical Bulletin*, Central Bank of Malaysia. Oil price was obtained from *International Financial Statistics*, International Monetary Fund. The data were seasonal adjusted using the census X13 multiplicative or additive method and were transformed into the logarithm. The sample period is from January, 2010 to July, 2016. The beginning of sample period is restricted by the availability of the monthly export price indexes in Malaysia, which begins from January, 2010.

The standard stochastic volatility (SV) model is expressed as follows:

$$\begin{aligned} y_t &= \mu + \epsilon_t^y,\ \epsilon_t^y \sim N(0, exp^{h_t}) \\ h_t &= \mu_h + \phi_h\left(h_{t-1} - \mu_h\right) + \epsilon_t^h,\ \epsilon_t^h \sim N(0, \omega_h^2) \end{aligned} \quad (1)$$

where y_t is ln e_t, ln is logarithm, N is normally distributed and exp is exponential. The logarithm volatility, h_t is assumed to follow a stationary autoregressive with order one process with $|\phi_h| < 1$ and unconditional mean, μ_h. The process is initialised with $h_t \sim N(\mu_h, \omega_h^2/(1 - \phi_h^2)$.

The stochastic volatility with h_t follows a stationary autoregressive with order two process (SV2) model is expressed as follows:

$$\begin{aligned} y_t &= \mu + \epsilon_t^y,\ \epsilon_t^y \sim N(0, exp^{h_t}) \\ h_t &= \mu_h + \phi_h\left(h_{t-1} - \mu_h\right) + \rho_h\left(h_{t-2} - \mu_h\right) + \epsilon_t^h,\ \epsilon_t^h \sim N(0, \omega_h^2) \end{aligned} \quad (2)$$

where when $\rho_h = 0$, model 2 is reduced to model 1.

The stochastic volatility in mean (SVM) model is expressed as follows:

$$\begin{aligned} y_t &= \mu + \lambda exp^{h_t} + \epsilon_t^y,\ \epsilon_t^y \sim N(0, exp^{h_t}) \\ h_t &= \mu_h + \phi_h\left(h_{t-1} - \mu_h\right) + \epsilon_t^h,\ \epsilon_t^h \sim N(0, \omega_h^2) \end{aligned} \quad (3)$$

where λ captures the extent of volatility feedback and when $\lambda = 0$, the SVM model is reduced to the SV model.

The stochastic volatility with *t* error (SVT) model is expressed as follows:

$$\begin{aligned} y_t &= \mu + \epsilon_t^y,\ \epsilon_t^y \sim t_v(0, exp^{h_t}) \\ h_t &= \mu_h + \phi_h\left(h_{t-1} - \mu_h\right) + \epsilon_t^h,\ \epsilon_t^h \sim N(0, \omega_h^2) \end{aligned} \quad (4)$$

The stochastic volatility with moving average (SVMA) model is expressed as follows:

$$\begin{aligned} y_t &= \mu + \epsilon_t^y \\ \epsilon_t^y &= u_t + \psi u_{t-1},\ u_t \sim N(0, exp^{h_t}) \\ h_t &= \mu_h + \phi_h\left(h_{t-1} - \mu_h\right) + \epsilon_t^h,\ \epsilon_t^h \sim N(0, \omega_h^2) \end{aligned} \quad (5)$$

where u_t and $|\psi| < 1$ (Chan and Hsiao, 2014). The SV, SV2, SVM, SVT and SVMA are used to estimate volatility of all exchange rates and oil price. Volatility of which stochastic volatility model will be used in the analysis or estimation is based on the largest value of marginal likelihood.

The export models to be estimated are specified as follows:

Model 1 $\ln x_t = \beta_{11} \ln e_t + \beta_{12} \ln y_t + \beta_{13} v_t + \beta_{14} o_t + u_{1,t}$ (6)

Model 2 $\ln x_t = \beta_{21} \ln e_t + \beta_{22} \ln y_t + \beta_{23} v_t^+ + \beta_{24} v_t^- + \beta_{25} o_t^+ + \beta_{26} o_t^- + u_{2,t}$ (7)

where $v_t^+ = \sum_{j=1}^{t} \Delta v_j^+$, $\Delta v_t^+ = \max(\Delta v_t, 0)$ and $v_t^- = \sum_{j=1}^{t} \Delta v_j^-$, $\Delta v_t^- = \min(\Delta v_t, 0)$ are partial sum process of positive and negative changes in v_t, respectively, $o_t^+ = \sum_{j=1}^{t} \Delta o_j^+$, $\Delta o_t^+ = \max(\Delta o_t, 0)$ and $o_t^- = \sum_{j=1}^{t} \Delta o_j^-$, $\Delta o_t^- = \min(\Delta o_t, 0)$ are partial sum process of positive and negative changes in o_t, respectively and $u_{i,t}$ (i = 1, 2) is a disturbance term (Schorderet, 2001; Shin, Yu and Greenwood-Nimmo, 2014; Choudhry and Hassan, 2015). Generally, exchange rate is expected to have negative impact on bilateral exports. Foreign demand is expected to have positive impact on bilateral exports. Exchange rate volatility or oil price volatility is expected to have negative impact on bilateral exports (Bahmani-Oskooee and Harvey, 2011).

The error correction models of the export models respectively are as follows:

$$\begin{aligned} \text{Model 1 } \Delta \ln x_t = \ & \beta_{30} + \textstyle\sum_{i=0}^{a} \beta_{31i} \Delta \ln e_{t-i} + \sum_{i=0}^{b} \beta_{32i} \Delta \ln y_{t-i} + \sum_{i=0}^{c} \beta_{33i} \Delta v_{t-i} \\ & + \textstyle\sum_{i=0}^{d} \beta_{34i} \Delta o_{t-i} + \sum_{i=1}^{f} \beta_{35i} \Delta \ln x_{t-i} + \beta_{36}\, ec_{t-1} + u_{3,t} \end{aligned} \quad (8)$$

$$\begin{aligned} \text{Model 2 } \Delta \ln x_t = \ & \beta_{40} + \textstyle\sum_{i=0}^{a} \beta_{41i} \Delta \ln e_{t-i} + \sum_{i=0}^{b} \beta_{42i} \Delta \ln y_{t-i} + \sum_{i=0}^{c} \beta_{43i} \Delta v_{t-i}^+ \\ & + \textstyle\sum_{i=0}^{d} \beta_{44i} \Delta v_{t-i}^- + \sum_{i=0}^{f} \beta_{45i} \Delta o_{t-i}^+ + \sum_{i=0}^{g} \beta_{46i} \Delta o_{t-i}^- \\ & + \textstyle\sum_{i=1}^{h} \beta_{47i} \Delta \ln x_{t-i} + \beta_{48}\, ec_{t-1} + u_{4,t} \end{aligned} \quad (9)$$

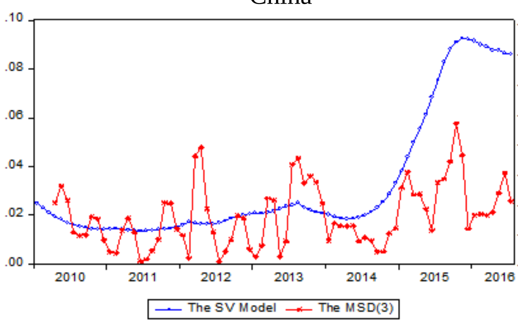
where Δ is the first difference operator, ec_{t-1} is an error correction term and $u_{i,t}$ (i = 3, 4) is a disturbance term. The ordinary least squares (OLS) estimator with Newey-West standard error is used when no-autocorrelation of the disturbance term is found to be statistically significant and the OLS estimator with Huber-White standard error is used when homoscedasticity of the disturbance term is found to be statistically significant.

4. RESULTS AND DISCUSSIONS

The results of the Dickey and Fuller unit root test statistic, which are not reported show that the variables in this study are the mixture of I(1) and I(0) variables. The estimations of the stochastic volatility models are based on the means of the 21000 draws from the posterior distribution using the Gibbs sampler after a burn-in period of 1000 (Chan and Hsiao, 2014). Exchange rate volatility is found the best estimated by the SVMA model for China and Singapore. The SVM model is the best to estimate exchange rate volatility for Japan, Korea and the US and also for oil price volatility. The results of the SV Models, which are not reported demonstrate that the Ljung-Box tests of the null hypothesis of no serial correlation in the standardised residuals are all not rejected. The McLeod-Li tests of the null hypothesis of no serial correlation in the squared standardised residuals are also all not rejected. The stochastic volatility models are said to be good to capture the time-varying volatility of the data. The parameters estimated are found mainly to be statistically significant. The stochastic volatility process is highly persistent for all models. The posterior means of ϕ_h of the stochastic volatility models are in the values of 0.94 to 0.99. The plots of exchange rate volatility, which is computed by the moving standard deviation with order three [MSD(3)] and estimated by the SVMA/SVM model are given in Figure 1. Exchange rate volatility moves in the same direction. However, the exchange rate volatility estimated by the SVMA/SVM model tended to be non-stationary compared with exchange rate volatility computed by the MSD(3), which is stationary. This can imply that the SVMA/SVM model captures better the exchange rate volatility clustering.

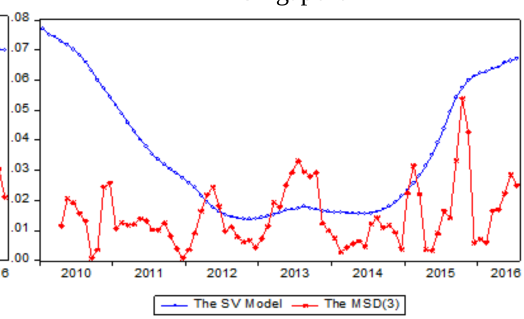
Figure 1: Exchange Rate Volatility Computed by the MSD(3) and Estimated by the SV Model, January, 2010 – July, 2016

China



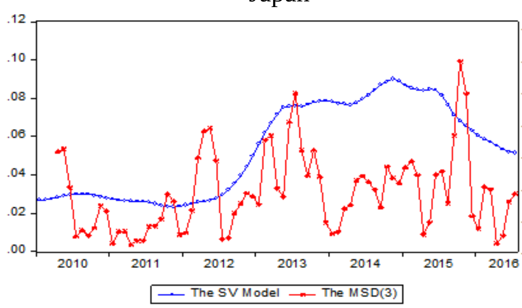
ML = 155.3

Singapore



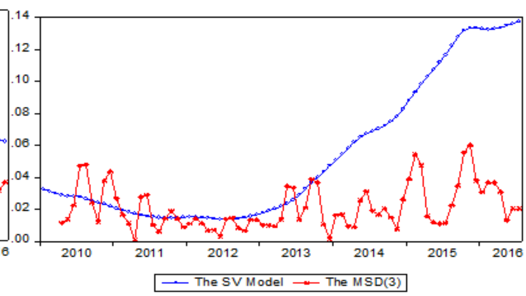
ML = 144.8

Japan

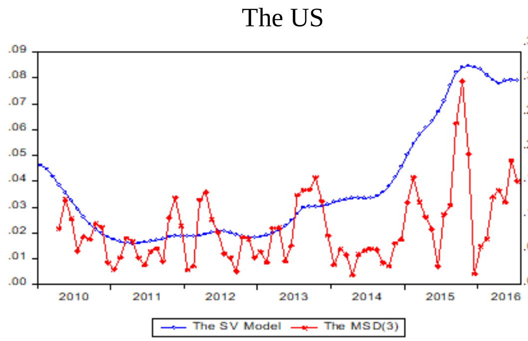


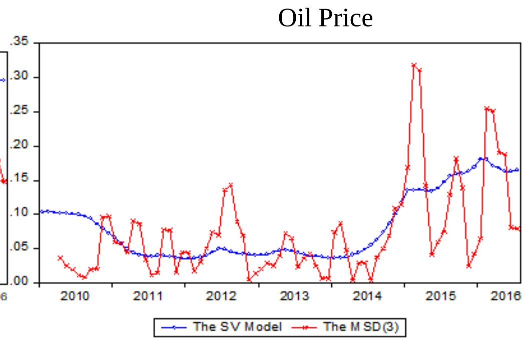
ML = 109.6

Korea



ML = 135





ML = 141.2 ML = 66.5

Note: ML is the marginal likelihood of the SV model.

The ARDL bounds testing approach and the long run coefficients of the ARDL approach are given in Table 1. The Wald statistics are found to be statistically significant. Therefore, there are long-run relationships between exports and their determinants. Generally, exchange rate volatility has no significant long-run impact on Malaysia's export to China, except export of SITC 8. Conversely, oil price volatility has significant long-run impact on Malaysia's total exports and exports of SITC 4, SITC 5, SITC 6, SITC 8 and SITC 9 to China. Exchange rate volatility and oil price volatility are found to have significant long-run impact on Malaysia's exports to Singapore, Japan and Korea. Exchange rate volatility is found to have significant impact on Malaysia's total exports and exports of SITC 0, SITC 1, SITC 4, SITC 7 and SITC 9 to Singapore whereas oil price volatility is found to have significant impact on Malaysia's total exports and exports of SITC 0, SITC 1, SITC 3, SITC 4 and SITC 8 to Singapore. Exchange rate volatility is found to have significant impact on Malaysia's exports of SITC 0, SITC 2, SITC 3, SITC 4, SITC 5, SITC 6, SITC 7 and SITC 9 to Japan. Oil price volatility is found to have significant impact on Malaysia's total exports and exports of SITC 0, SITC 1, SITC 3, SITC 4, SITC 5, SITC 6 and SITC 7 to Japan. Exchange rate volatility is found to have significant impact on Malaysia's exports of SITC 2, SITC 5, SITC 7 and SITC 8 to Korea. Oil price volatility is found to have significant impact on Malaysia's total exports and exports of SITC 0, SITC 5, SITC 6 and SITC 8 to Korea. For Malaysia's exports to the US, exchange rate volatility is found to have more significant long-run impact than oil price volatility on exports. Exchange rate volatility is found to have significant impact on Malaysia's exports of SITC 0, SITC 5, SITC 7, SITC 8 and SITC 9 to the US. Oil price volatility is found to have significant impact on Malaysia's total exports and export of SITC 8 to the US. In the long run, positive exchange rate volatility and negative exchange rate volatility are found to have more significant impact than positive oil price volatility and negative oil price volatility on Malaysia's exports to China and Singapore. Conversely, positive exchange rate volatility and negative exchange rate volatility are found to have about the same impact as positive oil price volatility and negative oil price volatility on Malaysia's exports to Japan, Korea and the US.

Table 1: The Results of Bounds Testing Approach for Cointegration and the Long Run Coefficients of the ARDL Approach

Model 1 – China

	$\ln x_{t,t}$	$\ln x_{0,t}$	$\ln x_{1,t}$	$\ln x_{2,t}$	$\ln x_{3,t}$	$\ln x_{4,t}$
$\ln e_t$	1.2416**	2.9784***	0.5787	3.8662**	3.3711*	0.7630
$\ln y_t$	0.1250**	-0.8501***	-0.7865*	-0.2177	-0.8657***	0.7588***
v_t	2.3362	-5.5265	7.4943	-3.6482	2.0283	3.0888
o_t	-1.8838***	-0.5175	-3.2753	1.2575	-0.4813	-5.6256***
W	7.2732@@@	7.9495@@@	15.9758@@@	6.0968@@@	12.7633@@@	6.2568@@@

	$\ln x_{5,t}$	$\ln x_{6,t}$	$\ln x_{7,t}$	$\ln x_{8,t}$	$\ln x_{9,t}$
$\ln e_t$	-0.2594	7.3060***	0.8506**	-1.8691**	2.2173
$\ln y_t$	-0.2087**	-0.0834	0.2076**	-0.0504	-0.0978
v_t	2.8189	-7.2782	-1.3984	5.7951*	-4.3503
o_t	-1.6293*	-8.8542***	-0.0966	2.1566**	-3.9702*
W	6.6360@@@	6.1350@@@	12.0708@@@	10.5881@@@	3.8930@

Model 1 – Singapore

	$\ln x_{t,t}$	$\ln x_{0,t}$	$\ln x_{1,t}$	$\ln x_{2,t}$	$\ln x_{3,t}$	$\ln x_{4,t}$
$\ln e_t$	1.9185***	0.8308***	1.1600***	3.1228**	2.3535***	-0.2529
$\ln y_t$	0.8985	0.3485*	1.1562***	-2.9848***	0.1319	0.5527
v_t	15.4678***	-1.7390**	-4.5978***	5.8005	-4.8416	8.2794*
o_t	-4.0609**	1.3904***	2.8514***	-0.8784	2.6055*	-5.4003**
W	8.6235@@@	5.8849@@@	12.3571@@@	4.9630@@@	13.6726@@@	7.4493@@@

	$\ln x_{5,t}$	$\ln x_{6,t}$	$\ln x_{7,t}$	$\ln x_{8,t}$	$\ln x_{9,t}$
$\ln e_t$	-0.6588**	0.3221	0.2311	0.7617**	-2.6565
$\ln y_t$	1.7449***	0.0262	1.0313***	0.6021	16.7809**
v_t	-0.1062	-0.6574	4.5236***	0.6893	83.6472**
o_t	0.9930	0.2874	-0.2335	0.9192**	-12.2972
W	15.6560@@@	13.3509@@@	11.4234@@@	8.2351@@@	4.0794@@

Model 1 - Japan

	$\ln x_{t,t}$	$\ln x_{0,t}$	$\ln x_{1,t}$	$\ln x_{2,t}$	$\ln x_{3,t}$	$\ln x_{4,t}$
$\ln e_t$	-0.1914	-1.2477**	9.3317	7.2395***	2.2258***	-2.2772**
$\ln y_t$	-0.6202***	-0.1565	-16.2995**	1.4451**	-1.6290***	-1.6065**
v_t	-1.4586	-8.8361***	32.0068	30.9565***	10.1610***	-16.6818***
o_t	-2.3136***	1.4898***	-11.8839**	-0.2570	-1.9120***	-2.8345***
W	13.8620@@@	18.3112@@@	2.4900	4.7643@@	13.5029@@@	13.5005@@@

	$\ln x_{5,t}$	$\ln x_{6,t}$	$\ln x_{7,t}$	$\ln x_{8,t}$	$\ln x_{9,t}$
$\ln e_t$	-2.2060**	-1.1564	-2.9057***	0.1617	7.0783*
$\ln y_t$	0.0911	-1.4075**	1.3979**	-0.8215**	4.2666*
v_t	-10.6767***	-11.2574**	-14.1956***	-0.4408	35.0510**
o_t	-0.6044*	0.3706***	0.5317*	-0.3591	-0.5030
W	4.5107@@	13.0976@@@	4.4324@@	7.3314@@@	7.4787@@@

Model 1 - Korea

	$\ln x_{t,t}$	$\ln x_{0,t}$	$\ln x_{1,t}$	$\ln x_{2,t}$	$\ln x_{3,t}$	$\ln x_{4,t}$
$\ln e_t$	0.1534	0.9196	6.0690	-19.9494	1.6967	-2.1417
$\ln y_t$	-3.0367**	0.9643	-1.9685	37.8329***	-2.8683*	0.5201
v_t	1.4215	1.3951	-9.0401	58.0147*	-2.6956	3.5473
o_t	-2.4140**	-2.8903**	-0.2649	-12.1026	-0.0517	-0.4425
W	4.4530@@	7.8813@@@	8.0268@@@	5.2451@@@	4.3332@@	4.2335@@
	$\ln x_{5,t}$	$\ln x_{6,t}$	$\ln x_{7,t}$	$\ln x_{8,t}$	$\ln x_{9,t}$	
$\ln e_t$	-0.2436	0.7484	-6.7589*	2.7127	-0.5267	
$\ln y_t$	2.0832**	2.6377	-8.1844**	0.2100	0.6228	
v_t	5.0104**	6.0640	15.0616*	-11.6894*	-4.6327	
o_t	-2.2777**	-7.5186**	-1.7434	5.0515*	0.3293	
W	14.4244@@@	4.9441@@	4.9013@@	5.5683@@@	9.0501@@@	

Model 1 – The US

	$\ln x_{t,t}$	$\ln x_{0,t}$	$\ln x_{1,t}$	$\ln x_{2,t}$	$\ln x_{3,t}$	$\ln x_{4,t}$
$\ln e_t$	0.5979	-23.8337***	-10.2084**	0.6855	-9.4053	-2.1136
$\ln y_t$	0.5595	-4.6927	6.0445*	-2.4817*	-9.7983**	-9.8215**
v_t	0.2847	98.4353**	38.0701	-3.4192	37.8693	18.1329
o_t	1.5793**	-4.0865	1.7804	-1.4903	5.1899	-4.3850
W	6.0196@@@	4.0034@	14.6784@@@	12.6062@@@	16.1700@@@	3.4037
	$\ln x_{5,t}$	$\ln x_{6,t}$	$\ln x_{7,t}$	$\ln x_{8,t}$	$\ln x_{9,t}$	
$\ln e_t$	-5.4978**	-0.2395	-0.3483	2.6531**	10.4386**	
$\ln y_t$	2.3314	0.3483	-0.6553**	-0.1049	16.8291***	
v_t	30.2687**	6.0651	5.9659**	-13.0672**	-69.7834***	
o_t	-2.1934	-1.1946	0.3857	2.9969***	3.6585	
W	4.8015@@	5.1030@@@	11.0574@@@	3.1466	6.9535@@@	

Model 2 - China

	$\ln x_{t,t}$	$\ln x_{0,t}$	$\ln x_{1,t}$	$\ln x_{2,t}$	$\ln x_{3,t}$	$\ln x_{4,t}$
$\ln e_t$	-0.4927	2.3670**	5.3155**	-0.1594	-0.1274	-0.2476
$\ln y_t$	0.0993	-0.6348***	-1.0061**	0.4269*	-1.1149***	0.8267***
v_t^+	7.0902**	-7.4489*	-13.4218**	20.5297**	14.4789***	4.2991
v_t^-	-3.6033	7.6443	34.1240**	-24.8528**	-29.6143***	16.0780*
o_t^+	-0.8968	1.8289	-1.2761	-1.6316	-2.1915	-2.1345
o_t^-	-1.3297	-0.7971	-0.7843	-1.4905	-1.4612	-5.4624**
W	4.2664@@	3.1754	9.3907@@@	3.8556@@	5.8582@@@	5.1188@@@
	$\ln x_{5,t}$	$\ln x_{6,t}$	$\ln x_{7,t}$	$\ln x_{8,t}$	$\ln x_{9,t}$	
$\ln e_t$	0.4194	11.9708**	-0.3589	1.9847*	-6.7718	
$\ln y_t$	-0.4683***	-1.3005***	0.2159***	-0.1685	1.1179	
v_t^+	-4.3424**	-9.8058	2.1931***	0.3344	37.8969*	
v_t^-	13.4607**	54.1194**	-3.4835*	2.0072	0.0919	

	$\ln x_{5,t}$	$\ln x_{6,t}$	$\ln x_{7,t}$	$\ln x_{8,t}$	$\ln x_{9,t}$
o_t^+	-0.9613	-32.2650***	0.5176	-0.6802	-1.4804
o_t^-	-1.0061	8.1425	0.3583	1.9954*	-10.4410**
W	7.7713@@@	4.2301@@	6.4359@@@	5.4943@@@	3.9500@@

Model 2 - Singapore

	$\ln x_{t,t}$	$\ln x_{0,t}$	$\ln x_{1,t}$	$\ln x_{2,t}$	$\ln x_{3,t}$	$\ln x_{4,t}$
$\ln e_t$	-4.1541**	0.6312	2.7985***	-0.0671	4.4217***	-4.3711***
$\ln y_t$	3.0795**	1.4202***	2.3652***	-3.5303*	0.2736	0.2014
v_t^+	15.2910**	2.6697**	-1.0078	21.2495*	5.0694	11.4433**
v_t^-	0.6087	0.3353	2.3528**	-9.5205*	-0.2106	-7.6222***
o_t^+	-0.1229	-0.7244	-0.6048	-4.3502	-5.9934***	-0.1168
o_t^-	-1.3066	0.5991	1.6154*	10.1044*	5.1281**	-0.5934
W	1.3263	3.2783@	3.9551@@	3.2593@	3.8938@@	6.5270@@@

	$\ln x_{5,t}$	$\ln x_{6,t}$	$\ln x_{7,t}$	$\ln x_{8,t}$	$\ln x_{9,t}$
$\ln e_t$	0.2223	0.5737	0.7838	-0.5099*	-25.0563
$\ln y_t$	1.0728**	0.0495	0.3079	0.9495***	-1.8159
v_t^+	0.1441	0.0193	2.0620	5.5946***	40.9737
v_t^-	1.0591	0.2894	3.0541**	-1.3341***	-26.8308
o_t^+	-0.3710	-0.2391	-0.6449	0.5484*	12.6727
o_t^-	0.7266	0.5568	0.3643	0.0718	-5.2483
W	9.4036@@@	9.0756@@@	3.2926@	3.5400@	0.8834

Model 2 - Japan

	$\ln x_{t,t}$	$\ln x_{0,t}$	$\ln x_{1,t}$	$\ln x_{2,t}$	$\ln x_{3,t}$	$\ln x_{4,t}$
$\ln e_t$	0.9256***	-0.6887	9.5843***	1.0712**	1.0789***	1.4319***
$\ln y_t$	-0.7613*	0.0695	-6.8666	1.6907*	-2.8398**	-0.1001
v_t^+	5.3048***	-6.5439***	33.8197**	5.4151**	6.3091**	-0.9798
v_t^-	5.1447***	-8.4221**	145.2237***	-1.0487	-0.5622	13.0991**
o_t^+	-0.0915	-0.8752	31.6498***	1.0924	1.9239***	1.1281
o_t^-	-0.5184	2.3723**	-31.1310***	-0.4580	-1.3294	-1.7878**
W	5.3984@@@	3.7089@@	7.1609@@@	3.9828@@	5.2051@@@	7.4783@@@

	$\ln x_{5,t}$	$\ln x_{6,t}$	$\ln x_{7,t}$	$\ln x_{8,t}$	$\ln x_{9,t}$
$\ln e_t$	0.1080	0.2284**	-0.0120	0.1889	-1.1889
$\ln y_t$	-0.1088	-1.0041**	1.1559	-0.2907	6.9620**
v_t^+	-0.8864	-0.9377	-1.6688*	-1.4012*	-2.9063
v_t^-	2.8841**	0.6453	-1.0764	0.9755	-9.0855
o_t^+	0.1194	0.0044	-0.1943	0.7330	0.0567
o_t^-	-0.1830	-0.1518	0.4456	-0.2965	-2.5592
W	6.9482@@@	9.9029@@@	3.2632@	3.4251@	7.4787@@@

Model 2 - Korea

	$\ln x_{t,t}$	$\ln x_{0,t}$	$\ln x_{1,t}$	$\ln x_{2,t}$	$\ln x_{3,t}$	$\ln x_{4,t}$
$\ln e_t$	0.7101	0.9079	-2.5721	0.2355	1.5096	-1.7963
$\ln y_t$	-0.3580	4.2665***	17.2466***	43.6546***	-2.2746*	-1.4669
v_t^+	-9.8728	-11.8853*	52.8171	12.1933	-11.2270	38.3888*
v_t^-	-1.4222	6.3416**	57.7485***	-31.9321**	0.4807	-36.1164***
o_t^+	-0.1477	0.1195	2.6783	5.8519**	-1.1156	-2.1323*
o_t^-	-0.1271	-0.8215	-9.6060**	-9.8040***	0.4547	1.7950
W	3.9433@@	4.1479@@	4.3602@@	3.8224@@	3.4200@	4.5611@@@

	$\ln x_{5,t}$	$\ln x_{6,t}$	$\ln x_{7,t}$	$\ln x_{8,t}$	$\ln x_{9,t}$
$\ln e_t$	1.2213**	0.6497	-0.4911	1.4339	-2.3886***
$\ln y_t$	4.0090***	3.7141***	-5.8891***	-1.5233	2.6468*
v_t^+	5.0375	6.0474	10.5412	-20.3326*	9.8587
v_t^-	4.6156	13.4962***	-12.6359**	-16.7943**	-10.8086**
o_t^+	-0.9460	-2.8076***	1.7091*	-0.6740	-1.4953
o_t^-	1.3072*	2.2539***	-1.4666	2.5152*	-2.6221***
W	5.7617@@@	4.9998@@@	5.7145@@@	5.7941@@@	7.3707@@@

Model 2 – The US

	$\ln x_{t,t}$	$\ln x_{0,t}$	$\ln x_{1,t}$	$\ln x_{2,t}$	$\ln x_{3,t}$	$\ln x_{4,t}$
$\ln e_t$	1.4820***	-5.3586	0.2438	-1.2579**	5.0249**	-1.2505*
$\ln y_t$	0.0171	-11.1893*	4.3385*	-3.1352***	-1.0703	-5.5940***
v_t^+	-1.9582	72.0395	15.2110	1.1461	-1.9492	-4.3225
v_t^-	-0.6133	4.3641	5.5532	0.0750	-12.2677	0.9152
o_t^+	-0.3156	0.3073	0.0695	1.0273	-10.1484*	2.5396
o_t^-	0.6664*	-0.5928	-1.2463	-3.1239**	3.4357	-1.1556
W	4.3726@@	2.3792	9.6734@@@	8.2793@@@	11.9962@@@	4.1583@@

	$\ln x_{5,t}$	$\ln x_{6,t}$	$\ln x_{7,t}$	$\ln x_{8,t}$	$\ln x_{9,t}$
$\ln e_t$	-0.1224	0.6155**	1.1056***	0.9921***	-2.8196**
$\ln y_t$	3.6594**	2.6572***	0.3529	0.2564	7.1315**
v_t^+	6.2720	-9.2422**	0.7221	-5.0827**	19.6434**
v_t^-	-3.4851	2.6178	-2.5672***	-4.5149**	-12.2672*
o_t^+	1.0634	1.7625**	0.1600	-0.0758	-3.9624
o_t^-	0.2723	-1.2535*	0.8232**	2.1960***	2.4723
W	5.6511@@@	12.4553@@@	9.6625@@@	4.1912@@	4.3124@@

Notes: W is the Wald-statistic for the bounds testing approach of cointegration. *** (**, *) denotes significance of the t-statistic at the 1% (5%, 10%) level. @@@ (@@, @) denotes significance of the F-statistics at the 1% (5%, 10%) level.

The results of the error correction models are displayed in Table 2. The coefficients of the one lag of error correction terms are found to be less than one or about one and to have the expected negative signs and statistically significant. This implies the validity of an equilibrium relationship among the variables in the estimated model. The coefficients of exchange rate and foreign demand are found in many cases to be statistically significant. There are many cases of exchange rate volatility and oil price volatility found to have a significant impact on exports. Hence, some sectors of exports are sensitive to exchange rate volatility or oil price volatility whilst some sectors of exports are less sensitive to exchange rate volatility or oil price volatility. Moreover, some sectors of exports react negatively or positively to exchange rate volatility and oil price volatility. For Malaysia's exports to China, exchange rate volatility has relative more significant impact on exports in the short run than in the long run. Exchange rate volatility is found to have significant impact on total exports and exports of SITC 4 and SITC 7. Oil price volatility is found to significant impact on exports of SITC 0, SITC 2, SITC 7, SITC 8 and SITC 9. Exchange rate volatility is found to have more significant short-run impact compared to oil price volatility on Malaysia's export to Singapore and Japan. Exchange rate volatility is found to have significant impact on Malaysia's total exports and exports of SITC 2, SITC 3, SITC 5, SITC 7 and SITC 9 to Singapore. Oil price volatility is found to have significant impact on Malaysia's total exports and exports of SITC 1, SITC 2 and SITC 5 to Singapore. Exchange rate volatility is found to have significant impact on Malaysia's total exports and exports of SITC 0, SITC 3, SITC 4, SITC 6, SITC 7, SITC 8 and SITC 9 to Japan. Oil price volatility is found to have significant impact on Malaysia's total exports and exports of SITC 0, SITC 1 and SITC 3 to Japan. Exchange rate volatility is found to have significant impact on Malaysia's exports of SITC 1, SITC 2, SITC 4 and SITC 7 to Korea. Oil price volatility is found to have significant impact on Malaysia's export of SITC 7 to Korea. Exchange rate volatility and oil price are found to have about the same significant impact on Malaysia's exports of the US. Exchange rate volatility is found to have significant impact on exports of SITC 0 and SITC 8. Oil price volatility is found to have significant impact on exports of SITC 6 and SITC 8. In the short run, positive and negative exchange rate volatility and positive and negative oil price volatility are mostly found to have significant impact on Malaysia's exports to China, Singapore, Japan, Korea and the US.

Table 2: The Results of the Error-Correction Models

Model 1 – China

	$\Delta \ln x_{t,t}$	$\Delta \ln x_{0,t}$	$\Delta \ln x_{1,t}$	$\Delta \ln x_{2,t}$	$\Delta \ln x_{3,t}$	$\Delta \ln x_{4,t}$
constant	8.0866***	8.3609***	6.6644***	7.2123***	15.3088***	4.7548***
$\Delta \ln e_{t-i}$	0.5976	2.3548$^{@@}$	5.0920	1.9473	5.7115**	1.1063
$\Delta \ln y_{t-i}$	0.1277**	-0.8258(F)	0.3299	-0.2809	-0.5960**	0.8807***
Δv_{t-i}	15.2984**	-4.5107	-21.0258	16.6957	9.2489	49.0068***
	$\Delta \ln x_{t,t}$	$\Delta \ln x_{0,t}$	$\Delta \ln x_{1,t}$	$\Delta \ln x_{2,t}$	$\Delta \ln x_{3,t}$	$\Delta \ln x_{4,t}$
Δo_{t-i}	-1.5183	12.0301**	10.9129	-22.0376$^{@@@}$	-4.7104	-9.7926
$\Delta \ln x_{j,t-i}$	-	-0.8258(F)	-	-	-	0.1120
ec_{t-1}	-0.7013***	-0.6463***	-0.8975***	-0.5851***	-1.0311***	-0.7646***
Adj. R^2	0.3449	0.4611	0.5262	0.3636	0.4963	0.4381

	$\Delta \ln x_{5,t}$	$\Delta \ln x_{6,t}$	$\Delta \ln x_{7,t}$	$\Delta \ln x_{8,t}$	$\Delta \ln x_{9,t}$
constant	6.1439***	9.4919***	9.4796***	4.9230***	2.9201***
$\Delta \ln e_{t-i}$	0.0229	3.7272**	0.1513	-3.8772***	1.7545
$\Delta \ln y_{t-i}$	-0.1425*	0.1768	0.1685**	-0.1455	0.0859
Δv_{t-i}	2.2700	-5.2631	12.4862**	2.0733	2.9942
Δo_{t-i}	0.2565	-7.3449(F)	4.7269**	7.6347**	-9.0157**
ec_{t-1}	-0.6631***	-0.6049***	-0.9305***	-0.8536***	-0.3832***
Adj. R^2	0.2856	0.3171	0.4641	0.4396	0.2046

Model 1 – Singapore

	$\Delta \ln x_{t,t}$	$\Delta \ln x_{0,t}$	$\Delta \ln x_{1,t}$	$\Delta \ln x_{2,t}$	$\Delta \ln x_{3,t}$	$\Delta \ln x_{4,t}$
constant	4.3646***	3.4978***	-0.0187	6.4295***	6.2453***	2.9913***
$\Delta \ln e_{t-i}$	3.8189@@	-0.1910	-1.3337*	0.7271	0.4108	-0.3862
$\Delta \ln y_{t-i}$	7.0745@@	0.2017**	0.5962***	-0.4865**	0.1237	0.0553
Δv_{t-i}	-40.0435@@@	-0.6962	-1.0174	-45.316@@@	-31.993**	-0.5004
Δo_{t-i}	19.4706@@@	1.4239	6.2765**	10.0067***	-1.1856	-2.8905
$\Delta \ln x_{j,t-i}$	1.92115@@@	-	-	-0.4783@@	-	-
ec_{t-1}	-0.8992***	-0.6447***	-0.8881***	-0.3902***	-0.9435***	-0.6601***
Adj. R^2	0.6472	0.2946	0.4519	0.3810	0.4708	0.2966
	$\Delta \ln x_{5,t}$	$\Delta \ln x_{6,t}$	$\Delta \ln x_{7,t}$	$\Delta \ln x_{8,t}$	$\Delta \ln x_{9,t}$	
constant	0.3651***	7.3207***	4.5185***	3.7376***	-20.1598***	
$\Delta \ln e_{t-i}$	-0.5224	0.9475	-0.1579	0.2148	47.2505@@	
$\Delta \ln y_{t-i}$	-0.5687(F)	0.0514	-0.2197(F)	-0.1858(F)	5.5866***	
Δv_{t-i}	22.1631@@@	5.2287	21.7269***	-1.1026	-131.2407@@	
Δo_{t-i}	-4.5981@@	0.1274	0.1274	1.6106	-1.4396	
ec_{t-1}	-1.0560***	-0.9558***	-0.8732***	-0.7375***	-0.2859***	
Adj. R^2	0.5859	0.4531	0.4264	0.3603	0.2371	

Model 1 – Japan

	$\Delta \ln x_{t,t}$	$\Delta \ln x_{0,t}$	$\Delta \ln x_{1,t}$	$\Delta \ln x_{2,t}$	$\Delta \ln x_{3,t}$	$\Delta \ln x_{4,t}$
constant	11.9257***	9.6435***	18.1924***	-7.7007***	14.3875***	18.9601***
$\Delta \ln e_{t-i}$	-0.0520	-1.7555**	2.7301	0.8839	0.3686	-1.6078
$\Delta \ln y_{t-i}$	-0.5180**	-0.0412	-2.8547*	1.3794**	-1.4543***	-1.4408**
Δv_{t-i}	-21.9273@@@	-40.2932@@@	2.5317	5.9133(F)	-24.3621**	-63.5666@@@
Δo_{t-i}	-18.3227@@@	6.9420**	23.1230@@	0.4048	18.2408@@@	6.5608(F)
$\Delta \ln x_{j,t-i}$	-	-	-0.9700@@@	-0.2727(F)	-	-
ec_{t-1}	-0.8502***	-1.0916***	-0.2756***	-0.8445***	-0.9888***	-1.0729***
Adj. R^2	0.4994	0.5741	0.4522	0.6309	0.5309	0.5268
	$\Delta \ln x_{5,t}$	$\Delta \ln x_{6,t}$	$\Delta \ln x_{7,t}$	$\Delta \ln x_{8,t}$	$\Delta \ln x_{9,t}$	
constant	6.9522***	13.2826***	4.6827***	8.1645***	-16.6418***	
$\Delta \ln e_{t-i}$	0.3505(F)	-1.6639	0.2986(F)	-0.5706*	-3.2176(F)	
$\Delta \ln y_{t-i}$	-0.5191(F)	-1.3249*	-0.3458(F)	-0.4654	-5.1473@	
Δv_{t-i}	-7.7870	-55.9212***	-12.8456**	-25.1885***	-54.3906**	
Δo_{t-i}	-0.4308	3.3827(F)	-2.0769(F)	0.4211	4.7937	
$\Delta \ln x_{j,t-i}$	-0.3156***	-	-0.2550**	-	-	
ec_{t-1}	-0.6812***	-1.0056***	-0.6699***	-0.6981***	-0.7022***	
Adj. R^2	0.5556	0.5204	0.5557	0.3301	0.4564	

Model 1 – Korea

	$\Delta \ln x_{t,t}$	$\Delta \ln x_{0,t}$	$\Delta \ln x_{1,t}$	$\Delta \ln x_{2,t}$	$\Delta \ln x_{3,t}$	$\Delta \ln x_{4,t}$
constant	20.9469***	1.9721***	12.8793***	-87.3203***	21.3340***	0.7521***
$\Delta \ln e_{t-i}$	2.8311***	1.5453	-10.0523@@	7.9757	2.6835(F)	-0.7886
$\Delta \ln y_{t-i}$	0.2823(F)	0.4273	-4.6889***	50.1445@@@	-2.4209**	-0.0535
Δv_{t-i}	-4.6967	2.2689	81.8160**	-36.6129@@@	-11.7585	-40.7388*
Δo_{t-i}	3.8669	-4.1571	-6.8493	-7.8862	6.5263	3.2352
$\Delta \ln x_{j,t-i}$	-0.6035@@	-	-	-0.1716	-0.3340***	-0.2036*
ec_{t-1}	-0.8483***	-0.7827***	-0.6406***	-0.4287***	-0.8601***	-0.6824***
Adj. R^2	0.7054	0.3425	0.3935	0.5539	0.6635	0.4147

	$\Delta \ln x_{5,t}$	$\Delta \ln x_{6,t}$	$\Delta \ln x_{7,t}$	$\Delta \ln x_{8,t}$	$\Delta \ln x_{9,t}$
constant	-3.3125***	-2.3742***	18.7777***	4.9388***	0.8079***
$\Delta \ln e_{t-i}$	-0.8318	-11.9842@@@	20.2811@@@	1.0044(F)	-1.5652
$\Delta \ln y_{t-i}$	1.1557***	1.3096***	-1.7361(F)	-11.0945@@@	-9.7293@@@
Δv_{t-i}	3.1097	10.1966(F)	-41.6977@@@	-15.181	1.7772
Δo_{t-i}	0.5404	7.8349(F)	8.7190***	1.5304	-2.7574
$\Delta \ln x_{j,t-i}$	-	-1.51298@@@	-0.4886@@@	-	-
ec_{t-1}	-0.9742***	-0.5739***	-0.4785***	-0.5500***	-0.7338***
Adj. R^2	0.4891	0.7574	0.4457	0.3520	0.3981

Model 1 – The US

	$\Delta \ln x_{t,t}$	$\Delta \ln x_{0,t}$	$\Delta \ln x_{1,t}$	$\Delta \ln x_{2,t}$	$\Delta \ln x_{3,t}$	$\Delta \ln x_{4,t}$
constant	3.3970***	19.8879***	-15.0480***	15.6862***	60.0662***	34.7721***
$\Delta \ln e_{t-i}$	-0.0607	25.7642@@@	13.2804@@	-2.2311	-6.1585	-2.6634
$\Delta \ln y_{t-i}$	6.2585@@@	-5.6170	8.6133	-4.1061	-34.9114	-2.6725
Δv_{t-i}	3.5038	-139.6596@@@	-16.9947(F)	25.5770	-40.9930	33.1326
Δo_{t-i}	0.7524	1.7372	-2.6655	-9.7534	3.2978	3.8283
$\Delta \ln x_{j,t-i}$	-1.0068@@@	-	-	-	-	-0.7231@@@
ec_{t-1}	-0.4745***	-0.3756***	-1.0265***	-0.9469***	-1.0130***	-0.6336***
Adj. R^2	0.4649	0.2830	0.4918	0.4447	0.5124	0.5581

	$\Delta \ln x_{5,t}$	$\Delta \ln x_{6,t}$	$\Delta \ln x_{7,t}$	$\Delta \ln x_{8,t}$	$\Delta \ln x_{9,t}$
constant	1.1271***	5.0845***	11.4514***	4.7500***	-52.3763***
$\Delta \ln e_{t-i}$	-0.9422	-1.6848	-0.1087	-8.9600@@@	-12.4237@
	$\Delta \ln x_{5,t}$	$\Delta \ln x_{6,t}$	$\Delta \ln x_{7,t}$	$\Delta \ln x_{8,t}$	$\Delta \ln x_{9,t}$
$\Delta \ln y_{t-i}$	2.3348	-1.1605	1.1971	4.4019@@	-33.0997@
Δv_{t-i}	9.6417	11.1901	-0.2056	42.8486@@@	-38.1706
Δo_{t-i}	-0.5692	10.7648@@	2.3148	2.6921@	-0.0982
$\Delta \ln x_{j,t-i}$	-0.1620	-0.4820@@	-	1.7491@@	-
ec_{t-1}	-0.6798***	-0.8685***	-0.8577***	-0.7118***	-0.6348***
Adj. R^2	0.3819	0.5775	0.4226	0.4873	0.3866

Model 2 – China

	$\Delta \ln x_{t,t}$	$\Delta \ln x_{0,t}$	$\Delta \ln x_{1,t}$	$\Delta \ln x_{2,t}$	$\Delta \ln x_{3,t}$	$\Delta \ln x_{4,t}$
constant	5.0892***	5.2399***	12.0100***	3.0657***	11.8665***	3.3185***
$\Delta \ln e_{t-i}$	1.4481$^{@@}$	1.2828	7.0256	4.5928$^{@@@}$	4.4216*	1.4688
$\Delta \ln y_{t-i}$	0.1166	-0.3328***	-0.1639	-0.0861	0.9159(F)	-2.2428$^{@@}$
Δv^{+}_{t-i}	-5.1191$^{@@@}$	3.8164$^{@@}$	-9.3739	-21.2646$^{@@@}$	0.2602	-7.2598(F)
Δv^{-}_{t-i}	-0.4006(F)	-2.2566	21.6908	17.2299$^{@@}$	6.9972	17.956**
Δo^{+}_{t-i}	-0.5483(F)	0.6404	-0.2203	1.2927	-2.0141	1.8456(F)
Δo^{-}_{t-i}	1.2529(F)	1.5472$^{@@}$	-1.3807	-0.6659	0.9361	5.9468$^{@@@}$
$\Delta \ln x_{j,t-i}$	-	-	-	-	-0.2094**	0.1715*
ec_{t-1}	-0.5091***	-0.4614***	-0.9495***	-0.5243***	-0.9388***	-0.7136***
Adj. R^2	0.5245	0.3815	0.4628	0.4194	0.6636	0.5578

	$\Delta \ln x_{5,t}$	$\Delta \ln x_{6,t}$	$\Delta \ln x_{7,t}$	$\Delta \ln x_{8,t}$	$\Delta \ln x_{9,t}$
constant	8.6524***	9.5366***	7.9097***	5.1175***	-1.8342***
$\Delta \ln e_{t-i}$	2.8580$^{@@}$	18.4411$^{@@@}$	0.2067	-0.9442	-2.4647(F)
$\Delta \ln y_{t-i}$	0.0804(F)	-0.5612**	0.1936**	0.0531	-1.6958$^{@@@}$
Δv^{+}_{t-i}	-0.9744	-18.3360$^{@@@}$	0.9776*	-2.9187**	-17.5217$^{@@@}$
Δv^{-}_{t-i}	-14.6606$^{@@}$	-14.3794(F)	-0.5334	8.4607**	-3.2467
Δo^{+}_{t-i}	-0.7222(F)	16.4047$^{@@@}$	-0.0504	-0.3337	-10.6639$^{@@@}$
Δo^{-}_{t-i}	2.6040$^{@@}$	-4.3938(F)	1.0536**	1.1418	12.3999$^{@@@}$
$\Delta \ln x_{j,t-i}$	-	-1.0115$^{@@@}$	-	-	-0.9141$^{@@}$
	$\Delta \ln x_{5,t}$	$\Delta \ln x_{6,t}$	$\Delta \ln x_{7,t}$	$\Delta \ln x_{8,t}$	$\Delta \ln x_{9,t}$
ec_{t-1}	-0.7865***	-0.3772***	-0.8736***	-0.5138***	-0.2944***
Adj. R^2	0.4231	0.7102	0.4555	0.4014	0.5886

Model 2 – Singapore

	$\Delta \ln x_{t,t}$	$\Delta \ln x_{0,t}$	$\Delta \ln x_{1,t}$	$\Delta \ln x_{2,t}$	$\Delta \ln x_{3,t}$	$\Delta \ln x_{4,t}$
constant	0.1526***	0.3998***	-4.4361***	5.2113***	3.5479***	7.3179***
$\Delta \ln e_{t-i}$	5.3852$^{@@@}$	-0.4213	-3.7345$^{@@}$	0.3500	0.8160	-1.6769
$\Delta \ln y_{t-i}$	0.8106***	-0.5020$^{@@}$	0.0756(F)	-0.2669	0.2476	-0.1351
Δv^{+}_{t-i}	-7.1586(F)	15.8260$^{@@@}$	4.7326	-1.8727	13.9632(F)	8.7528
Δv^{-}_{t-i}	2.3480$^{@@}$	0.0088	0.0372	-1.1162	4.1283$^{@@@}$	2.9329(F)
Δo^{+}_{t-i}	0.2564	-0.5773**	-0.0333	-0.6241	6.9714$^{@@}$	-3.0209**
	$\Delta \ln x_{t,t}$	$\Delta \ln x_{0,t}$	$\Delta \ln x_{1,t}$	$\Delta \ln x_{2,t}$	$\Delta \ln x_{3,t}$	$\Delta \ln x_{4,t}$
Δo^{-}_{t-i}	-0.5442	0.4793**	0.5618	1.8283***	-8.3346$^{@@@}$	2.1891
$\Delta \ln x_{j,t-i}$	-0.1946*	-0.2085**	-0.6146$^{@@}$	-1.1756$^{@@@}$	-0.5108$^{@@}$	-
ec_{t-1}	-0.2029***	-0.5354***	-0.6381***	-0.2331***	-0.8271***	-0.7539***
Adj. R^2	0.3475	0.4255	0.5448	0.4486	0.6285	0.4092

	$\Delta \ln x_{5,t}$	$\Delta \ln x_{6,t}$	$\Delta \ln x_{7,t}$	$\Delta \ln x_{8,t}$	$\Delta \ln x_{9,t}$
constant	2.4851***	7.0962***	3.3641***	4.3465***	5.8949**
$\Delta \ln e_{t-i}$	-0.3329	1.2719	-0.1610	-0.4324	-2.1871
$\Delta \ln y_{t-i}$	-0.2118(F)	0.0549	0.0629	-1.1781$^{@@}$	2.6683**
Δv^{+}_{t-i}	16.9590**	3.7708	2.4748	-1.3706**	-5.3780
Δv^{-}_{t-i}	-3.7819$^{@@}$	-0.4246	-2.8828$^{@@}$	26.4181$^{@@@}$	-4.4717
Δo^{+}_{t-i}	-0.5463	-0.4748	1.0950$^{@@}$	-0.6364$^{@}$	0.6042

$\Delta\, o^{-}_{t-i}$	0.7841*	0.8781	0.5603*	0.2157	0.8414
$\Delta \ln x_{j,t-i}$	-	-	-1.0047@@@	-0.3657@	-
ec_{t-1}	-0.9197***	-0.9331***	-0.4109***	-0.9272***	-0.1561**
Adj. R^2	0.5670	0.4590	0.4770	0.5695	0.0789

Model 2 – Japan

	$\Delta \ln x_{t,t}$	$\Delta \ln x_{0,t}$	$\Delta \ln x_{1,t}$	$\Delta \ln x_{2,t}$	$\Delta \ln x_{3,t}$	$\Delta \ln x_{4,t}$
constant	10.0596***	4.8121***	9.8734***	-1.6118***	16.3348***	5.1094***
$\Delta \ln e_{t-i}$	3.5448@@@	0.0763(F)	5.2132(F)	3.6776@@@	2.0026@	1.2948
$\Delta \ln y_{t-i}$	-0.3246	-0.0851	-11.4870@@	1.2099*	4.6536@@@	-0.4474
$\Delta\, v^{+}_{t-i}$	-9.8859@@@	3.4353@	-5.3589(F)	1.0869	-15.5155@@@	-0.7377
$\Delta\, v^{-}_{t-i}$	2.3293	2.9599@@	-47.5031*	-3.8613	26.3339@@@	3.2691
$\Delta\, o^{+}_{t-i}$	0.0864	-1.3756(F)	-51.4016@@@	-1.7937(F)	1.4957**	0.1966
$\Delta\, o^{-}_{t-i}$	3.7695@@@	5.7551	36.3662@@@	0.4466	4.3589@@@	-0.7996
$\Delta \ln x_{j,t-i}$	-0.4998@@	-0.2753**	-0.8367@@@	-0.3186***	-0.6857@@@	-
ec_{t-1}	-0.7651***	-0.6824***	-0.4417***	-0.7429***	-0.7624***	-0.8773***
Adj. R^2	0.5552	0.5842	0.7199	0.5836	0.6810	0.4069

	$\Delta \ln x_{5,t}$	$\Delta \ln x_{6,t}$	$\Delta \ln x_{7,t}$	$\Delta \ln x_{8,t}$	$\Delta \ln x_{9,t}$
constant	6.6834***	11.0339***	2.5848***	5.4123***	-16.8923***
	$\Delta \ln x_{5,t}$	$\Delta \ln x_{6,t}$	$\Delta \ln x_{7,t}$	$\Delta \ln x_{8,t}$	$\Delta \ln x_{9,t}$
$\Delta \ln e_{t-i}$	0.1709	0.4246	0.3535	0.0489	0.4429
$\Delta \ln y_{t-i}$	0.5364	-0.0989	0.6014	-0.3268	-6.6955@@
$\Delta\, v^{+}_{t-i}$	-0.4996	-0.4196	-0.5784	-0.5747	2.6586(F)
$\Delta\, v^{-}_{t-i}$	-0.9707	3.8229	-0.7840	-3.8921	-2.7771
$\Delta\, o^{+}_{t-i}$	-0.1091	-0.4513	0.0120	-0.4328	0.5216
$\Delta\, o^{-}_{t-i}$	-0.1839	0.5270	0.2945	0.6608	2.2003(F)
$\Delta \ln x_{j,t-i}$	-0.8310***	-0.8970***	-0.5975***	-0.5873***	-0.6678***
ec_{t-1}	6.6834***	11.0339***	2.5848***	5.4123***	-16.8923***
Adj. R^2	0.4203	0.4755	0.2486	0.2913	0.5072

Model 2 – Korea

	$\Delta \ln x_{t,t}$	$\Delta \ln x_{0,t}$	$\Delta \ln x_{1,t}$	$\Delta \ln x_{2,t}$	$\Delta \ln x_{3,t}$	$\Delta \ln x_{4,t}$
constant	11.1043***	-13.2682***	-61.7870***	-171.9878**	20.5235***	9.0520***
$\Delta \ln e_{t-i}$	2.6464***	1.3263	-7.5801@	-4.6008(F)	3.4150(F)	-1.3760
$\Delta \ln y_{t-i}$	-0.5707	2.3308***	48.0308@@@	-57.2016@@	-2.4522**	-1.4830
$\Delta\, v^{+}_{t-i}$	8.2394	-16.6812*	-178.5486@@	22.6869	-2.0270	-44.2151(F)
$\Delta\, v^{-}_{t-i}$	-5.0697	8.5845*	-229.6909@@@	-27.1999**	-2.8855	39.7965@@
$\Delta\, o^{+}_{t-i}$	1.7137@@	0.7703	12.1848@@	3.0639	-2.2954*	0.5892(F)
$\Delta\, o^{-}_{t-i}$	-0.1443	-0.4859	-7.8369@	-3.5561	1.5183	3.2696*
$\Delta \ln x_{j,t-i}$	-0.3116**	0.4608@	-	1.0966@	-0.2951**	-0.1554
ec_{t-1}	-0.9030***	-0.9757***	-0.7337***	-0.8312**	-0.9475***	-0.8249***
Adj. R^2	0.6561	0.3706	0.6655	0.4677	0.6631	0.5226

	$\Delta \ln x_{5,t}$	$\Delta \ln x_{6,t}$	$\Delta \ln x_{7,t}$	$\Delta \ln x_{8,t}$	$\Delta \ln x_{9,t}$

constant	-8.9827***	-7.9681***	21.0066***	10.7202***	-9.8233***
$\Delta \ln e_{t-i}$	-0.6156	-0.1458(F)	1.4108**	3.1534@	-2.6040**
$\Delta \ln y_{t-i}$	1.7716***	0.8334*	-0.2628(F)	-0.5912	-18.6201@@@
Δv^{+}_{t-i}	8.2623	19.1566***	-27.4131@@@	-11.5938	6.6446
Δv^{-}_{t-i}	1.9858	-22.7868@@@	0.3531(F)	52.9791@@@	-6.6243
Δo^{+}_{t-i}	-0.4299	0.9225(F)	0.5065	-0.1214	9.5836@@@
Δo^{-}_{t-i}	0.6397	-5.1177@@@	1.3442@	0.9342	-0.5575
$\Delta \ln x_{j,t-i}$	-0.1915*	-0.7307@@@	-	-	-
ec_{t-1}	-0.8293***	-0.8345***	-0.5836***	-0.6815***	-0.8678***
Adj. R^2	0.5338	0.7040	0.5156	0.4031	0.4854

Model 2 – The US

	$\Delta \ln x_{t,t}$	$\Delta \ln x_{0,t}$	$\Delta \ln x_{1,t}$	$\Delta \ln x_{2,t}$	$\Delta \ln x_{3,t}$	$\Delta \ln x_{4,t}$
constant	5.6470***	11.1392***	-16.9570***	20.4651***	4.4789***	27.5852***
$\Delta \ln e_{t-i}$	0.6777*	-3.1277**	-0.0292	-1.3000	-12.3471(F)	-1.2542
$\Delta \ln y_{t-i}$	0.2687	-1.4395	6.4343	-3.8579	-35.5234	-0.9570
Δv^{+}_{t-i}	-1.2427**	-32.4751@@@	-49.6980@@	0.8870	0.0023	-2.1718
Δv^{-}_{t-i}	0.5961	1.7045	6.1412	-6.6453	-20.7869*	0.7290
Δo^{+}_{t-i}	-0.1519	0.7728	1.9311	1.2239	-13.8068**	1.4307
Δo^{-}_{t-i}	0.3891	0.0915	-1.7933	-3.8578*	7.7197	-0.5305
$\Delta \ln x_{j,t-i}$	-	-0.4653@@	-	-	-	-0.2357**
ec_{t-1}	-0.6396***	-0.1744***	-0.9643***	-0.9540***	-1.0477***	-0.7965***
Adj. R^2	0.2838	0.2784	0.4591	0.5214	0.5657	0.5514

	$\Delta \ln x_{5,t}$	$\Delta \ln x_{6,t}$	$\Delta \ln x_{7,t}$	$\Delta \ln x_{8,t}$	$\Delta \ln x_{9,t}$
constant	-7.0239***	-6.3308***	6.4681***	5.6851***	-13.2350***
$\Delta \ln e_{t-i}$	-0.7764	-1.5002	0.8069**	4.4397@@@	-1.6353
$\Delta \ln y_{t-i}$	4.0142	3.6395(F)	15.0298@@@	4.8036(F)	12.2910*
Δv^{+}_{t-i}	0.0398	4.8577(F)	0.4057	16.5585@@	9.6886***
Δv^{-}_{t-i}	4.7704**	1.6321	2.1270@	8.1857@@@	-3.4837
Δo^{+}_{t-i}	1.3076	1.2611*	-0.2214	0.1332	-1.4261
Δo^{-}_{t-i}	-0.0876	1.1231(F)	-0.8407@	-2.6677@@	1.4069

	$\Delta \ln x_{5,t}$	$\Delta \ln x_{6,t}$	$\Delta \ln x_{7,t}$	$\Delta \ln x_{8,t}$	$\Delta \ln x_{9,t}$
$\Delta \ln x_{j,t-i}$	-	-	-	2.4551@@@	-
ec_{t-1}	-0.7072***	-1.1201***	-0.8966***	-0.8383***	-0.5339***
Adj. R^2	0.3834	0.6340	0.5070	0.5769	0.2923

Notes: See also Table 1 for explanations. Adj. R^2 is the adjusted R^2. (F) denotes coefficient of normalised restriction.

The SVMA/SVM model is found to be the best stochastic volatility model based on the marginal likelihood to estimate exchange rate volatility or oil price volatility. In the short run and long run, the coefficients of exchange rate and foreign demand in many cases are found to have significant impact on bilateral exports. In many cases, exchange rate volatility and oil price volatility are found to have significant impact on Malaysia's bilateral total exports and sub-categories of Malaysia's bilateral total exports although their impact differs across bilateral exports. Moreover, positive exchange rate volatility, negative exchange rate volatility, positive oil price volatility and negative oil price volatility are found to have significant impact on Malaysia's bilateral total exports and sub-categories of Malaysia's bilateral total exports although their impact differs across bilateral exports. Some industries are more sensitive to exchange rate volatility. Furthermore, there are more cases exchange rate volatility is found to have significant impact than oil price volatility on Malaysia's bilateral exports and sub-categories of Malaysia's bilateral total exports in the short run and long run. The finding that exchange rate volatility to have significant impact on exports is same with the findings such as Pino, Tas and Sharma (2016) and Bahmani-Oskooee and Aftab (2017), amongst other. Exchange rate volatility and oil price volatility have insignificant impact on exports can be due to incomplete transmission between exchange rate volatility or oil price volatility and export price because exporting firm absorbs lose temporarily to maintain its market share in foreign country (Gopinath, Itskhoki and Rigobon, 2010; Bandt and Razafindrabe, 2014: 64; Bernini and Tomasi, 2015; Choudhri and Hakura, 2015). Also, there is no connection between exchange rate volatility and the real economy may be due to local currency pricing, heterogeneous international distribution of commodities and noise traders in the foreign exchange rate markets (Devereux and Engel, 2002). Foreign demand is found to be negative in some cases can be due to an increase in foreign demand turns to be substitution for import. Hence, exports of Malaysia reduced. Exchange rate is found to be negative in some cases can be due to an increase in exchange rate turns to be cheaper of imported goods and therefore, the imported values from Malaysia reduced.

5. POLICY IMPLICATION

A more stable international environment would encourage export. It can be achieved through more effectively international cooperation to minimise international shocks. A more stable exchange rate and also a more stable oil price would encourage exports. Nonetheless, exchange rate volatility is unlikely to be fully eliminated under flexible exchange rate regime. However, exchange rate volatility can be reduced or minimised through various methods of exchange rate risk hedging in the forward market, future market or money market. Exchange rate volatility can be an opportunity to exporters to obtain higher profits. It is not easy to eliminate oil price volatility. A more diversified export can reduce overall shocks. Exporters from Malaysia can reduce their risks through a more diversified of their exports with more focus on exports to Association of Southeast Asian Nations Economic Community (AEC). AEC can provide an alternative export market to exporters from Malaysia.

6. CONCLUDING REMARKS

Exchange rate volatility and oil price volatility are found to be good estimated by the SVMA/SVM model. Generally, export models estimated are found to be cointegrated. Exchange rate and foreign demand are found mostly to be statistically significant in the short run and long run. Exchange rate volatility and oil price volatility are both found in many cases to have significant impact Malaysia's bilateral exports in the short run and long run although their impact differs across bilateral exports and sub-categories of bilateral exports and also relative more cases exchange rate volatility than oil price volatility is found to have significant impact on bilateral exports. Moreover, positive exchange rate volatility, negative exchange rate volatility, positive oil price volatility and negative oil price volatility are found to have significant impact on Malaysia's bilateral exports in the short run and long run although their impact differs across bilateral exports and sub-categories of bilateral exports. Exports can be sensitive to various shocks such as exchange rate volatility and oil price volatility. Nonetheless, some bilateral exports or sub-categories of exports are less sensitive to the shocks. A more stable international environment and a more stable exchange rate would encourage exports. It can be achieved more effectively through international cooperation to minimise those shocks. A more diversified export can reduce the impact of overall shocks on bilateral exports.

ACKNOWLEDGEMENTS

The author would like to thank Joshua C.C. Chan for commenting the code and estimation of the stochastic volatility models.

A version of the paper was presented in the 3rd Applied Financial Modelling Conference – The Importance of Commodity Markets in Financial and Macroeconomic Stability, Universiti Tunku Abdul Rahman (UTAR), Kampar, Perak, 7th - 8th November 2017.The author would like to thank the participants of the conference and the reviewers of the journal for their constructive comments. The author thanks some financial support from the grant of Universiti Malaysia Sabah (SBK0328-2017).

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