MALAYSIA-CHINA TRADE AND MACROECONOMIC LINKAGES IN THE GLOBALIZATION ERA: A VECX* MODELING

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Abstract
This paper studies the dynamic relationship of trade balance, exchange rate, outputs, and producer prices between Malaysia and China, from 1997: M1 to 2010: M3. The empirical framework is constructed based on the VARX and VECX* modeling procedures in the presence of I*(1)* exogenous variables. The supplementary analyses of Persistent Profile, generalized Impulse Response Functions, and Variance Decomposition show how the core variables evolve with respect to economic shocks. Results indicate that the Marshall-Lerner condition holds in the long-run but the short-run J-curve is unclear. However, output contraction presences due to the foreign exchange shocks though inflationary effect is less evident following the producer prices shock. Such findings do not uphold the demand channel established by Keynesian economics, implying that Malaysia's devaluation for export gains is insufficient to sustain output expansion and, China has yet to be Malaysia's main source of imported inflation. The study generally supports the complementary role, - instead of the conflicting feature of China in the Malaysia-China bilateral trading.

Keywords: Exchange rates, J-curve, contractionary effect, bootstrapping, VARX, VECX*

JEL Classification: F14, C53, C32, O24

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1. Introduction

Malaysia was the first nation among the Association of Southeast Asian Nations (ASEAN) members to forge diplomatic relations with China in the 1970s. The two nations have committed to bilateral trade integration, in addition to support for the multilateral framework within the ASEAN+6 regime. Despite the tough competition in manufacturing exports, Malaysia's liquefied natural gas remains a highly demanded energy resource in China. The natural rubber, tourism and education sectors have also been important sources of revenue for Malaysia vis-à-vis China. At the same time, China recognizes Malaysia as an influential player within ASEAN and various ASEAN-driven collaboration platforms, such as the ASEAN Regional Forum and the East Asian Summit. China is now Malaysia's largest trading partner, second-largest export destination and largest source of imports. In 2009, the Malaysia-China trade reached $59 billion—about 18.9% of Malaysia's global trade volume, surpassing the Malaysia-US trade share (10.9%). The figure for Malaysia-China trade was only $4.7 billion in 1990 or about 8% of Malaysian trade volume. The trade expansion is likely to accelerate with the formalization of a bilateral trade liberalization pact on track under the ASEAN-China Free Trade Agreement (Wang, 2005; Okamoto, 2005).

In line with this, some studies have documented the complementary effects of China for its neighbors (e.g. Cheong, 2000; Hai, 2000; Ahearne, *et al*., 2003; Wong, 2003; Chan & Hooy, 2010). In recent years, Chinese imports from the Asian region are growing faster than its exports, not only in terms of raw materials and production resources but also manufactured products. The advanced neighbors (e.g. Japan, Singapore, South Korea, and Taiwan) are selling consumer goods, intermediates, and machinery to China. These nations have also set up production plants in China to process exports to the rest of the world. As for developing neighbors such as Malaysia, Thailand, Indonesia, and Vietnam, they are joining with China in multinational production networks. Multinational corporations are incorporating China into the global production system along with earlier entrants and hence promoting regional trading. China's own enterprises are specializing, in coordination with regional counterparts, and so raising intra-industry trade in differentiated products. In other words, the emergence of China as an economic powerhouse has resulted in an increase of labor diversification and intra-regional trading, which, in the long run, may lead to regional economic integration similar to the European Union or the North American Free Trade Agreement (see Chan, *et al.*, 2003; Chan, 2008).

Yet, others have pointed out the conflicting (competing) features of China's economic rise. There are worries that China's yuan regime, investment magnetism, and low labor costs, as well as its accession to the World Trade Organization in November 2001, may have positioned the country as a formidable economic competitor that threatens to crowd out other developing Asian countries (Lall, 2004; Lall & Albaladejo, 2004; Zhang & Wan, 2007; Greenaway, *et al*., 2008). As Chinese industry becomes more technologically sophisticated, its exports range is broadening and posing a potential threat to middle-income exporters of more capital- or skill-intensive products, including Malaysia (Jenkins, 2008). In fact, Malaysia has suffered a continuous seven-year trade deficit with China since 2002 - which peaked at $4.2 billion in 2007, before the major correction in 2009. In addition, the growing competition in outsourcing activities and the reallocation of the electrical and electronic production base towards China have also pressured Malaysia's job market. McKibbin and Woo (2003) further suggests that the full integration of Chinese labor force into the international division of labor could de-industrialize the ASEAN-4 (Indonesia, Malaysia, Philippines, Thailand) when it leads to reduction of FDI flows to them.[1] Some observers have also, directly or indirectly, related the resurgence of China since the late-1980s and the devaluation of the renminbi (or, Chinese yuan) in 1994 to the Asia financial crisis (e.g. Makin, 1997; Corsetti, *et al.*, 1999; among others). The fall of the renminbi implied a real exchange rate appreciation for the dollar-pegged currencies in East Asia, which their fragile financial systems were unable to absorb. Some of them were thrown into prolonged current account deficits and forced to devalue their currencies in order to regain their export market share, which eventually led to the Asia financial crisis in 1997. Such concerns have gravely challenged the consensus of sustainable trade competitiveness at the regional level. Until today, no conclusive consensus has been reached regarding the economic emergence of China. It is still difficult to assess whether the complementarities between China and regional economies offsets its competitive threat (Lall, 2004)

This study focuses on the Malaysia-China case to assess if the real exchange rate fluctuations as well as the demand and supply channels determine the performance of bilateral trade balances in the liberalization era, 1997-2010. The conventional trade balance model using the absorption approach is insufficient to gauge the dynamic relationship of trade-exchange rate-output-price. Our model involves the modification of previous specifications applied by Shirvani & Wilbratte (1997) and Kandil & Mirzaie (2005). For better policy implications, the graphical representation of the Impulse Response Function (IRF) and Persistent Profile analyses are also conducted to capture the dynamic responses of economic shocks. The outcome of the empirical results is adequate and relevant to justify the Marshall-Lerner condition, the J-curve[2] phenomenon, and the output (expansion or contraction) and price (inflationary) effects[3] due to macroeconomic shocks between Malaysia and China. Together, the complementary/conflicting features of the trade and macroeconomic relationship can be further clarified.

In exploring the trade-output-exchange rate relationship for Malaysia and China, three distinguished issues are being considered. The first concerns the fact that Malaysia is a small and open economy, with the exchange rate regime playing an important role in economic development. When compared to the Chinese population of 1.3 billion people, the Malaysian market size is relatively small, with only 28 million residents. In 2007, China's total trade was reported to be $2,170 billion (third worldwide) and its current account surplus amounted to $372 billion, ranked at the top globally. Though Malaysian trade openness is now among the highest in the world (about 200% of its GDP), its total trade volume is relatively still small. It is necessary, in the methodological sense, to develop an econometric model that allows the

[1] This will happen, however, only if these countries allow the drop in FDI inflow to lower the rate of technological diffusion to their economies. If the ASEAN-4 can prevent themselves from falling behind technologically, then they can find lucrative niches within the international production chains that characterize manufacturing activities.

[2] Theory suggests a perverse temporal negative response of the trade balance to a real depreciation in the short run, due to the dominance of the price effect over the volume effect at the early stage, but followed by the larger export and import elasticities that would improve the trade balance. However, the empirical evidences are at best mixed. Among others, Dornbusch & Krugman (1976), Krugman & Baldwin (1987), Helkie & Hooper (1987), Onafowora (2003), supported the J-curve effect but Rose & Yellen (1989), Bahmani-Oskooee *et al*. (2006) and Ahmad & Yang (2007) disagreed. Moreover, Backus *et al*. (1994), Marwah & Klein (1996) and Bahmani-Oskooee & Ratha (2007) extended the literature by finding support for the S-curve behaviour in the trade balance-exchange rate relationship.

[3] On the one hand, devaluation generates an expansionary effect via aggregate demand; on the other hand, it has a negative impact on the aggregate supply through its effect on the cost of imported intermediate inputs. See Eichengreen & Hausmann (1999), Calvo & Reinhart (2001), Rajan & Shen (2002), Ahmed *et al*. (2002) for details.

possibility of drawing a distinction between endogenous and exogenous variables, which are integrated of I*(1)*. This paper employs the VARX and VECX* modeling procedures advanced by Pesaran *et al*. (2000) which applied in Garratt *et al*. (2003, 2006) and Assenmacher-Wesche & Pesaran (2009) to construct a cointegrating VARX in the presence of I*(1)* exogenous or long-run forcing variables (which, in our case, the Chinese variables). A reduced-form error correction of the VECX* model can then be estimated, where variables are separated into the conditional model and marginal model, respectively. This approach allows us to incorporate long-run relationships as well as short-run dynamic restrictions from economic theory.

The second issue relates to the time period of the study. Malaysia has practiced various exchange rate regimes in the past four decades: the Bretton Woods system, managed floating, free floating, and basket of currency-floating eras. Different regimes have reflected diverse policy responses, and the empirical results could be inconsistent with the theoretical prediction, over time. As for China, the open policy started in 1978, but the progress of trade and exchange rate liberalization was slow prior to the 1990s. During the period, the Malaysia-China bilateral trading was still minor. In addition, the collection and compilation of macroeconomic data in both nations are also limited by the unavailability of high frequency data (especially the Chinese series). So, analysis of earlier series may not be relevant and could be at risk of inaccurate policy implications. We therefore focus on the post-liberalization period (January 1997 to March 2010) where both Malaysia and China were experiencing trade expansion and economic liberalization. Then again, the 1990s are well known as a period of financial instability and currency crises. We first conduct a preliminary test of endogenous break(s)[4] on each series and impose the break dates as dummy variables in the VARX and VECX* models. The final analysis covers from January 1997 to September 2009, allowing for six-month out-sample forecasting of our trade model.

Then, what follows involves the estimation issue for small sample size, particularly, in regard to the size and power properties of time series analysis. Though with 153 high frequency (monthly) observations, our study only covers a 12-year length of time. Given this, we employ the nonparametric bootstrap method, an alternative to the large sample data tests based on asymptotic theory. It was well noted in the literature that bootstrap's ability to provide asymptotic refinements often leads to a reduction of size distortions in finite sample bias and it generally yields consistent estimators and test statistics (Mantalos & Shukur, 1998; Chang, Park and Song, 2006). This method is later applied to test the number of VARX cointegrating ranks and to test the significance of log-likelihood ratio (LR) statistics of the over-identifying long-run restrictions. This method is also applied in the measures of estimation uncertainty and confidence intervals for generalized IRF and Persistent Profile.

To this end, our study is designed in the following manner. Section 2 shows the theoretical representation of the trade-exchange rate-output-price model that forms the basis of our empirical model. This is followed by the estimation procedures and data description. Estimation results are discussed in section 3. Finally, in section 4, conclusion and policy implications are drawn.

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[4] To determine the potential endogenous break(s), we follow the structural break tests of Lumsdaine & Papell (1997) and Saikkonen & Lütkepohl (2002).

2. Data and Methodology

The present study takes as a point of departure the standard trade model, variants of which are employed in the literature by Shirvani & Wilbratte (1997) and Kandil & Mirzaie (2005).

2.1 The Trade Balance-Output-Exchange Rate Model

Accordingly, we posit that the demand for imported goods depends upon the relative price of imports and domestic income, expressed as follow:

$$M_d = M_d\,(RP_m, Y) \tag{1}$$

where M_d = domestic demand for imports, RP_m = relative price of imported goods to domestically produced goods, and Y = domestic real income. Letting E = the nominal exchange rate, defined as the domestic price of foreign currency, the relative price of imported goods can be expressed as:

$$RP_m = E\,(P_x^* / P) = E\,(P^* / P\,)\,(P_x^* / P^*) = (1/ Q)\,RP_x^*, \tag{2}$$

where $Q = EP^*/P$. P_x^* is the foreign currency price of foreign exports, P and P^* are the domestic and foreign price indexes of all goods, Q is the real exchange rate, defined as the relative price of domestic to foreign goods, and RP_x^* is the relative price of foreign exports to foreign produced goods, respectively. With Q thus defined, an increase in its value indicates a real devaluation of the domestic currency. Substituting RP_m from equation (1), we obtain:

$$M_d = M_d\,(RP_x^*/Q\,) \tag{3}$$

Similarly, the foreign country's demand for imports depends upon foreign income as domestic relative export prices:

$$M_d^* = M_d^*\,(RP_x \cdot Q, Y) \tag{4}$$

Given that domestic exports are foreign imports and vice versa, that is,

$$X_s = M_d^*, X_s = M_d \tag{5}$$

we write the domestic balance of trade, TB, as the following ratio:

$$TB = X_s / M_d = M_d^* / M_d = M_d^*\,(RP_x \cdot Q, Y^*\,) / M_d\,(RP_x^* / Q, Y\,) \tag{6}$$

Assuming RP_x and RP_x^* being constant, Eq (6) can be rewritten in the following general form:

$$TB = f\,(Q, Y, Y^*), \qquad \partial TB / \partial Q > 0, \partial TB / \partial Y < 0, \partial TB / \partial Y^* > 0 \tag{7}$$

This model expresses the trade balance as a function of the real exchange rate and the levels of domestic and foreign incomes. Taking the natural logarithm of both sides, we have the following model, with a stochastic term added to capture short-term departures from long-run equilibrium:

$$ln(TB_t) = \alpha_0 + \alpha_1 \, ln\,(Y_t) + \alpha_2 \, ln\,(Y_t^*) + \alpha_3 \, ln\,(Q_t) + \mu_t \quad (8)$$

where *ln* represents the natural logarithm, and μ is a white process. Note that expressing the trade balance as the ratio of exports to imports allows all variables to be expressed in log form and obviates the need for an appropriate price index to perform our basic statistical tests. However, given that China plays an important role in the supply chain of Malaysian economics, it is important to include the producer prices of both nations. Such consideration is vital to investigate the potential inflation or deflation effect following economic shocks. If the domestic and foreign prices are indeed non-constant and integrated of I*(1)*, the assessment of the price effects is possible. Then, Eq (8) can be represented by

$$ln(TB_t) = \alpha_0 + \alpha_1 \, ln(Y_t) + \alpha_2 ln(Y_t^*) + \alpha_3 ln(Q_t) + \alpha_4 \, ln(PP_t) + \alpha_5 ln(PP_t^*) + \mu_t \quad (9)$$

TB is a unit-free measure of the trade balance, which is defined as the ratio of Malaysian exports to imports vis-à-vis China. *Q* is defined as the real Malaysian Ringgit (RM)/yuan, and *PP* and PP^* are the domestic and foreign producer price. If the Marshall-Lerner condition holds, then $\alpha_3 > 1$ so that a real devaluation of domestic currency (RM) improves the trade balance of Malaysia-China trade. Conventionally, real domestic income will be negatively signed ($\alpha_1 < 0$) as an increase in Malaysian income is expected to increase its imports of commodity j, and *TB* deteriorates. Real foreign income is to be positively signed ($\alpha_2 > 0$) because an increase in Chinese income implies more demand for Malaysian exports and hence *TB* improves. However, if a rise in Malaysian income is due to an increase in the production of substitute goods for j, the estimate of α_1 could be positive. In the same way, the estimate of α_2 could be also positive or negative (Bahmani-Oskooee & Mitra, 2009). In addition, we assume that changes of producer prices are reflected in import and export prices. A rise in the domestic producer price hampers export competitiveness, and so $\alpha_4 < 0$. Then, $\alpha_5 > 0$ because an increase in the foreign producer price will cause imports to be more expensive and reduce the demand for imports.

2.2 The VARX and VECX* Estimation

Pesaran *et al*. (2000) modified and generalized the approach to the problem of estimation and hypothesis testing in the context of the augmented vector error correction model. Garratt *et al*. (2003, 2006) extended the idea and developed the VECX* model along the same lines. They distinguish between an $m_y \times 1$ vector of endogenous variables y_t and an $m_x \times 1$ vector of exogenous I*(1)* variables x_t among the core variables in $z_t = (y'_t, x'_t)$ with $m = m_y + m_x$. Since our sample period consists of the Asia financial crisis, the dot-com bubble, and the global subprime crisis, structural break(s) are necessarily included in the model. Depending on the number of crisis detected by the break tests of Lumsdaine and Papell (1997) and Saikkonen and Lütkepohl (2002), we impose the shift dummy variable ($D_{crisis,t}$) and the impulse dummy variable ($\Delta D_{crisis,t}$), where $\Delta D_{crisis,t} = D_{crisis,t} - D_{crisis,t-1}$. The former captures the shift in the long-run relations, whereas the latter applies for the short-run dynamic models. The VECX* is then given by

$$\Delta y_t = -\prod\nolimits_y z_{t-1} + \Lambda \Delta x_t + \sum_{i=1}^{p-1} \Psi_{\mathrm{i}} \, z_{t-i} + c_0 + c_1 t + c_2 D_{crisis,t} + v_t \quad (10)$$

$$\Delta x_t = \sum_{i=1}^{p-1} \Gamma_{\mathrm{xi}} \, \Delta z_{t-i} + c_{x0} + u_t \quad (11)$$

where there are r cointegrating relation(s) among the 6×1 vector of variables z_t in the conditional model (10) contains four endogenous (Malaysia) variables, $y_t = \{TB_t, Y_t, Q_t, P_t\}$ and marginal model (11) with two weakly exogenous foreign (China) variables, $x_t = \{Y_t^*, P_t^*\}$. $\Pi_y = \alpha_y\beta'$, α_y is an $m_y \times r$ matrix of error correction coefficients and β' is an $m \times r$ matrix of long-run coefficients and Ψ_i and Λ are the short-run parameters, t is time trend, c_0 is the intercept, and p is the order of VECX*. In the marginal model, Γ_{xi} are the short-run parameters, and c_{xo} is the intercept. It is assumed that u_t and v_t are serially uncorrelated and normally distributed. Notice that we need to restrict the trend coefficients in equation (10) in order to avoid the quadratic trends and the cumulative effects of $D_{crisis,t}$ in the level solution (Pesaran *et al*., 2000), as follow:

$$c_1 = \Pi_y d_1, \qquad c_2 = \Pi_y d_2 \tag{12}$$

where c_1 and c_2 are an arbitrary $m_y \times 1$ vector of fixed constants. Note that d_1 and d_2 are unrestricted if Π_y is full rank; in that case $d_1 = \Pi_y^{-1} c_1$ and $d_2 = \Pi_y^{-1} c_2$. However, if Π_y is rank deficient, d_1 and d_2 cannot be fully identified from c_1 and c_2 but can be estimated from the reduced form coefficients. In this case, the reduced form trend coefficients are restricted.

3.3 Data Description

Our analyses are all based on high frequency series, spanning from January 1997 to March 2010—a period of economic liberalization and trade expansion for both China and Malaysia. Real exchange rates (Q) are compiled by having the nominal RM/yuan adjusted for relative price changes using consumer price indexes (CPI), whereas trade balance (TB) ratios are computed based on the export/import series. Since monthly observations of GDP are not available, domestic and foreign incomes (Y, Y^*) are proxy by the industrial production index (IPI). The aggregate trade series are sourced from the Direction of Trade Statistics compiled by the International Monetary Fund, whereas the CPI, IPI, producer price indexes, and foreign exchange series are sourced from DataStream.

3. Empirical Discussion

The preliminary examination of the data properties is conducted using the unit root tests by Lumsdaine & Papell (1997) and Saikkonen & Lütkepohl (2002). The data are overwhelmingly integrated of I*(1)* where unit roots are rejected at first difference. These tests allow for endogenous structural break(s); for most cases, the break dates fall on the Asian financial crisis and subprime crisis periods.[5] We thereby impose two dummy variables on the trade model.

3.1 Dynamic Long-run Relationship and Error Correction Modeling

Before proceeding to the cointegration test of long-run relationship, we first have to determine the lag orders of endogenous and exogenous variable outlined in Eq (10). For this purpose, the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC) are applied to the underlying unrestricted VARX model. SBC has selected the lag orders of 3 for both conditional and marginal models, whereas AIC selected a higher and same order lag for the endogenous (4) and exogenous (3) variables, respectively. According to Garratt *et al*. (2003) and Affandi (2007), underestimating the lag orders is generally more serious than overestimating them. As such, the subsequent analyses are based on the VARX*(4, 3). Since the six-month out-

[5] Results of unit root tests are not presented here but are available upon request.

sample forecasting will be conducted, all analyses will only cover from January 1997 to September 2009.

Insert [Table 1] about here

Next, we need to determine the number of cointegrating relations given by r = rank ($\prod_y$), as defined by Eq (10). Following Pesaran *et al*. (2000), the modified Johansen-Juselius (1992) cointegration test is conducted using trace statistics for a model with weakly exogenous regressors. The test results are reported in Table 1. It appears that the trace statistics suggest the presence of one cointegrating relation (*r = 1*) at 10% significant level, which is in line with the trade theory expectation. In order to exactly identify the long-run relationship, we then impose a normalized restriction to produce the long-run estimate of the Malaysia-China trade model (Table 2).

Insert [Table 2] about here

The log-likelihood ratio (LR) statistic for the normalized (exactly identified) restriction is identical to the value reported in the value of maximized log-likelihood function for the cointegration test. However, the dummy for the subprime mortgage crisis is excluded from the model, as insignificant statistics are reported during the restriction test. Then again, we are aware that for most coefficients other than the real exchange rates and *D97*, the asymptotic standard errors are not statistically significant. It is therefore reasonable to re-estimate the cointegration relation by imposing the over-identifying restriction on the variables. Yet, LR tests could over-reject in small samples (Affandi, 2007; Garratt *et al*., 2006). The bootstrapped critical values based on 1,000 replications of the LR statistic are computed. Using the observed initial values of each variable, the estimated model, and a set of random innovations, an artificial data set is generated for each of the 1,000 replications under the assumption that the estimated version of the model is the true data-generating process. The bootstrapped critical values for the joint test are reported at 22.9725 (95% confidence level) and 19.5385 (90% confidence level), while the LR statistic of over-identifying restriction is reported as 22.5245 (p-value = 0.001). Hence, the restriction can be rejected, and the macroeconomic variables included in our trade model are in fact the influential factors. The results also suggest that the presence of the Asian financial crisis (but not the subprime crisis) as dummy variable does affect the long-run relationships.

Long-run estimates reported in Table 2 show that the trade balance is significant and responsive to changes in the real exchange rate of RM/yuan. Recall from Eq (7) and (9) that a real devaluation of domestic currency (RM) will improve the trade balance ($\partial TB / \partial Q > 0$), only if the sum of the price elasticity of demand for exports and imports is greater that unity. Since the *lnTB* is defined as the ratio of Malaysian exports to imports vis-à-vis China, the reported coefficient of *lnQ* = 3.0446 > 1 is sufficiently large to support the Marshall-Lerner condition in the long run. As such, we foresee positive trade gains if the Malaysian ringgit is to depreciate against the Chinese yuan, which was evidently true during the Asia financial crisis. Conversely, if devaluation happens for the Chinese yuan, the conflicting feature may emerge because the bilateral imports and exports are sensitive to changes in RM/yuan, which will be reflected in the export and import prices. The finding is a theoretical prediction but not in line with recent studies that failed to support the trade-exchange rate relationship (e.g., Rose & Yellen, 1989; Bahmani-Oskooee, *et al*., 2006; among others).

The modeling of VECX* short run dynamics is presented in Table 3 and several points are noteworthy. First of all, the lagged error correction term (ECT_{t-1}) carries its expected negative and significant sign, indicating that the system - once being shocked, will necessarily adjust back to the long run equilibrium. However, the relatively small coefficient (-0.1933) would imply a rather slow speed of adjustment. Second, the negative lagged ΔlnQ_{t-1} followed by a significant and positive lagged ΔlnQ_{t-2} seems to support for the J-curve in short run, as suggested by Bahmani-Oskooee and Mitra (2009). Third, the dummy for Asia crisis is significant but other lagged endogenous variables are insignificant. As for the exogenous foreign variables, some weak significant lagged effects are detected for Chinese output and producer price.

Insert [Table 3] about here

Despite the R^2 reported as 0.46 in Table 3, four additional diagnostic tests are also conducted. For serial correlation, we use the Lagrange Multiplier (LM) test. The error correction model is clean of autocorrelation problems as the null hypothesis of serial correlation in residuals failed to be rejected, in the presence of lagged dependent variable. The insignificant *F*-statistic is reported at 1.233 (p-value= 0.27) with 12 degrees of freedom. Using the square of the fitted values, the Ramsey Regression Equation Specification Error Test (RESET) then tests for functional misspecification. The model is considered as correctly specified with the *F*-statistic reported as insignificant (p-value=0.67, d.f. =1). Likewise, the heteroscedasticity test statistic is again insignificant (p-value=0.87). And lastly, the normality test of skewness and kurtosis of residuals also do not pose any problem to the VECX* model, with an insignificant chi-squared statistic reported at 3.475 (p-value=0.18).

A subsequent and important inspection of model stability is to apply the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests to the residuals of the error-correction VECX* model and the long-run VARX coefficient estimates. For the CUSUM test, the recursive residuals are plotted against the break points, while the CUSUMSQ plots the squared recursive residuals against the break points. As a graphical presentation, these two statistics are then plotted within two straight lines, which are bounded by 5% significance level. If any point lay beyond this 5% level, the null hypothesis of stable parameters is rejected or otherwise. Clearly, Figure 1 supports the stability of estimated coefficients for our Malaysia-China trade model as both statistics are within the critical lines.

Insert [Figure 1] about here

The actual (LTBMC) and fitted values (Forecast) for the trade model are displayed in Figure 2. Out of the 159 data points in the full sample, 153 from January 1997 to September 2009 are used for econometric modeling, while six months or two quarters of the trade balance series are kept for out-sample forecasting. The unconditional forecast is performed based on the forecasts of the exogenous variables using the marginal model. Some outliers are observed by varying magnitude during the 1997 Asian crisis, the 2001 dot-com crisis, and the 2008 subprime crisis. However, the preliminary break tests only detected the Asian crisis and the subprime crisis. Overall, the fitted values seem to track the main movements of the trade balance series reasonably well in terms of forecasting magnitude and direction. As for the out-sample forecast, the prediction errors are considerably small except for February and March 2010, where the trade surplus was highly recorded. The forecasting assessment in Table 4 reported low forecast bias and satisfactory forecast accuracy, indicating that our trade model is well specified.

Insert [Figure 2] about here

Insert [Table 4] about here

3.2 Shock Responses and Speed of Convergence

A good way of measuring the speed of convergence of the cointegrating relations to equilibrium is to examine the dynamic responses of the endogenous variables to various types of shocks, in particular shocks to the real RM/yuan, Malaysian output, and prices. We first consider the effect of system-wide shocks on the cointegrating relations using the Persistence Profile developed by Pesaran and Shin (1996). On impact, the Persistence Profile is normalized to take the value of unity, but the rate at which it tends toward zero provides information on the speed with which the equilibrium correction takes place in response to shocks. In addition to the point estimates, the 95% Confidence Bounds—which are generated by employing the nonparametric bootstrap method using 1,000 replications—are also illustrated as dotted lines (Figure 3). The system-wide shock has affected all long-run relations significantly in the beginning, before the effects eventually disappear in the long run. The half-life is about two months, and the whole effect takes around six months to complete. The result seems to be consistent with the error correction process of the VECX* model.

Insert [Figure 3] about here

Next, to analyze the effect of a shock to a variable on the expected future values of the endogenous variables, we employ the generalized IRFs, which measure the change to the n-period forecast of each of the variables that would be caused by a shock to the particular variable. In contrast to the orthogonalized impulse response, the generalized IRFs do not require orthogonalization of shocks and is invariant to the ordering of the variables in the VAR (Pesaran and Shin, 1998) and in our case, the VARX model. In this section, we first consider the responses of the trade balance variable to a positive unit shock of most concerned endogenous variable—real RM/yuan. Shown in Figure 4, a unit shock (depreciation) of the real RM/yuan is followed by the response of an expansion in trade balance series. The impact lasted about a year and stabilized in the 13^{th} month. When there is currency devaluation, we generally expect that the trade balance deteriorates at first, because the price change occurs quickly, while trade quantities (volume) change more slowly. After a moderate time period, the volume effect become large enough to offset the price effect and the trade balance improves to exhibit the so-called J-curve phenomenon. However, in Figure 4, a 1% depreciation of the Malaysian ringgit brings about a 6% gain in the trade balance almost immediately—in the first 2.5 months—which lowers to a 3% gain in the following months. In other words, depreciation of the RM/yuan resulted in an overall trade surplus for Malaysia against China, where the price effect failed to dominate the volume effect even in the early stage. Perhaps, this is the result of Chinese imports growing faster than exports (against ASEAN) in recent years. Though there is no clear pattern of a J-curve for Malaysia-China bilateral trade, the finding is consistent with the long-run estimation that the bilateral trade is sensitive to real exchange rate changes.

Insert [Figure 4] about here

Insert [Figure 5] about here

The generalized IRFs of the trade balance to a unit shock in output and producer prices are given in Figure 5. The result indicates the extent to which demand and supply channels affect the bilateral trade balances. The trade balance series depicts a V-shape adjustment to Malaysian output (industrial production) shocks. Domestic consumers may increase their demand for Chinese goods due to the income effect, resulting in temporal trade balance deterioration, but this effect gradually ends within a year. Response to foreign (China) output demonstrates a similar magnitude effect, though the impact lasts longer, about 15 months. This could be due to the substitution effect under which Chinese consumers shift their demand for Malaysian exports to other goods and services. Conversely, IRFs of trade balance responses to Malaysian and Chinese producer prices follow an increasing path. The impacts remain positive and stabilize within a year. The figure seems to indicate some early signs of trade expansion following the producer price shocks.

The effects of real exchange rate shock on output and producer prices are shown in Figure 6. The point estimates are bounded by the 95% bootstrapped confidence intervals using 1,000 replications. Clearly, Malaysia shows a greater response to the foreign exchange rate shock, perhaps due to the greater openness of the Malaysian economy. However, a positive unit shock (depreciation) of real RM/yuan is contractionary for Malaysian output. An initial 1% depreciation of the Malaysian ringgit results in a 1.2% reduction of industrial production in the first two months. The impact stabilizes after eight months at approximately 0.8% below its base value. Such a finding of the contractionary effect due to devaluation is along the lines of studies by Rajan & Shen (2002), Ahmed, *et al*. (2002), and Bahmani-Oskooee & Miteza (2003). Indeed, Kim and Ying (2007) have underlined that devaluation may be more contractionary than previously thought because of financial liberalization and improvement in information technology; devaluation worsens the balance of payments of countries with heavy foreign currency liabilities. There is also an adverse effect on the country's reputation, impairing its ability to raise foreign capital.

Insert [Figure 6] about here

Likewise, Chinese output responds negatively to the positive shock of RM/yuan (in which the yuan appreciates), but the impact is minor. The deterioration of production (about 0.2%) is observed in the second and third months and the impact stabilizes after nine months at approximately 0.1% below its base value. Keep in mind that China practices an export-led growth policy based on maintenance of an undervalued yuan. The finding may partly justify China's rigid policy of keeping the yuan from appreciating against world currencies in the past decade. On the other hand, the response(s) of producer prices to foreign exchange shocks are muted and are generally insignificant statistically. As for the Malaysian producer price shock, the impact could be slightly inflationary, but the scale is small. It is still inconclusive whether devaluation has inflationary or deflationary effects.

Subsequent analysis uses the Variance Decompositions (VDCs) in an attempt to gauge the extent of shocks to a variable that can be explained by other variables considered in the VARX model. VDCs can be considered as an out-sample causality test, which provides a quantitative measurement of how much the movement in one variable can be explained by other variables in the VAR system in terms of the percentage of forecast error variance. However, the results based on conventional orthogonalized VDCs are found to be sensitive to the number of lag lengths used and the ordering of the variables in the equation. The errors in any equation in a VAR are normally serially uncorrelated by construction, but there may be contemporaneous correlations across errors of different equations. To overcome this problem, the generalized VDCs of forecast error is applied (see Pesaran and Pesaran, 1997).

Insert [Table 5] about here

Table 5 presents the generalized VDCs for our VARX model. Among the six variables in the system, the Chinese variables (industrial production and producer price) seem to be the most exogenous variables, as most of the shocks are explained by their own innovations (87%–97%) over the horizon of 24 months. Such a finding provides the methodological support for the VARX and VECX* modeling approach employed in this study. On the other hand, trade balance and real foreign exchange rate are found to be endogenous. In line with the long-run estimates, innovation from the real foreign exchange rate explains a substantial portion of the forecast error variance in the trade balance (about 20%). As for the foreign exchange rate, the major innovation comes from Chinese producer price. Yet, the Malaysian producer price is relatively exogenously determined, though it was included in the conditional model as an endogenous variable.

4. Conclusion and Policy Implications

The present study explores the dynamic relationship of trade balance, exchange rates, outputs, and producer prices for Malaysia-China in the liberalization era. The empirical framework was constructed based on the VARX and VECX* modeling procedure put forward by Pesaran *et al*. (2000) and Garratt *et al*. (2006). The application of Persistent Profile and IRFs shows how the core variables (TB, Y, PP, Q) evolve with respect to economic shocks. With additional scrutiny of generalized VDCs and forecasting assessment, the comprehensive analyses allow us to draw useful insights about the Marshall-Lerner condition, the J-curve phenomenon, and the output (expansion or contraction) and price (inflationary or deflationary) effects between Malaysia and China.

First of all, the Marshall-Lerner condition holds for Malaysia against China in the long run. The short-run J-curve pattern is not visible through the IRFs analysis but noticeable in the error correction modeling. This would suggest a potential gain in Malaysian balance of payment if ringgit depreciated against the yuan. Theoretically, in a Keynesian economy with excess capacity, devaluation boosts net exports and, through the multiplier effect, fosters economic growth. Such demand channel, however, does not work well in the Malaysia-China case during and after the Asia financial crisis. Based on the generalized IRFs, a positive unit shock of real RM/yuan (in which RM depreciates) results in a contractionary effect for Malaysian output. If we refer to the generalized VDCs analysis, the percentage variance of industrial production is not well explained by the innovations in variance of the real foreign exchange. In addition, domestic and foreign incomes are only significant through lagged effects in the short run but not in the long run model, suggesting that the demand side effects are temporal. In other words, devaluation for export gains is insufficient to sustain output expansion for Malaysia against China. It is worth noting, that the success of currency depreciation in improving the trade balance largely depends on switching demand in the proper direction and amount, as well as on the capacity of the home economy to meet the additional demand by supplying more goods. Since the trade expansion due to currency shock is temporal and the short-run adjustments are slow, productivity growth in real and tradable sectors is essentially vital to enhance the external competitiveness and hence economic growth.

From the supply side's viewpoint, Malaysia is a typical semi-industrialized nation, where inputs for manufacturing are still largely imported and not produced domestically due to deficiency in economy of scale; for instance, the automobile, the chemical and allied industry production and textile manufacturing. Firms' input cost may increase following currency devaluation. However, our analysis of IRFs has not shown clear inflationary or deflationary effect following the shock in real Malaysian ringgit. And, the lagged variables of the producer price were statistically insignificant in the error correction modeling of VECX*. Both the Malaysian and Chinese producer prices are also relatively exogenously determined, as indicated by the VDCs analysis. Putting together, the results suggest that negative impact from the higher cost of imported inputs from China (due to ringgit depreciation) does not dominate the production stimulus from lower relative prices for domestically traded goods. In other words, China has yet to be Malaysia's main source of imported inflation.

At the present stage, China has shown complementary features and been supportive of regional trading. In mid-August 2010, China began trading the Malaysian ringgit against the yuan on its domestic foreign exchange market. The aim is to promote bilateral trade between China and Malaysia and facilitate the use of the yuan to settle cross-border trade. Yet, the potential conflicting (competing) aspect of the trade relationship cannot be ignored. Manufacturing accounted for 92.4% of China's merchandise exports in 2006, and the trend persists. Malaysia remains competitive in machinery, electronic equipment, and energy supply, but not competitive in clothing and textile manufacturing, food, agricultural and leather-related products, and transportation. Malaysia needs to upgrade its export structure and reduce low-end and labor-intensive manufacturing. Malaysia's focus should be on high value-added production, design, and service sectors, before China overtakes it in these areas. Since both nations are now promoting the respective services sectors, further bilateral liberalization and strategic collaboration in services trading should be an important focus of Malaysia-China trade. These services may include education, medical tourism, transportation, and construction, as well as financial services. The two nations could experience economic gains in market structure and product diversification as well as economies of scale from regional trade integration.

Lastly, the authors foresee a comprehensive structural model to be developed to include additional economic theorems and other variables in the VARX and VECX* modeling in future research. We also propose to disaggregate the trade data by employing imports and exports at the industry level, for example, the 21 export and import categories set by the Malaysian Ministry of

International Trade and Industry, so that the potential aggregation bias can be avoided and better industry policy can be developed.

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Table 1: VARX Cointegrating Test, January 1997–September 2009

H_0	H_1	Trace Statistics	Bootstrapped Critical Values	
			95%	90%
$r = 0$	$r = 1$	86.92[a]	87.6639	81.2677
$r \leq 1$	$r = 2$	48.83	57.6497	53.2201
$r \leq 2$	$r = 3$	20.49	34.4511	31.7246
$r \leq 3$	$r = 4$	7.40	16.2293	14.3547

Notes: [a] denotes significant at 90% confidence level. The 95% and 90% critical values are generated by the bootstrap method using 149 observations and 1,000 replications. The underlying VARX trade model is of lag order (4, 3) and contains unrestricted intercept.

Table 2: Normalized Long-run Estimates and Restriction Test

$$lnTB_t = 0.5695 lnY_t - 0.4720 lnPP_t + 3.0446 lnQ_t - 0.1416 lnY_t^* + 1.1472 lnPP_t^* - 0.3078 D97_t$$

(0.3837) (0.4131) (0.8150)[c] (1.3174) (0.9775) (0.1758)[a]

95% Bootstrapped CV for LR: 22.9725	LR test: 22.5245 [0.001]
90% Bootstrapped CV for LR: 19.5385	

Note: [a, b, c] denote significant at the 10%, 5%, and 1% levels, respectively. Asymptotic standard errors are reported in parentheses ( ) and p-value of LR statistics is reported in [ ].

Table 3: Error Correction Representation of the VECX* Trade Model

VECX*	Regressor	Coefficient	Std Error	T-sta [P-value]
Conditional Model (Endogenous Variables)	c	-0.4096[b]	0.1897	-2.1588[0.033]
	$\Delta lnTB_{t-1}$	-0.2696[c]	0.0987	-2.7300[0.007]
	$\Delta lnTB_{t-2}$	-0.1458[a]	0.0876	-1.6631[0.099]
	$\Delta lnTB_{t-3}$	-0.2569[c]	0.0734	-3.4981[0.001]
	ΔlnY_{t-1}	-0.7529[c]	0.2836	-2.6545[0.009]
	ΔlnY_{t-2}	-0.4516	0.3306	-1.3658[0.174]
	ΔlnY_{t-3}	-0.1082	0.2766	-.39120[0.696]
	$\Delta lnPP_{t-1}$	0.5848	0.9505	.61525[0.539]
	$\Delta lnPP_{t-2}$	-0.3194	0.9520	-0.3355[0.738]
	$\Delta lnPP_{t-3}$	0.4820	0.9548	0.5048[0.615]
	$\Delta ln(Q_{t-1})$	-0.4646	0.4853	-0.9573[0.340]
	$\Delta ln(Q_{t-2})$	1.7282[c]	0.4810	3.5932[0.000]
	$\Delta ln(Q_{t-3})$	-0.3928	0.5007	-0.7845[0.434]
	$\Delta D97$	-0.0942[b]	0.0489	-1.9264[0.044]
	ECT_{t-1}	-0.1933[c]	0.0878	-2.2014[0.030]
Marginal Model (Exogenous Variables)	ΔlnY^*_{t-1}	0.8014[a]	0.4192	1.9117[0.058]
	ΔlnY^*_{t-2}	0.1541	0.5137	.30008[0.765]
	ΔlnY^*_{t-3}	0.1575	0.4206	.37436[0.709]
	$\Delta lnPP^*_{t-1}$	1.5930	1.8617	.85570[0.394]
	$\Delta lnPP^*_{t-2}$	4.5957[b]	2.1936	2.0950[0.038]
	$\Delta lnPP^*_{t-3}$	-3.0073	1.9446	-1.5465[0.124]
Diagnostic Tests				
R^2	AUTO	RESET	Normal	Hetero
0.46	1.233[0.27]	0.183[0.67]	3.475[0.18]	0.026[0.87]

Notes: [a, b, c] denote significant at the 10%, 5%, and 1% levels, respectively. AUTO is the Lagrange Multiplier test for serial correlation; RESET is the Ramsey Regression Equation Specification Error Test for functional form; Normal is a test that examines for normality in the errors; and Hetero tests for heteroscedasticity. Except for the Normal test that uses chi-squared statistics, all diagnostic tests are conducted using *F*-statistics.

Figure 1: Diagnostic Tests of CUSUM and CUSUMSQ

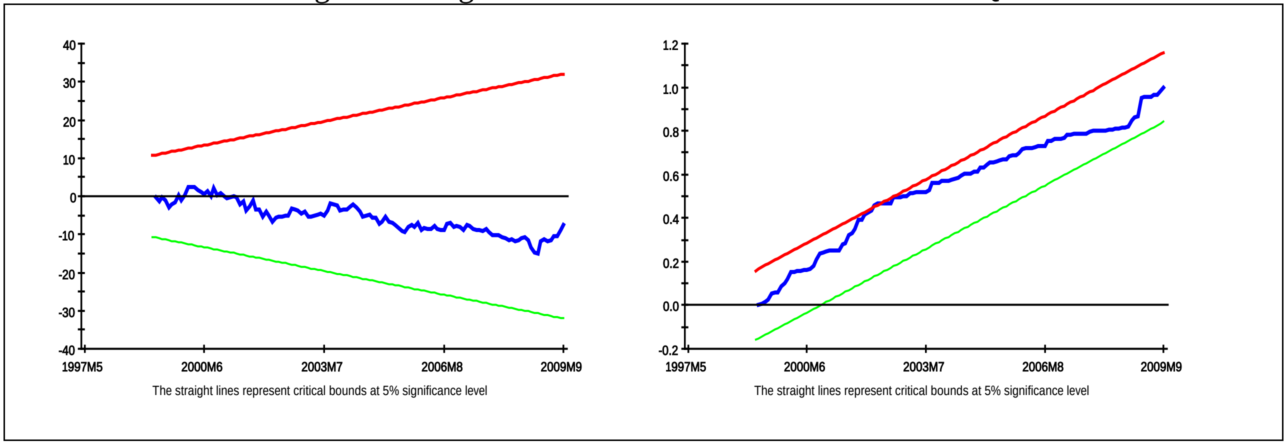

Figure 2: Multivariate Dynamic Forecasts for the Level of Malaysia-China Trade Model

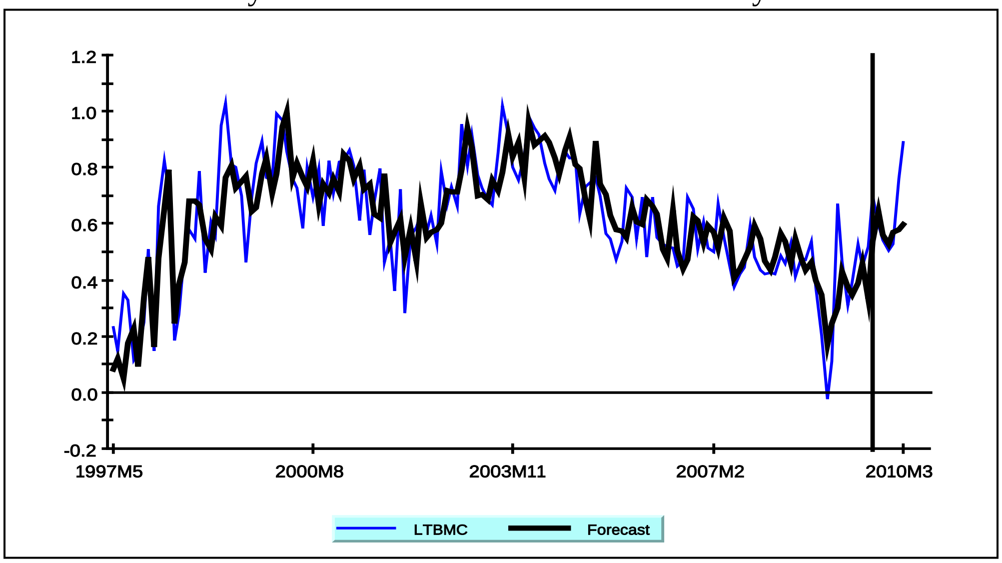

Table 4: In-sample and Out-sample Forecast Assessment of Trade Model

	Actual *lnQ*	Prediction of *lnQ*	Error
2009M10	0.59866	0.64591	-0.04726
2009M11	0.54362	0.56257	-0.01895
2009M12	0.50551	0.52753	-0.02203
2010M1	0.52725	0.56916	-0.04191
2010M2	0.76087	0.57956	0.18131
2010M3	0.88732	0.59801	0.28931

Forecasting Assessment		
	1997M5-2009M9	2009M10-2010M3
Mean	0.00000	0.056746
Mean Absolute	0.096313	0.10012
Mean Sum Squares	0.014603	0.020234
Root Mean Sum Squares	0.12084	0.14225

Figure 3: Persistence Profile and System-Wide Shock to Cointegrating Relation

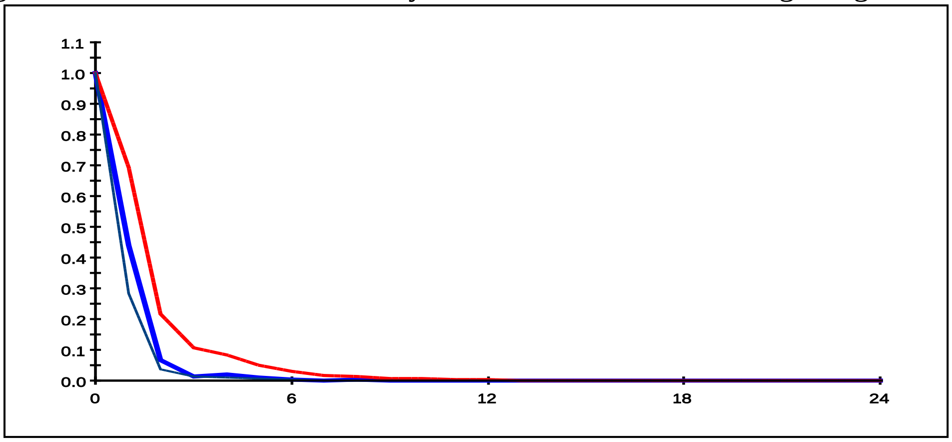

Figure 4: Response of Malaysia-China Trade Balance to Real RM/Yuan Shock

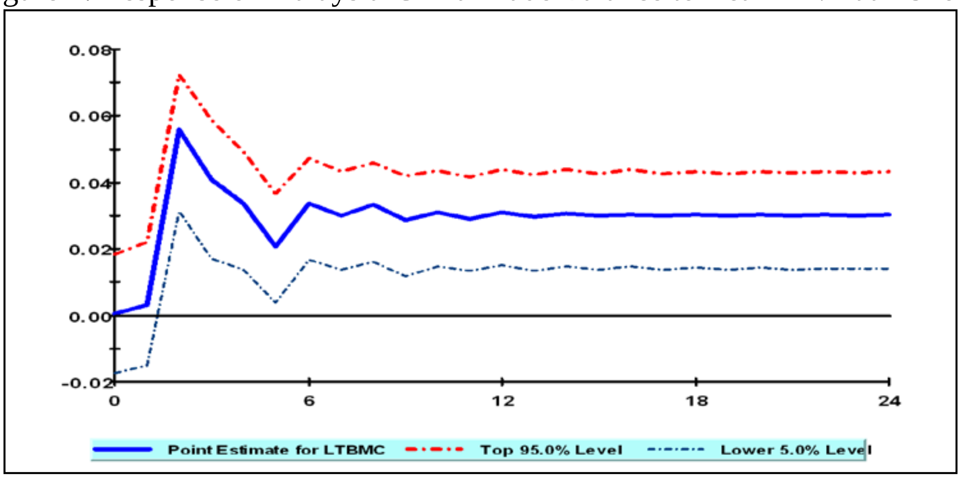

Figure 5: Responses of Malaysia-China Trade Balance to Shocks in Output and Prices with 95% Bootstrapped Confidence Bounds

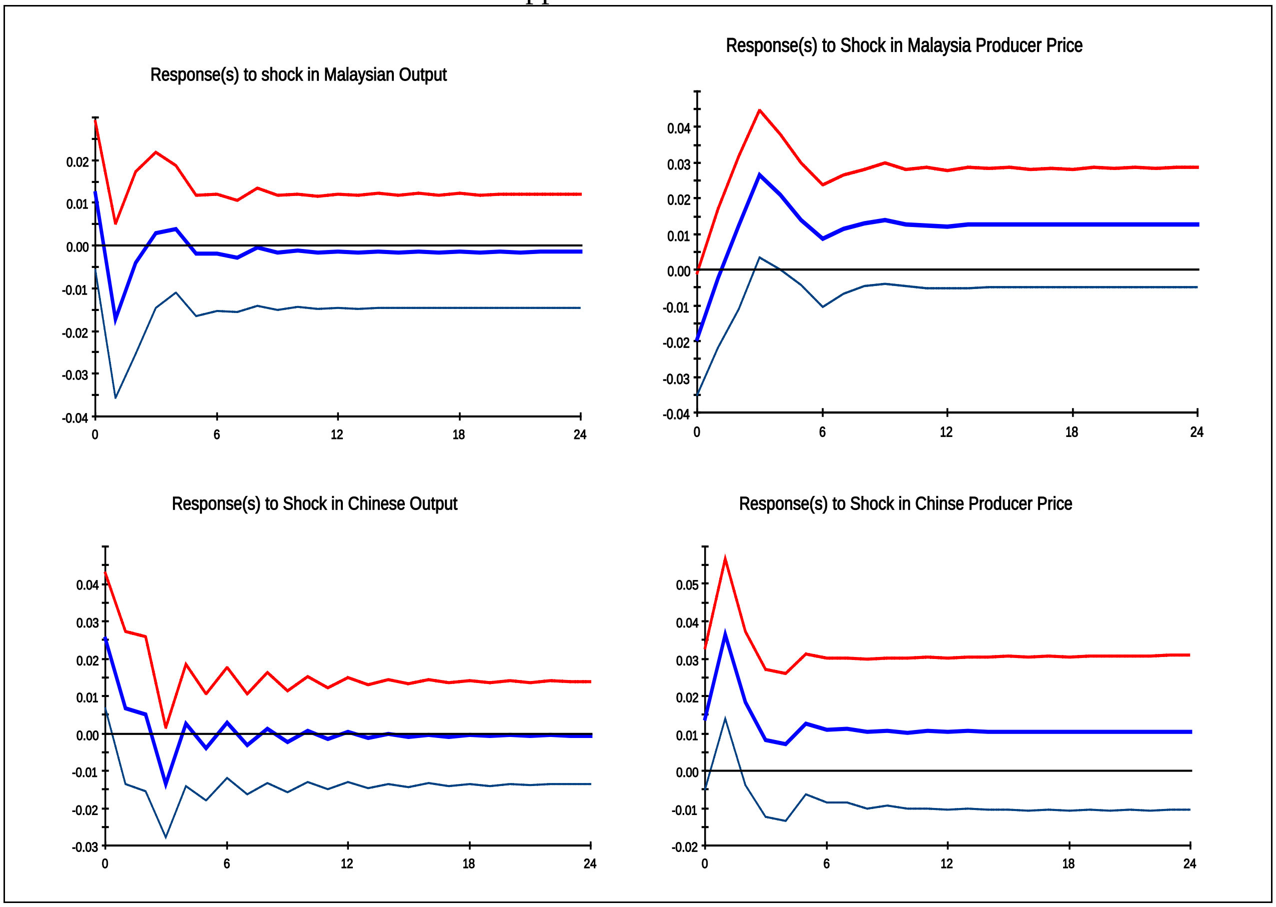

Figure 6: Response(s) of Output and Prices to Positive Unit Shocks in Real RM/Yuan with 95% Bootstrapped Confidence Bounds

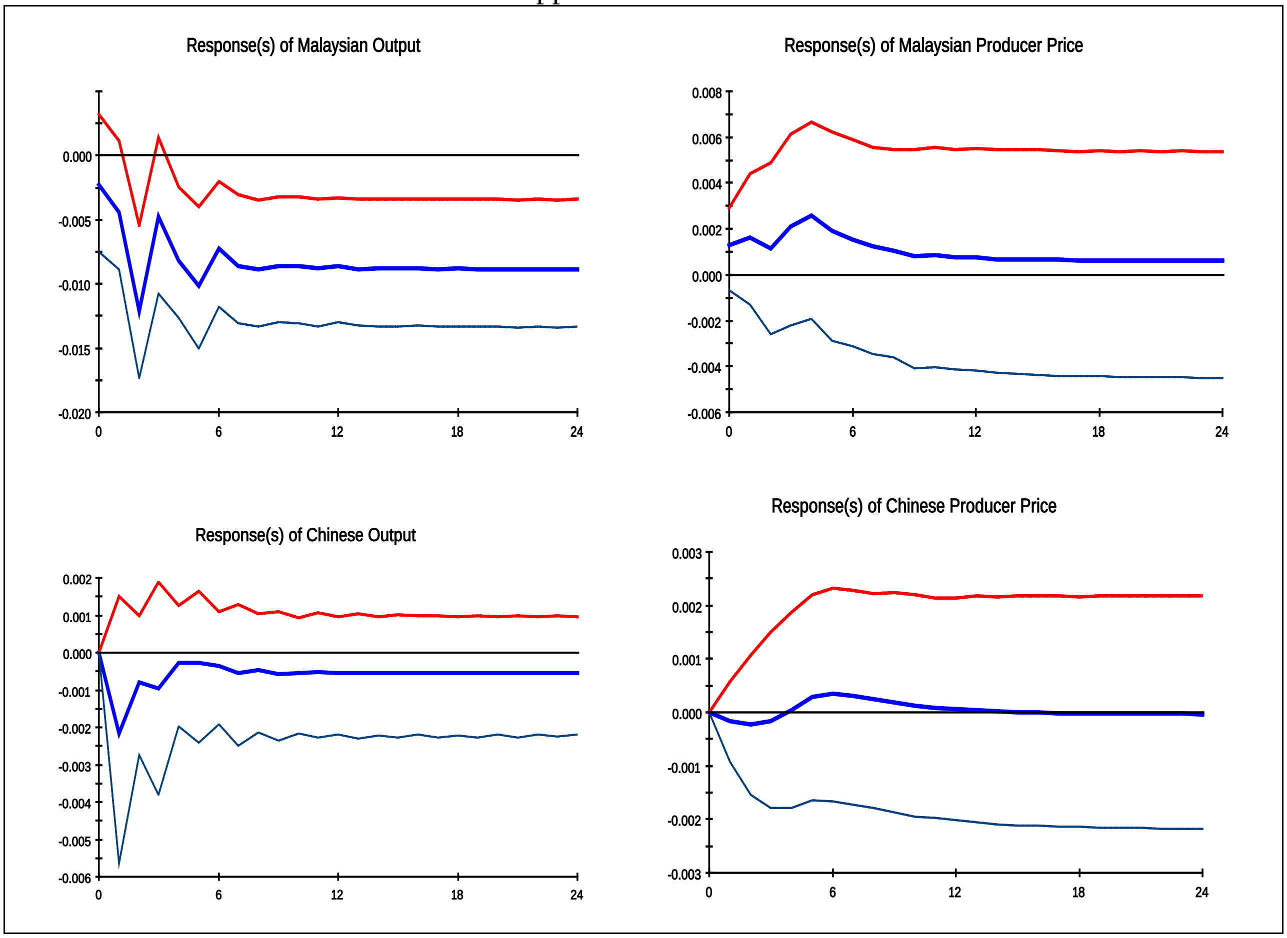

Table 5: Generalized Variance Decomposition for VECX*

	Horizon	% of Variance Explained by Innovations in					
		TB	Y	PP	Q	Y*	PP*
TB	4	**70.78**	1.29	4.48	15.76	2.39	5.22
	8	**68.77**	0.95	4.28	17.95	1.77	4.69
	12	**67.56**	0.75	4.30	19.25	1.39	4.29
	16	**66.80**	0.63	4.29	20.12	1.14	4.04
	20	**66.29**	0.54	4.27	20.71	0.96	3.86
	24	**65.92**	0.47	4.26	21.14	0.84	3.72
Y	4	5.51	**65.68**	2.03	6.50	8.80	20.28
	8	7.47	**53.76**	1.73	7.94	10.63	28.94
	12	8.64	**48.46**	1.69	8.35	11.30	32.75
	16	9.39	**45.43**	1.68	8.63	11.66	34.77
	20	9.89	**43.53**	1.69	8.80	11.89	36.01
	24	10.23	**42.23**	1.69	8.92	12.04	36.85
PP	4	1.82	2.22	**89.14**	1.04	0.19	8.87
	8	0.93	1.35	**85.38**	0.75	0.13	10.65
	12	0.83	1.00	**83.04**	0.53	0.08	11.43
	16	0.83	0.82	**81.72**	0.41	0.06	11.81
	20	0.85	0.71	**80.92**	0.34	0.05	12.03
	24	0.86	0.64	**80.38**	0.29	0.04	12.17
Q	4	6.68	0.47	5.79	**78.70**	5.23	6.16
	8	22.15	1.38	4.52	**61.91**	3.80	6.50
	12	29.73	1.83	4.23	**53.26**	3.10	6.48
	16	34.11	2.10	4.08	**48.27**	2.70	6.41
	20	36.91	2.27	3.99	**45.09**	2.44	6.36
	24	38.82	2.39	3.92	**42.90**	2.27	6.32
Y*	4	0.13	0.04	1.97	0.27	**97.37**	2.38
	8	0.17	0.04	2.33	0.19	**97.07**	2.03
	12	0.17	0.03	2.41	0.16	**96.99**	1.86
	16	0.16	0.03	2.46	0.14	**96.95**	1.76
	20	0.16	0.02	2.50	0.13	**96.92**	1.70
	24	0.16	0.02	2.52	0.13	**96.89**	1.65
PP*	4	0.27	0.13	8.81	0.01	3.31	**90.90**
	8	0.21	0.11	11.78	0.02	2.82	**87.87**
	12	0.13	0.08	12.79	0.02	2.71	**86.67**
	16	0.10	0.07	13.26	0.01	2.67	**86.04**
	20	0.07	0.06	13.53	0.01	2.66	**85.66**
	24	0.06	0.05	13.70	0.01	2.65	**85.42**