The Effects of Shocks on the Real Exchange Rate of ASEAN-5 and China

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Abstract

For the past two decades, issues concerning economic integration have been a major discourse in international trade economics. This paper explores real exchange rate responses to shocks in exchange rate determinants for ASEAN-5 and China (Indonesia, Philippines, Malaysia, Singapore, Thailand and China), assuming economic integration among these countries. Interdependent, dynamic, and multi-countries Panel Vector Autoregression (pVAR) models with monthly data are employed in this study to obtain more precise effects than using annual data. The study found that contractionary monetary policy causes depreciation in the real exchange rate. However, increasing GDP, inflation, government expenditure and trade liberalization are associated with the real exchange rate appreciation. The estimated models show that trade liberalization has the strongest effect towards the real exchange rate.

Keywords: Real Exchange Rate, ASEAN-5 and China, Panel Vector Autoregression model

1. Introduction

The ASEAN integration tremendously hosted the region to be in single trade zone and international trade has been the engine of economic growth for the Association of Southeast Asian Nations region for a long time. In terms of trade openness, the ASEAN region has been on top in Asia, while in terms of export size, the ASEAN region was also the largest in Asia until China took over the lead in 2004.All ASEAN countries would give separate offers to India except Singapore, with whom India has had zero tariff rates since 2005. Each of these offers

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consists of individual tariff reduction schedules of about 9700 tariff lines according to the Harmonized System (HS) 8-digit level. And the manufacturing industry in ASEAN plays a strategic role with its large contribution to Gross Domestic Product, high labour absorption, significant export contribution, and high forward and backward linkages to other sectors (Surjaningsih and Permono, 2014).

Furthermore, China has become the top export destination for Malaysia and Thailand. In fact, few scholars have investigated the effects of China's trade expansion on the trade performance of its East Asia counterparts, and a common consensus is that China has played a complementary role rather than crowding out the trade potentials of its neighbours, including those from ASEAN; see, for example, Fernald et al. (1999), Eichengreen et al. (2007), and Athukorala (2009).The exchange rate directly affects inflation through the cost of import (pass-through effect) while its impact on output works through the international trade activities. The depreciation of the exchange rate will give a positive impact towards the export of a country because the cost of the goods exported will be cheaper if converted into the importer's currency.

This study covers issues concerning on shocks of government consumption, monetary policy and trade openness that will have impacts on the exchange rate fluctuation where stable exchange rate is the key to successful in outward-oriented, export-based development strategies as opined by Dumrongrittikul and Anderson (2014). They also stated that poorly aligned exchange rates with fundamentals can lead to financial instability and such instability can spread widely to macroeconomics of developing countries. In some of the emerging countries including ASEAN, the exchange rate fluctuations make the excess capital inflow due to the exchange rate inefficiency. Fung (2007) examined the influence of the exchange rate towards the extensive and intensive margins of the company and concluded that there was a negative impact through the appreciation of the exchange rate towards extensive margin in trade.

The objective of this paper is to show the impulse responses of the real exchange rate fluctuation caused by the shock of real GDP, nominal interest rate, trade openness, government consumption, and inflation, using monthly data from CEIC database. The data is based on the panel of ASEAN-5 and China to estimate the result more efficiently and accurately. It is also aimed at providing which variables can strongly affect the exchange rate by studying the impacts of different types of shocks.

This research is organized as follows: Section 2 covers the theoretical framework based on the existing literature review, Section 3 discusses the Empirical results, and Section 4 discusses the results, conclusion and recommendations.

2. Literature Review

Two main strands of literatures are discussed in this section. The first strand focuses on the shocks on real exchange rates. Some empirical studies have similar topics that relied on standard time-series techniques. While these techniques can lead to inaccuracies of estimation and hypothesis testing when the frequency data or samples are limited; some critical issues can be occurred as well. More recent studies have turned to panel data co-integration methods

without using the monthly data. The estimation in this current study is done by using the panel VAR model as it gives more efficient and accurate results. Chinn (1999) mentioned a panel error correction model for fourteen OECD countries and shown that an increase in traded sector productivity induces a long run appreciation, while the government spending and terms of trade have no effect on the real exchange rates. However, these results are inconsistent with the work of Galstyan and Lane (2009). Bertrand Candelon (2006) demonstrated that a productivity increase in the tradable sector of new member states (NMS) in Europe relative to the euro area does indeed lead to an appreciation of the NMS real exchange rate and thus claims significantly negative effects from openness to the real exchange rate. Furthermore, Edwards (1988) generated a dynamic model for a small open developing economy that has a dual nominal exchange rate system. He also investigated the effects of various policies (including trade controls) that can influence the exchange rates and the dual exchange rate system including a fixed nominal exchange rate for commercial transactions and a freely floating nominal exchange rate for financial transactions giving rise to an exchange rate spread. Total assets of this country in domestic currency consist of domestic and foreign money with a positive initial stock of foreign money, given no international capital mobility.

The second strand of literature review discusses the empirical works on theoretically motivated signs on impulse responses function with some shocks on exchange rates and other variables which are closely related with this study. Dumrongrittikul and Anderson (2015) mentioned that the real GDP growth, productivity in the traded sector, the government consumption share and the degree of openness in the economy have a long run relationship with the real exchange rate. Cornell (1977), Mussa (1979) and Frenkel (1981b) have noted that exchange rate changes are largely unpredictable and Mussa (p. 10) stated that the natural logarithm of the spot exchange rate follows approximately a random walk as well. The exchange rate determination has focused intensively on developed countries but there is limited studies done with regard to the effects of shocks on real exchange rates of developing countries.

In this research, the interest is focused on shocks of the government expenditure, trade openness, contractionary monetary policy, real GDP and inflation to the real exchange rate fluctuation in ASEAN-5 and China. The limited frequency monthly data of ASEAN-5 and China will be host in the simulation using panel data methods. Furthermore, this study is expanded from the previous paper by adopting estimation from co-integrating relationships to createan impulse response analysis in order to examine the shock effects from aforementioned domestic factors on real exchange rates in the long run forASEAN-5 and China.

3. Theoretical Considerations and Models

Our model uses micro-foundations with a two-sector framework (traded and nontraded sectors) to examine the responses of the real exchange rate to the trade liberalization, government consumption and monetary policy.

We assume that the economy consists of producers, consumers and government. The producers produce exportable goods and non-tradable goods while the government and consumers consume importable goods and non-tradable goods.

The dual exchange rate system includes a fixed nominal exchange rate (E) for commercial transactions and a freely floating nominal exchange rate (δ) for financial transactions.

Total asset (A) of this country in domestic currency consists of domestic money (M) and foreign money (δF). In this paper, it is assumed that there is a negative relationship between the desired ratio of real domestic money (m = M/E) to real foreign money (δF/E).

The model incorporates an import tariff (τ). The price of exports in terms of foreign currency is set to one (P_X*=1). In addition, where P_N is the price of non-tradable goods, P_M* is the price of imports and P_M is the price of imports that includes the import tariff, we have P_M=E.P_M* +τ. The government consumes G that consists of imports (G_M) and non-tradable goods (G_N), we then have G = $P_N G_N$ + EP_M*G_M. Real government consumption (g) can be written as g = G/E.

Private demand for imports (C_M) and non-tradable goods (C_N) are modelled as the function of the relative price of imports to non-traded goods (e_M = P_M/P_N) and the level of real assets in term of exports (a = A/E). Thus C_M = $C_M(e_M,a)$ and C_N = $C_N(e_M,a)$.

The supply for both goods (Q_X and Q_N) is a function of the relative price of exports (P_X*=1 to non-traded goods (e_X = E/P_N).

The model defines the real exchange (q) as

$$q = \frac{E[\alpha P_M^* + (1-\alpha) P_X^*]}{P_N} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

This equation is used to determine the responses of the real exchange rate to the trade liberalization and government consumption.

3.1 Real exchange rate response to trade liberalization

A trade liberalization generated by a reduction in import tariffs decreases the price of imports (P_M) and increases the demand for traded goods, but substitution on tradable goods for non-tradable goods also causes a decline in the price of non-traded goods (P_N). From equation (1), the real exchange will be depreciated.

3.2 Real exchange rate response to expansionary government consumption

An increase in government's demand for non-tradable goods (g_N) will create higher demand and thus a rise in the price of non-tradable goods, generating a real exchange rate appreciation. However, government consumption is financed by public debt that must be paid back. This increase in taxes will lead to a fall in household assets, then a corresponding decline in demand for non-tradable goods and corresponding real exchange rate depreciation. If we assume that government expenditure is mostly on non-tradable goods, a rise in the price of non-tradable goods will play more dominant role, leading to a real exchange rate appreciation in response to an increase in government consumption.

3.3 Real exchange rate response to contractionary monetary policy

Under the assumption that the economy is small, capital is perfectly mobile, and investors have rational expectations, an increase in domestic interest rate will make domestic assets more attractive to investors, inducing net inflows on the capital account and boosting the supply of foreign currencies. The price of foreign currency falls substantially in the short run as a result, leading to an initial appreciation of domestic currency in new long-run equilibrium level. A subsequent depreciation of the domestic currency is expected thereafter, in line with UIP, and the price level gradually adjusts to the new long run equilibrium. Therefore, a short-run appreciation beyond its long run value is followed by a depreciation towards the terminal value to assure UIP and long-run PPP.

3.4 The Model

We applies Panel Vector Autoregressive Model which is mostly employed in applied macroeconomics. In Panel VAR model, all variables are treated as endogenous and interdependent as in VAR model. However, a cross sectional dimension is added to the equation. In some cases, exogenous variables could be added. ThePanel VAR has three features; 1) dynamic interdependencies, 2) static interdependencies, and 3) cross-sectional heterogeneity. All these features of panel VAR do not need to be used in all applications. When analysing the transmission of shocks across the financial markets of different countries, static interdependencies are needed to be used for the time period which is either monthly or quarterly. When countries in monetary union are analysed, the slope of heterogeneities is more important than the variance of heterogeneities. Moreover, dynamic cross sectional differences are seemed to be important when the panel includes developed and developing countries, or when it lumps together the markets with different trading volumes, different transaction costs, and so on. (Canova, F and Ciccarelli, M., 2013)

Since this paper tries to find out the effect of the real exchange rate fluctuation to the shock of trade openness, contractionary monetary policy, inflation, GDP and expansionary fiscal policy among ASEAN 5 and China. The contractionary monetary policy, government expenditure, inflation, trade liberalization, real exchange rate fluctuation and GDP are used as endogenous variables in VAR model. But the real exchange rate fluctuation is focused to the impact of shock which have to consider on left hand side. These endogenous variables are linear function of the real exchange rate fluctuation.

We also use Least Square Dummy Variable (LSDV) Model together with the panel VAR in order to eliminate unobserved heterogeneity, especially specific country effect. Then our panel VAR equations will become as follows:

$$REER_{it} = \alpha_i + \beta_{1i}GOV_{it-1} + \beta_{2i}SI_{it-1} + \beta_{3i}INFLA_{it-1} + \beta_{4i}OPEN_{it-1} + \beta_{5i}GDP_{it-1} + \gamma_1 D_1 + \gamma_2 D_2 + \gamma_3 D_3 + \gamma_4 D_4 + \gamma_5 D_5 + \gamma_6 D_6 + \varepsilon_{it}$$

Where SI_{it-1} is the contractionary monetary policy of country i at time t-1.GOV_{it-1} is the government expenditure of country i at time t-1. $INFLA_{it-1}$ is the inflation of country i at time t-1. $OPEN_{it-1}$ is the trade openness of country i at time t-1. GDP_{it-1} is the gross domestic product of country i at time t-1. $REER_{it}$ is the real exchange rate of country i at time t. $u_{i,t}$ is a

vector of random disturbances and identically and independently distributed.i is a country identification code from 1 to 6. t is time. γ is the coefficient of each dummy variable for specific country effect, and $D_1, D_2, D_3, D_4, D_5, D_6$ are the dummy variables for the effect of Thailand, Malaysia, Singapore, Philippines, Indonesia and China, respectively. If any dummy variable has value of 1, it means that we have a specific country effect in our model. On the other hand, if all dummy variables have value of 0, then we do not have any specific country effect in the model.

We perform shock identification with standard methods. In order to find the effects of shock across countries, in this paper, a panel VAR is estimated for the whole countries. However, it is difficult to explain the meaning directly from the Panel VAR model. Therefore we instead use the impulse responses to explain dynamic relationships between the real exchange rate fluctuations and the domestic factor shocks. In this paper, onetime shock mean one time of a unit shock which can also explain in term of 1% shock due to the nature log of each variable.

4. Empirical Results

4.1 Data Description

We aim to find the real exchange rate effect of shocks from domestic factors by using panel data which include monthly data from January 1970 to April 2016 for ASEAN-5 and China. The set of country specific data include real effective exchange rate (REER), real GDP, nominal interest rates, trade openness (trade value) and government consumption. However, the real GDP is unavailable in monthly data, so the industrial production index is used as a proxy variable of real GDP for all countries since industrial production has the highest percentage share on total GDP in ASEAN-5 and China. Moreover, openness level can be evaluated from total trade value. Increasing REER represents the appreciation of real exchange rate, and increasing nominal exchange rate represents contractionary monetary policy. By theoretical framework and available data, the real exchange rate is determined by log of government consumption (gov), log of nominal interest rate (si), log of inflation (infla), log of openness (open), and log of real GDP (gdp). We include China in the model because ASEAN countries have many deals with China which also has trade partnership with ASEAN as well. The number of observations is 3,336. We use data from CEIC database.

To estimate the panel vector autoregressive model, first, we have to find the long run relationship of the panel data for the model. We conducted Fisher panel unit root test and found that: reer~I(0), gov~I(0), si~I(0), infla~I(0), open~I(0) and gdp~I(0).

4.2 Estimating and Results

We use Bayesian information criteria to find optimal lag term for panel VAR model. The suitable lag term of the model is only one lag which provides stable results.

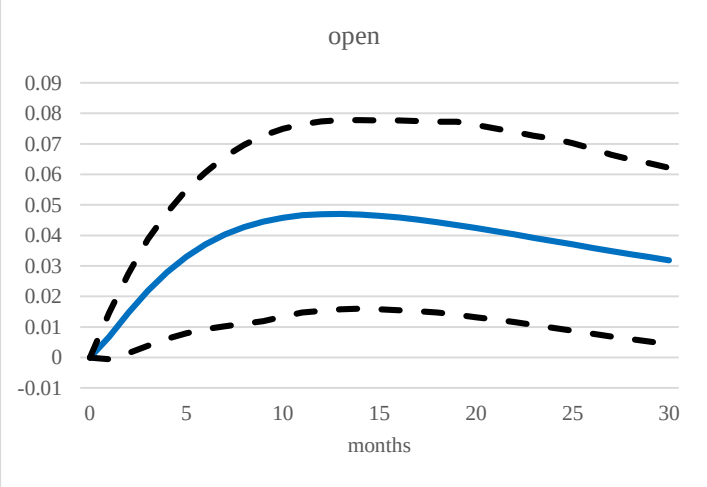
We focus on the real exchange rate effect of domestic-factor shocks which can be evaluated and explained by using impulse response functions. The estimation of panel VAR

model is conducted under least square dummy variable technique (LSDV) that eliminates fixed effect by generating dummy variable for each cross sectional country. Since panel VAR and impulse response function models are sensitive to the order of variables, so the most appropriate order for the model is contractionary monetary policy, fiscal policy, real effective exchange rate, inflation, trade liberalization and GDP respectively.

The impulse response function can quickly explain the real exchange rate effect given other variable shocks. Thus, the study mainly focuses on the effect of policy implementation, such as expansionary government policy, contractionary monetary policy and open economy or trade liberalization policy, to real effective exchange rate. The graph of impulse response function shows the impulse response as solid line and dot line represents 95% confident interval of prediction. Since it is impulse response function, the percentage change of real effective exchange rate comes from one unit shock of each variable especially the policy implementation. One unit shock in this case is 1% shock because of natural log form.

4.2.1 *Trade Liberalization Shock*

The impulse of trade liberalization (open) to response of real effective exchange rate represents that they have a positive relationship which means increasing trade liberalization causes a real exchange rate appreciation. Because the country in ASEAN-5 and China are the oriented export countries, freer trade can increase opportunities to export for these countries. Trade adjustment leads to real appreciation of the exchange rate. However, the response of exchange rate on trade liberalization slightly increases, which is highest in period 13 or 13th month after 1% shock on the total trade value which generates an appreciation of REER approximately by 0.047% in that period. The cumulative impulse response in the 30th month is



1.2% appreciation approximately.

Figure 1: Response of exchange rate to trade liberalization shock

4.2.2 *Expansionary Fiscal Policy Shock*

The result of fiscal policy shock shows a positive relationship with the real exchange rate. One percent of expansionary fiscal policy shock causes a sharp real exchange rate appreciation in the early period. The highest effect is at the 12thmonth after the shock with the effect of 0.0034% appreciation. The cumulative impulse response in the30th month is approximately 0.1% appreciation. Although the government expenditure leads to capital inflows and increase in the demand of domestic currency, the government consumption does not have any effect on domestic aggregate demand because it is offset by private demand since people expect higher taxes in the future, according to Ricardian equivalence, and the short-run effect is absorbed by sticky price. This relationship occurs because most of government expenditure is consumption.

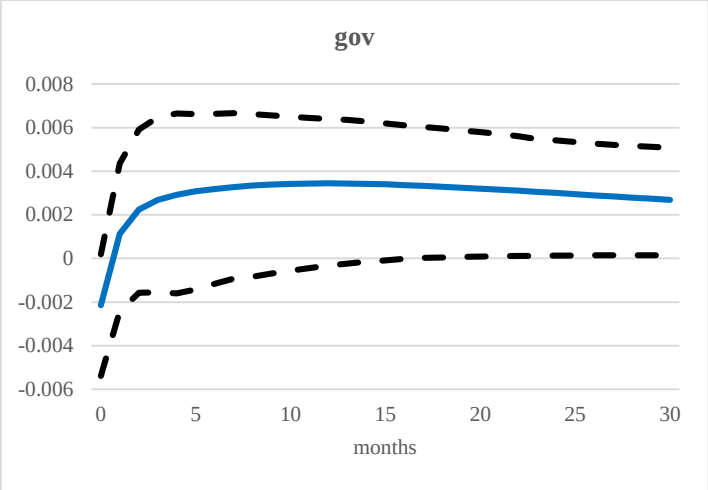


Figure 2: Response of exchange rate to expansionary fiscal policy shock

4.2.3 *Contractionary Monetary Policy Shock*

The shock of nominal interest rate from contractionary monetary policy implementation has a negative effect to real exchange rate. The magnitude of response slightly decreases to the highest effect period at 4 years after 1% shock of policy rate, approximately 0.022%. The cumulative response is 0.5% approximately. This represents that monetary policy is effective in ASEAN-5 and China, but an increase of policy rate leads to depreciation of the real exchange rate. The result is contrast with Uncover Interest rate Parity (UIP).

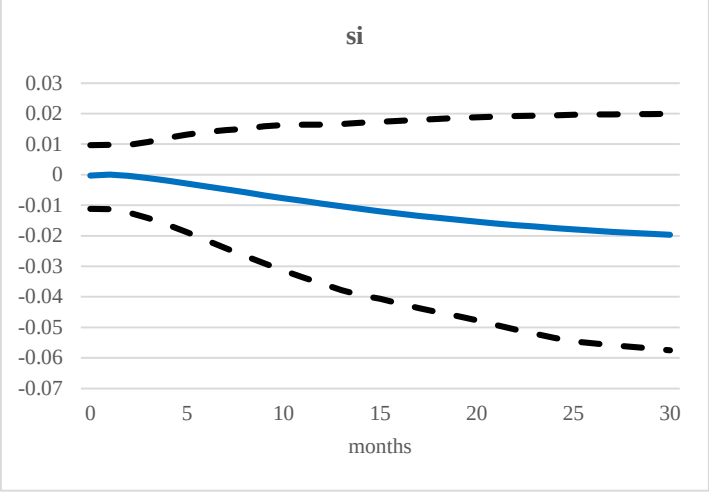


Figure 3: Response of exchange rate to contractionary monetary policy shock

4.2.4 *GDP Shock*

The result of GDP shock shows a positive relationship between GDP and the real exchange rate. The response of real exchange rate has the highest magnitude in the 8th month at 0.0098% appreciation after 1% shock in industrial production index. The cumulative response in the 30th month is 0.25% appreciation. The relationship is positive because we use industrial production index (IPI) as a proxy of real GDP. Thus, increasing IPI means increasing output of the country as well. This will increase the price and purchasing power of people in that country. On the other hand, output from exporting industries also affects the real exchange rate appreciation.

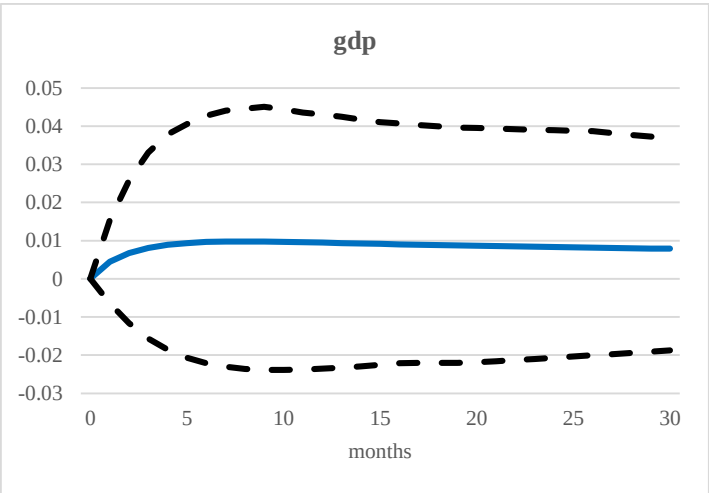


Figure 4: Response of exchange rate to GDP shock

4.2.5 *Inflation Shock*

The response of real exchange rate to inflation shock shows a positive relationship. Increasing inflation rate leads to appreciation of the real exchange rate as domestic price rises, and this reduces the competitiveness of the host country. The model finds that the response of

inflation shock is very small; the highest magnitude of real exchange rate effect is in the 9th month after 1% shock of inflation, with 0.005% appreciation. The cumulative response in the 30th month is 0.13 % appreciation approximately.

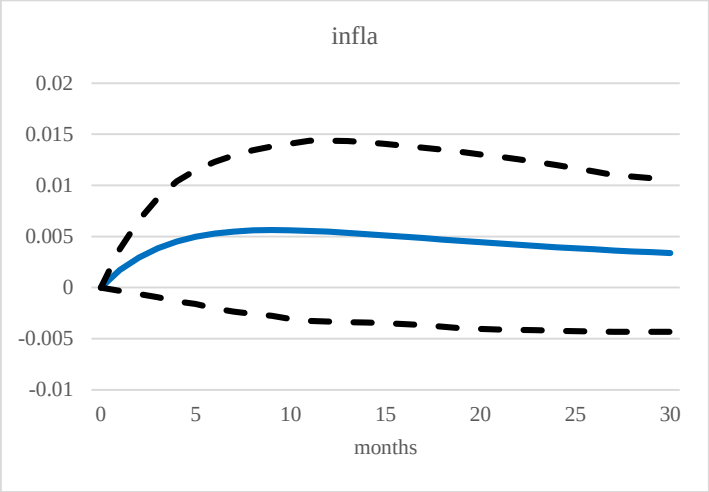


Figure 5: Response of exchange rate to inflation shock

5. Discussion and Conclusion

5.1 Discussion

This paper finds the relationships between the real exchange rate and domestic factor shocks. The real exchange rate appreciates after imposing 1% shock of government expenditure, inflation, trade liberalization, and industrial production index, which is a proxy of monthly GDP. However, the response of real exchange rate to contractionary monetary policy implementation is depreciation.

In the case of separate country, we find that some variables are non-stationary at level and thus difficult to interpret the result. Therefore the real exchange rate is needed to transform into the natural-log difference form (RER~I(1)), then we can explain the percentage change of the real exchange rate given 1% shock of domestic factor. However, the result from this case is difficult to understand since the effect for each country is different and the effect of some countries is very small (see Appendix). Moreover, some factor shocks are also non-stationary, for example, contractionary monetary policy in some countries; that means we need to simulate the model for every percentage change of the policy rate. Hence the panel data, whose all factors are stationary at level, should explain effectively more and easier to understand than using separate country model.

For the panel data model, using monthly data can result in very small magnitude of responses which is consistent with Ncube et al.(2011) for the case of Africa. The result of trade liberalization in our study is also consistent with Dumrongrittikul et al. (2015) that trade liberalization and government expenditure have the highest effect on the real exchange rate, but the real exchange rate does not respond to contractionary monetary policy shock which is

consistent with the long-run neutrality of money. However, the real exchange rate response direction for trade liberalization shock in our study is different because we focus only on ASEAN-5 countries and China while Dumrongrittikul et al. (2015) included other developing countries in ASEAN and Asia as well. And because ASEAN-5 and China are export oriented countries, trade liberalization leads to increase in exports from freer trade. This result supports LI (2004) which explains that temporary trade liberalization is a cause of short-run real exchange rate appreciation.

Additionally, the direction of real exchange rate response to monetary policy shock is also consistent with Dumrongrittikul et al. (2015) however the monetary policy is more effective for the case of ASEAN-5 plus China. Our explanation is that contractionary monetary policy leads to the real depreciation in this region and increasing of interest rate leads to capital inflows which cause appreciation in foreign exchange futures market and depreciation in foreign exchange spot market, according to Covered-Interest Arbitrage theory.

Moreover, the response to fiscal policy shock is very small. This can be occurred because the government consumption does not distort domestic market due to sticky price in short run and private consumption offset as suggested by Ricardian equivalence theory. We include the effect of GDP shock, which uses industrial product index as a proxy, and shock from inflation in our model as well. We find that both effects have positive relationships because inflation increases domestic prices which reduce competitiveness, and increasing of domestic output implies that we need to export more.

The robustness check, using first difference method solution to eliminate fixed effect, finds that the results of real exchange rate response to 1% shock of trade liberalization, fiscal policy implementation, monetary policy implementation and inflation, comply with our main results. We also try to estimate the impulse response function separately by country. The results of separate country find that they have different shock responses depending on country and it is difficult to explain because some policy variables are not stationary at levels. This problem can be solved by panel VARs model, which all of the variable are stationary after demeaning the data. Furthermore, the domestic factor shocks have a very small impact on real exchange rate change when comparing with panel data model.

5.2 Conclusion

By using panel VARs model and impulse response function with least square dummy variable technique to eliminate fixed effect, we can conclude that trade liberalization, growth and inflation generate real exchange rate appreciation, while contractionary monetary policy generates real exchange rate depreciation. Thus, the government should consider the effect of policy implementation. However, the real exchange rate response to government expenditure is consistent with the Ricardian equivalence theory.

Since the definitions of each variable in different countries are different, it may have the problem that impulse responses represent very small effects of domestic factor shocks. The variables that should be concerned are industrial production index (a proxy of GDP), contractionary monetary policy because each country has the different weight of production and different monetary policy implementation.

Appendix A. Response of exchange rate to shocks in each country

Contractionary Monetary Policy Shock

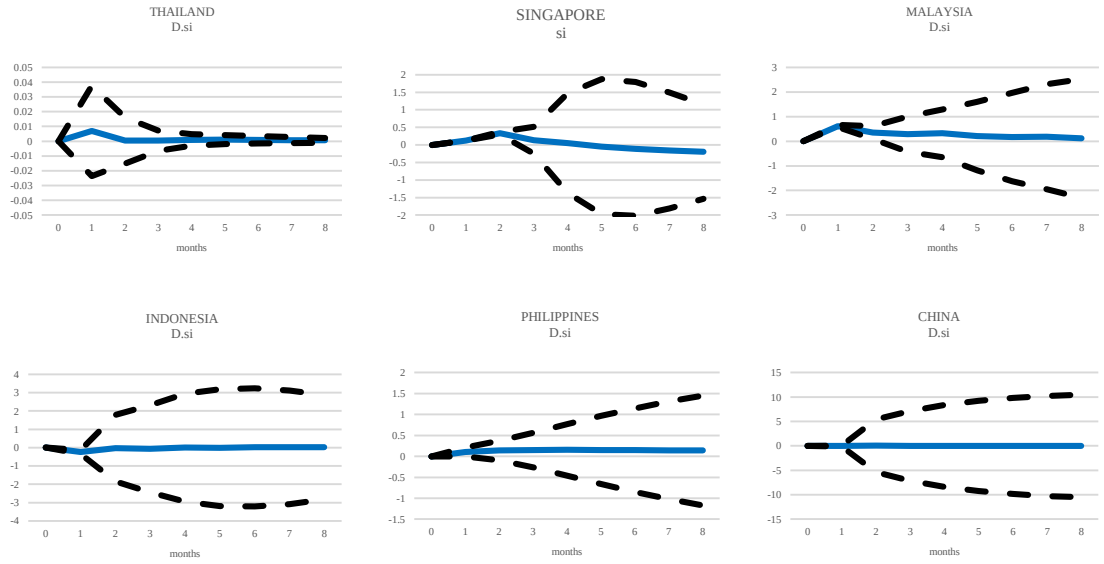


Figure A1: Response of exchange rate to contractionary monetary policy shock in each country

Expansionary Fiscal Policy Shock

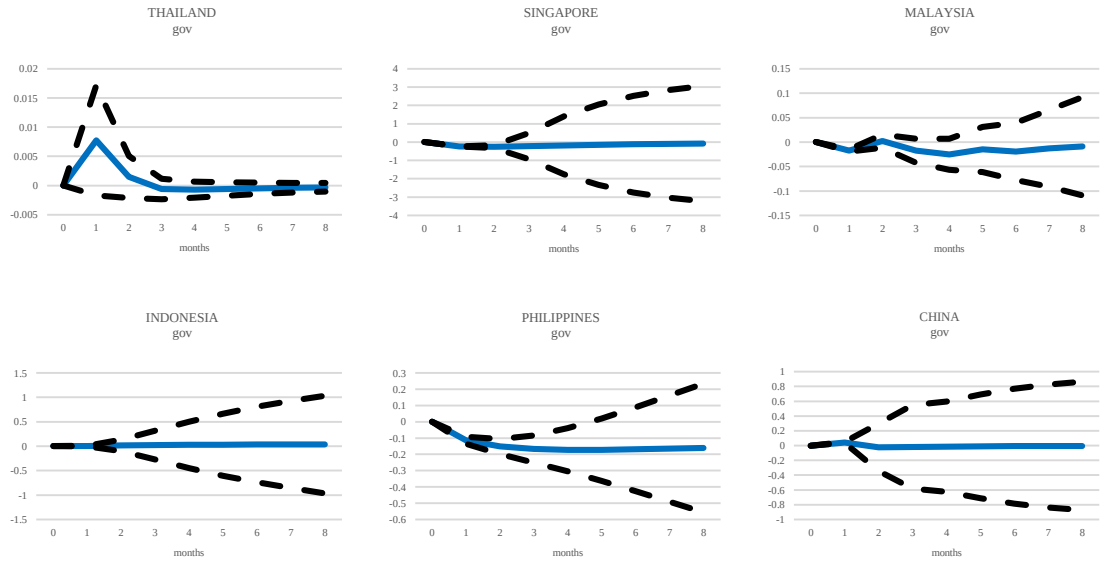


Figure A2: Response of exchange rate to expansionary fiscal policy shock in each country

Inflation Shock

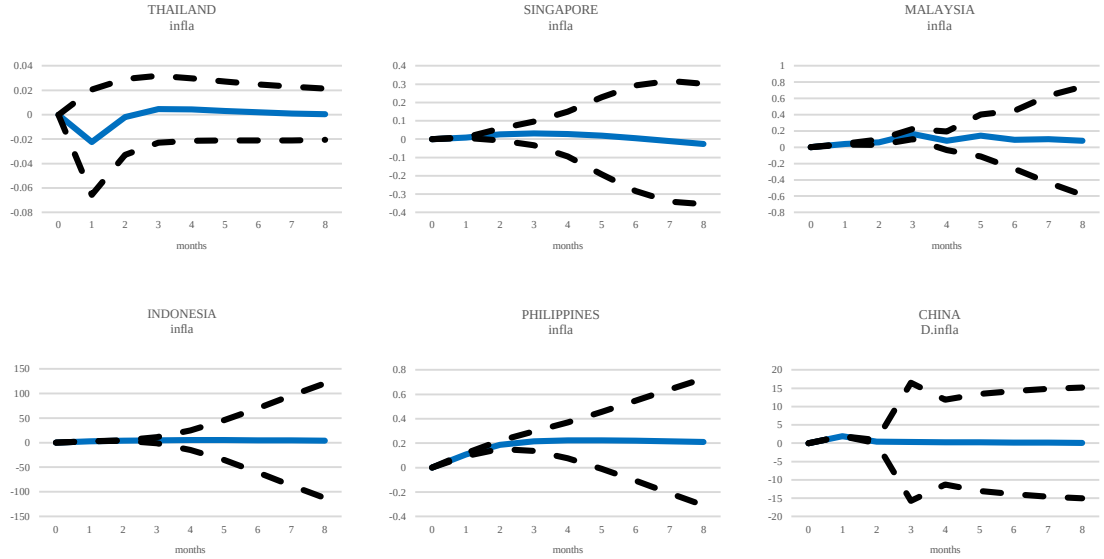


Figure A3: Response of exchange rate to inflation shock in each country

Trade Liberalization Shock

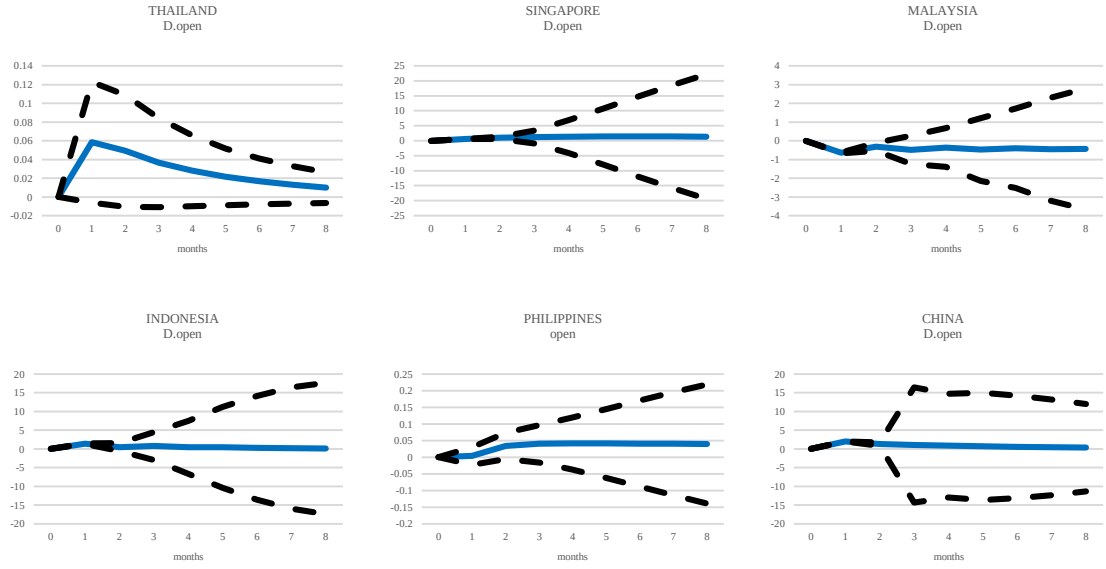


Figure A4: Response of exchange rate to trade liberalization shock in each country

GDP Shock

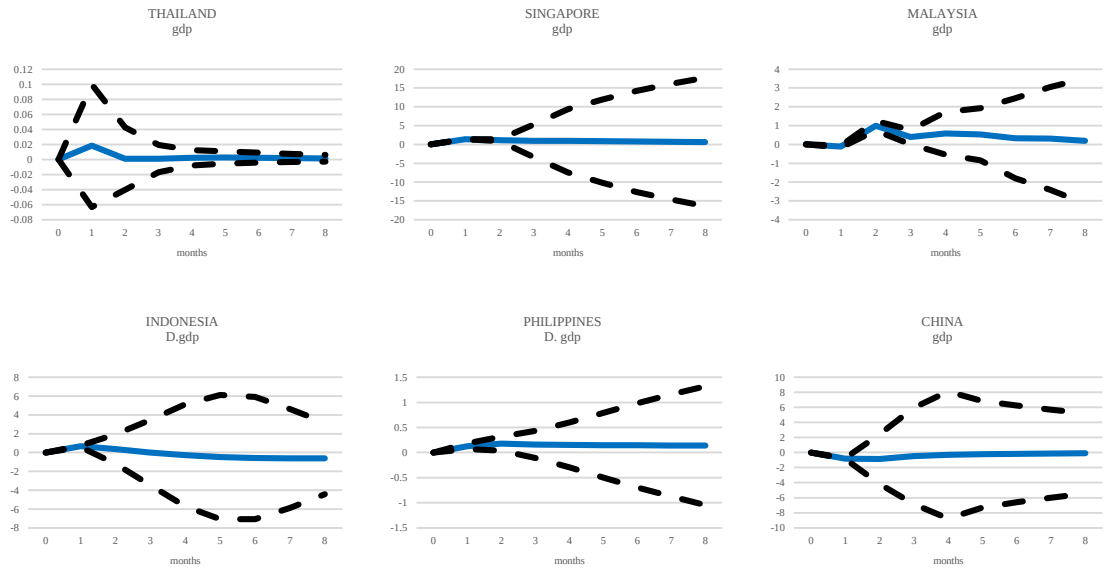


Figure 5A: Response of exchange rate to GDP shock in each country

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