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The Impact of External Shocks on Business Cycle Fluctuation in Several Developed Asian Countries

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Abstract

This paper conducts empirical analysis to investigate the impact of domestic shocks relative to that of internal shocks on business cycle fluctuation in several developed Asian economies. The factors that determine the volume and impacts of these shocks on business cycle fluctuation are also in the scope of analysis. We apply a structural vector auto-regression model (SVAR) with Blancher and Quah's identification. The results show that the domestic shocks are main sources of business cycle fluctuations in Asia countries; while the external shocks only have secondary impacts on the domestic economies. However, the impacts of external shocks are increasing over time. The factors that determine the volume of shocks on business cycle fluctuation include exchange rate, government consumption expenditure, terms of trade, trade openness and domestic monetary policy.

Keywords: business cycle fluctuation, external and domestic shocks, aggregate supply, aggregate demand
interest rate.

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1 Introduction

A study on sources to business cycle fluctuation is not a new topic of research but it remains one of the main researches in the literature of macroeconomics and growth. A business cycle fluctuation (BCF) is the cyclic change in the economic indicators (Bormotov, 2009) because of internal factors such as political instability, poor economic management and conflicts or external factors such as natural disasters, the exchange rate and the oil price or it can involve both internal and external factors. Many studies reveal that large economy has significant impacts on business cycle fluctuation in emerging economies, the so-called the impacts of external shocks on business cycle fluctuations. Using the structural vector auto-regression model, Ahmed et al. (2005) conduct analysis on the sources of business cycle fluctuation using data for Pakistan. The results showed that external shocks play an important role on economic fluctuations in Pakistan. Edwards (2006) focuses his analysis on Latin America countries. The results showed that external shocks have a wide impact on the GDP in the countries under currency union than the countries under flexible exchange rate. The joining of countries to the currency union does not help to reduce the effect of the external shocks such as sudden stops of capital inflows and current account reversals. Sosa and Cashin (2009) in their study on Caribbean countries showed that external shocks are the main source of business cycle fluctuations in the region. The climate shocks, a natural disaster and oil price shocks have a wide effect to reduce the output fluctuations in The Caribbean. Chang et al. (2002) apply the structural vector-autoregressive (SVAR) on the data of Taiwan revealed that the variation in Taiwanese output is due to the local shocks that led to the flexibility of the exchange rate and trade and financial liberalization, shocks in Asia have significant effects on the productivity fluctuations in Taiwan. Apart from these findings, Rzigui (2005) applies Common Trend Representation (CT model) and augmented Dickey–Fuller (ADF) unit root test and Johansen likelihood test for Tunisia showed that external shocks play the main role and affect various economic activities in Tunisia.

In contrast to the above results, some studies report relatively small impact of external shocks on determining the business cycle fluctuation. For example, Raddatz (2007) states that the domestic shocks (the internal factors) form the main source to economic instability in the low-income countries; while the external shocks (natural disasters and the volatility of foreign aid) play a slight role, but their effects should not be ignored. Boschi and Girardi (2008) apply Global vector- autoregressive VAR and VEC method. The model is estimated for Latin American countries. The results showed that domestic shocks and regional shocks are the main source of output fluctuations in Latin American countries. Hoffmaister and Rolds (2001) apply focus their study using data for Brazil and Korea. The results showed that external factors have a simple effect on the gross domestic products (GDP) compared to domestic shocks which are the main source of fluctuations in exchange rates and output, especially the factors that are related to supply factors.

In this paper, we seek to compare the impacts of external shocks relative to that of domestic shocks on domestic business cycle fluctuation. Apart from this, we also seek to identify the factors that determine the volume or impact of shocks on domestic business cycle fluctuation (BCF). Rather than focusing the study on emerging economies, we focus our study on several developed Asian economies that exhibit high degree of trade openness and economic achievement. We are interested to investigate if external shocks have large impact on the business cycle fluctuation in these economies that have large exposure to external effects through international trade and linkage. The results indicate that domestic shocks are the main source to business cycle fluctuations in these Asian economies while the external shocks are considered a secondary source to cause economic fluctuations. However, the impacts of external shocks should not be ignored as their impacts show the tendency to increase over time. The factors that determine the volume of shocks on business cycle fluctuation include exchange rate, government consumption expenditure, terms of trade, trade openness and domestic monetary policy/ interest rate. World oil price has no significant impact on determining the business cycle fluctuation in these economies.

The remaining sections are organized as follows: section two presents the literature review. Section three explains the methodology. Section four is about the data. Section five discusses the main results and section six concludes.

2. Literature review

2.1. Empirical findings - Causes of business cycle fluctuation

Previous studies have reported many factors that contribute to the business cycle fluctuation. A number of studies interpret the source of business cycle fluctuation to be external and domestic shocks. These studies report mixed results. Some studies report that external shocks as the main source to the business cycle fluctuation. Among them are Ahmed et al. (2005), Rzigui (2005), Edwards (2006), Sosa (2008) and Sosa and Cashin (2009). In contrast, other studies reveal that domestic shocks have larger impact relative to that of external shocks in determining the business cycle dynamics. These studies include Hoffmaister and Rolds (2001), Raddatz (2007), Boschi and Girardi (2008) and so on.

Some studies identify the factors/ determinants to business cycle fluctuations. Among these factors are technology factor, changes in infrastructure, investments and government consumption wedges. For instance, Ljungwall and Gao (2009) apply Business cycle accounting (BCA) method, standard neoclassical (benchmark growth) model with time varying shocks for India. The results showed that Technology advance and change in infrastructure have a major and main impact on business cycle fluctuations. Investments and government consumption wedges have a secondary role in generating fluctuations in business cycle. Besides, productivity can also have impact on the business cycle fluctuation. Focusing the study in U.S., Dejong et al. (2000) find that total factor

productivity shocks and marginal efficiency of investment shocks have significant and important effects on business cycle fluctuations. The productivity shocks contributed to economic recession. Apart from these factors, Broda (2004) conducts panel analysis covering 75 developing countries reports that exchange rate plays a main role in the change and volatility of GDP in the developing countries. The terms-of-trade contribute to the volatility in the GDP.

Rebelo (2005) discusses the causes of business cycle fluctuation. According to Rebelo (2005), business cycle is caused by a series of shocks such as technological, oil prices and tax shocks. Technological shocks are the main engine of the business cycle as they represent more than half of the effects of shocks occurred in the second world war (Rebelo, 2005). The positive technology shock has an important role in increasing the capital and hours of work which contribute to the increase in productivity; while technical progress has an effect on the productivity of old goods versus new goods which become more abundant and less costly. The alternative to technology shocks is any non-technological natural shocks. The moves in oil prices affect economic activities. The government spending and value of taxes have a significant effect on economy because of increasing the effect of the wars and crises. This affects high or low income families, causing lower consumption and higher working hours which contribute to higher productivity. Therefore, this leads to recession due to increasing the production and lower consumption which lead to a negative shock on the economy (Rebelo, 2005).

The movements in the oil price and the change in the energy sources have an impact on the economy, especially the movements of the oil price as a non-technology shock. The financial shock is represented by the tax rates and the government expenditures which have an impact on RBC model. These shocks have contributed to the improvement in the volatility of consumption, working hours as well as the relationship between the average production and working hours, but financial shocks are not the main source for the occurrence of economic fluctuations (trade) (Rebelo, 2005) .

2.2 Theoretical model – AD-AS model

The Aggregate Demand-Aggregate Supply (AD-AS) model is based on John Maynard Keynes's theory. The model explains price level and output which represent the relationship between the aggregate demand (AD) and aggregate supply (AS). This model is used to explain the Keynesian model of the business cycle. The move of two AD curves and AS curve can predict the effects of the exogenous on the price level and output.

The AD-AS framework has a demand side and a supply side, i.e. they complement each other. The demand side is explained by factors which have relating to the demand for goods. The supply side is explained by factors which have relating to the decisions of output, producers pricing and the markets (Krishna and Skott, 2005). The equation for the AD curve is

$$Y = Y^{d}(\frac{M}{P}, G, T, Z_1)$$

where Y is the real GDP, Y^{d} aggregate quantity demanded, M is the nominal money supply, G is the government spending ,T is the exogenous real taxes levied, P is the price level and Z_1 is the vector of other exogenous variable which affect the curve . The real money supply has a positive effect on AD; while the exogenous taxes have a negative effect on AD. The aggregate demand (AD) curve also depends on exogenous changes such as the foreign prices, nominal money supply, fiscal policy and fixed exchange rate. A change in these variables will lead to changes in AD curve. The short-run aggregate supply equation is

$$Y = Y^{s}(\frac{W}{P}, \frac{P}{P^{e}}, Z_2)$$

where W is the nominal wage rate, Y^{s} aggregate production supplied, P^{e} is the expected price level and Z_2 is the vector of exogenous variables which affect the demand curve (as in capital stock). The real wage has a negative effect on the aggregate supply (AS); while the price level has a positive effect on the aggregate supply (AS).

The long-run aggregate supply equation is

$$Y = Y^{s}(Z_2)$$

where Z_2 includes the factors (such as the population) that affect the supply curve (Krishna and Skott, 2005). The effect of the demand shocks stem from investment, government spending, consumption and the oil price for the developing countries. On the other hand, supply shocks stemming from the weather conditions affect agriculture; the shocks of the price of foreign currency and oil prices also play a role in influencing the supply (Reside, 2002).

The aggregate supply (AS) curve shows the quantity of the output that firms are willing to supply for each given price level; while the aggregate demand (AD) curve describes the combination between the output and price at goods market and money market equilibrium. AD represents the aggregate demand of goods and services used in consumption and investment and also goods that are exported outside the country (Reside, 2002).

3. Methodology

3.1. The framework of SVAR

The structural VAR is a tool used in econometrics and it analyses the inter-relationship between the variables in a linear equation and it is a method used to estimate the economic relationship (Breitung et al., 2004). Many empirical economic studies applied the structural vector auto-regression (SVAR) to examine the relationship between the economic variables and the impact of shocks on the economic variables. We apply SVAR framework based on the theory of AD-AS model in which each economy is determined by the aggregate demand and aggregate supply**.** The system equation consists of a foreign advanced economy of

U.S. and a domestic economy of Asia in which the domestic economy is determined by the advanced economy but not in other way. By the VAR framework,

$$C_0 Y_t = C_1 Y_{t-1} + \ldots + C_p Y_{t-p} + V_t \quad (1)$$

where Y_t is $K \times 1$ vector of evaluating a set of stationary (endogenous) variables which have the same sample period time (t=1,2,...,T). C_0 is $K \times K$ matrices of the interaction relationship between the endogenous variable Y_t (The main diagonal of the matrix is scaled to 1). C_i's (i=1,2,...,p) are $K \times K$ matrices. $V_t = D\varepsilon_t$ is $K \times 1$ vector of the structural shocks where D is $K \times K$ matrices of the relationship of variables in ε_t, and ε_t is $K \times 1$ vector of the structural shocks (errors). Every shock (error) has mean zero and variance-covariance matrices (i.e. $\varepsilon_t \sim N(0, \sum)$; $E(\varepsilon_t \varepsilon_t^{'}) = \sum = I_k$)(Breitung *et al.*, 2004).

The constant and other exogenous variables can be added to the basic model

$$C_0 Y_t = C + G + C_1 Y_{t-1} + \ldots + C_p Y_{t-p} + E_0 X_t + V_t \quad (2)$$

where C is $K \times 1$ constant term, G is any dummy variable such as trend or seasonal dummies. The X_t is $M \times 1$ vector of evaluating a set of stationary (exogenous) variables. E_0 is $K \times M$ matrices of the interaction relationship between the exogenous variable X_t with endogenous variable Y_t.In this study K= 5 and M= 6.

Y can be partitioned into internal and external variables and also to partition V, which stands for the structural shocks, can also be partitioned into internal and external shocks. Thus,

$$Y_t = \begin{pmatrix} Y_{1t} \\ \cdots \\ Y_{2t} \end{pmatrix} = \begin{pmatrix} \Delta OP_t \\ \Delta GDP - US_t \\ \Delta CPI - US_t \\ \cdots\cdots\cdots\cdots \\ \Delta GDP - Asia_t \\ \Delta CPI - Asia_t \end{pmatrix}, \quad \varepsilon_t = \begin{pmatrix} \varepsilon_{1t} \\ \cdots \\ \varepsilon_{2t} \end{pmatrix} = \begin{pmatrix} \varepsilon_t^{op} \\ \varepsilon_t^{es} \\ \varepsilon_t^{ed} \\ \cdots \\ \varepsilon_t^{ds} \\ \varepsilon_t^{dd} \end{pmatrix}, \quad X_t = \begin{pmatrix} \Delta TOT_t \\ \Delta GC_t \\ \Delta NER_t \\ \Delta MTP_t \\ \Delta TOP_t \\ \Delta IR_t \end{pmatrix}$$

where t denotes the time and the external stationary variable Y_{1t} consists of (world oil price (ΔOP_t), U.S gross domestic products $(\Delta GDP - US_t)$ and U.S consumer price index $(\Delta CPI - US_t)$. The internal stationary variables are represented by Y_{2t} which consists of (Asian gross domestic products $(\Delta GDP - Asia_t)$ and Asian consumer price index $(\Delta CPI - Asia_t)$. ε_{1t} is the vector of the external shocks for world oil price (OP) shocks , external supply shocks (es) and external demand shocks (ed). ε_{2t} is the vector of the internal shocks for domestic supply shocks

(ds) and domestic demand shocks (dd). There are six exogenous variables in the equation, i.e. interest rate (IR_t), term of trades (TOT_t), government consumption expenditure (GC_t), nominal effective exchange rate (NER_t), 3-month treasury bill rate of the U.S (MTB_t) and trades openness (TOP_t). All the variables are in stationary form and denoted in percentage by logarithm.

The model is constructed based on the theory of AD-AS model. The oil price and GDP are used to represent the aggregate supply (AS), and CPI represents the aggregate demand (AD).

The reduced form of SVAR model is obtained by multiplying both sides of Equation (1) by C_0^{-1},

$$Y_t = C_0^{-1} C_1 Y_{t-1} + \ldots + C_0^{-1} C_p Y_{t-p} + C_0^{-1} D\varepsilon_t \quad (3)$$

Let $C_i^* = C_0^{-1} C_i$; i = 1, 2, ... , p and $U_t = C_0^{-1} D_t \varepsilon_t$; t = 1, 2, ..., T

Equation (3) becomes

$$Y_t = C_1^* Y_{t-1} + \ldots + C_p^* Y_{t-p} + U_t \quad (4)$$

Finally, constant (C), dummy (G) variables and exogenous (X_t) variables are added to Equation (4) for better specifications of the model.

$$Y_t = C + G + C_1^* Y_{t-1} + \ldots + C_p^* Y_{t-p} + E_0 X_t + U_t \quad (5)$$

where U_t is the structural shocks (error) $K \times 1$ vector of independent identically distributed (the economic shocks in the vector U are iid) with mean zero and variance-covariance matrix $\sum$ (i.e. $E\left(U_t U_t^{'}\right) = \sum$). $\sum$ is $K \times K$ positive definite matrix. That is, $U_t \sim N\left(0, \sum\right)$, with all the elements off-diagonal of the covariance matrix are zero (i.e. $E\left(U_t U_{t-k}^{'}\right) = 0; \quad t \neq t-k$), implying that the structural shocks are uncorrelated.

Equation $U_t = C_0^{-1} D\varepsilon_t$ shows the link between two shocks variables in the reduced form U_t and structural shocks ε_t. The variance-covariance matrix of the reduced form can be written as follows:

$$\begin{aligned} E(U_t U_t') &= E\left(C_0^{-1} D\, \varepsilon_t \varepsilon_t' D' (C_0^{-1})'\right) \\ &= C_0^{-1} \sum (C_0^{-1})' \end{aligned} \quad (6)$$

SVAR system has two important analytical tools that are impulse response function (IRF) and forecast error variance decomposition (FEVD). They are explained below.

(1) Impulse response function

To obtain Impulse response function (IRF) for orthogonalized shocks i.e. when the shocks (ε_t) are instantaneously uncorrelated, Equation (1) can be re-written to get the dynamic interaction between Y_t (endogenous) variables, by the following:

$$[I_k - C(L)]\, Y_t = V_t \quad (7)$$

Multiplying Equation (7) by$[I_k - C(L)]^{-1}$, the following equation can be obtained:

$$Y_t = [I_k - C(L)]^{-1} V_t \quad (8)$$

where $C(L) = \sum_{j=0}^{p} C_j L^j$; $C_0 = I_k$ and $V_t = D\varepsilon_t$

$$Y_t = [I_k - C(L)]^{-1} D\varepsilon_t \quad (9)$$

Now, let $S(L) = [I_k - C(L)]^{-1} D \quad (10)$

Compensate Equation (10) into Equation (9)

$$Y_t = S(L)\,\varepsilon_t$$
$$= S_0\,\varepsilon_t + S_1\,\varepsilon_{t-1} + ... + S_p\,\varepsilon_{t-p} \quad (11)$$

And $S_0 = D$

From Equation (3), the $U_t = C_0^{-1} D\varepsilon_t$ and $C_0 = I_k$ (identity), then

$$\varepsilon_t = D^{-1} U_t \quad (12)$$

Now, Compensate Equation (12) into Equation (11) to obtain the following:

$$Y_t = S(L)\,D^{-1} U_t \quad (13)$$

Let $B_i = B_i = S_i D^{-1}$; i = 1, 2, ..., p and $B_0 = I_k$

$$Y_t = B_0 U_t + B_1 U_{t-1} + ... + B_p U_{t-p} \quad ; p=1,2,\ldots \quad (14)$$

Impulse response function (IRF) for orthogonalized shocks can be obtained by Equation (11) where $S_i = B_i D$ for i= 0, 1, 2,... . For long–run effect of orthogonalized shocks we can replace $S(1) = BD$. Equation (13) is the moving average (MA) which represents the reduced equation of SVAR (Breitung et al., 2004).

(2) Forecast error variance decomposition

The forecast error variance decomposition is constructed as the *h*-step forecast error from structural innovations (Breitung *et al.*, 2004).

$$Y_{T+h} - Y_{T+h|T} = S_0\varepsilon_{T+h} + S_1\varepsilon_{T+h-1} + ... + S_{h-1}\varepsilon_{T+1} \quad (15)$$

We denote the *ij*-th element of S_n as $\psi_{ij,n}$, the *k*-th element of the forecast error vector which becomes

$$Y_{k,T+h} - Y_{k,T+h|T} = \sum_{n=0}^{h-1} (\psi_{k1,n}\varepsilon_{1,T+h-n} + ... + \psi_{kK,n}\varepsilon_{K,T+h-n}) \quad (16)$$

The structural disturbances of the forecast error variance decomposition are serially uncorrelated:

$$\sigma_k^2(h) = \sum_{n=0}^{h-1} (\psi^2{}_{k1,n} + ... + \psi^2{}_{kK,n}) = \sum_{j=1}^{K} (\psi^2{}_{kj,0} + ... + \psi^2{}_{kj,h-1}) \quad (17)$$

The right hand side of Equation (17) indicates that the percentage contribution of variable *j* to the forecast error variance of variable *k* for *h*-step is

$$\omega_{kj}(h) = ((\psi^2{}_{kj,0} + ... + \psi^2{}_{kj,h-1}) / \sigma_k^2(h)) \quad (18)$$

3.2. Identifications of SVAR and specifications of model

By Blanchard and Quah's (1989) identification, the long-run impact matrix can be written in the formula: $U_t = S(1)\varepsilon_t$

$$\begin{pmatrix} U_t^{OP} \\ U_t^{GDP-US} \\ U_t^{CPI-US} \\ U_t^{GDP-Asia} \\ U_t^{CPI-Asia} \end{pmatrix} = \begin{pmatrix} S(1)_{11} & 0 & 0 & 0 & 0 \\ S(1)_{21} & S(1)_{22} & 0 & 0 & 0 \\ S(1)_{31} & S(1)_{32} & S(1)_{33} & 0 & 0 \\ S(1)_{41} & S(1)_{42} & S(1)_{43} & S(1)_{44} & 0 \\ S(1)_{51} & S(1)_{52} & S(1)_{53} & S(1)_{54} & S(1)_{55} \end{pmatrix} \begin{pmatrix} \varepsilon_t^{OP} \\ \varepsilon_t^{es} \\ \varepsilon_t^{ed} \\ \varepsilon_t^{ds} \\ \varepsilon_t^{dd} \end{pmatrix}$$

$S(1)$ is 5×5 long-run matrix, every row represents the relationship between the variable with other variables. For instance the first variable world oil price has impact on all the variables below it. However it does not affected by any variable. The second variable gets affected by the first variable only and it does not affect the first variable, but it affects the other variables below it.

The world oil price is ordered first as it likely affects all the variables below. The foreign variables of the U.S i.e. GDP-US and CPI-US are ordered above the domestic variables of GDP-Asia and CPI-Asia for the developed countries. The U.S has an external impact on the emerging Asian countries. Following the theory of AD-AS model, GDP can be interpreted as an aggregate supply and CPI as an aggregate demand.

In this study, a constant term and trend dummy are included in the SVAR model. The inclusion of lag length is based on the suggestion by the Schwarz Criterion and Hannan-Quinn Criterion. The lag length varies across countries and is ranging from 2 to 5.

4. Data

In this study, we use quarterly data for nine variables on six countries. These variables are gross domestic products (GDP), consumer price index (CPI), nominal effective exchange rate (NER), world oil price (OP), government consumption expenditure (GC), term of trades (TOT), 3-month Treasury bill rate of the U.S (MTB), interest rate (IR) and trades openness (TOP). These data are taken from International Financial Statistics (IFS), Economic research (Federal Reserve Bank) and DataStream. The five Asian countries considered in the analysis include Japan, Korea, Taiwan, Singapore and Hong Kong. The foreign country is represented by the United States. This is because the U.S is the main trade partner for Asian countries. The samples cover the period from 1970Q1 to 2010 Q4. All the variables are mentioned in natural logarithm forms. The variables are consumer price index, gross domestic products, nominal effective exchange rate, world oil price, government consumption expenditure and term of trades exclude variables that are given by percentage: Interest rate, 3- month Treasury bill rate of the U.S and trade openness. Before conducting the analysis, all the variables are checked for their stationarity condition using Augmented

Dicky-Fuller (ADF) test. Most variables are not stationary in levels and are transformed into stationary form after the first or second differencing process.

5. Results

(1) Factors that determine the volume or impacts of shocks on BCF

The results of VAR show that the exogenous variables have impacts on the aggregate demand (AD) and aggregate supply (AS) of Asian countries. TOT and IR have significant impacts on the domestic economy (AD or AS) of Hong Kong. On the other hand, TOP and IR have significant impacts on the economy of Korea. All exogenous variables have impacts on the economy of Japan. In Singapore, the exogenous variables have impacts on the economy of Singapore, except for MTB and IR. TOP and MTB have no significant impact on the economy of Taiwan (see Table A.1, Appendix A).

Terms of trade (TOT) measures the relative value of exports over imports. Theoretically, the increase of TOT implies the reaching of large value of export over imports. This implies large demand on domestic products in foreign markets. Therefore, domestic price (CPI) will increase. The increase in domestic CPI may lead to higher production (hence higher GDP) or lower demand on domestic product (hence export declines and GDP declines). The total impact of the TOT on GDP could be positive or negative. The results of VAR show that the increase in TOT has a positive impact on GDP or aggregate supply in Korea and Japan, but negative impacts on other economies. The empirical results of VAR show that the increase in TOT leads to the decline in CPI or aggregate demand, and so the increase of TOT fails to increase the CPI or aggregate demand of Asian countries in this study.

Trade openness (TOP) measures the ration of total trade over GDP. A higher value in TOP implies more openness in trade. The increase in TOP means greater exposure of domestic economies to external shocks, hence larger CPI or aggregate demand and supply, however supply can be lowered if demand on domestic goods declines. TOP has no significant impact on the economy of Taiwan and Hong Kong. The results indicate that the increase of TOP leads to lower GDP in most Asian countries in this study.

The government consumption or GC leads to higher demand and pushes the economic growth forward. The increase in GC leads to positive impacts on the aggregate supply and demand. The results show the GC has positive significant impacts on aggregate supply of Asian countries.

The increase in NER implies appreciation of domestic currency. This leads to higher demand on foreign goods as domestic consumers can spend more; that is to say, their purchasing power increases. Hence, aggregate demands increase and aggregate supply declines. The results show that the increase in NER leads to increase in aggregate supply in some Asian countries, but the positive impacts of increase NER in aggregate demand.

The increase of the U.S interest rate or MTB in general does not have significant impacts in the economies of Asian countries. The higher monetary

policy or the increase of interest rate controls the CPI which leads to lower CPI or aggregate demand and aggregate supply. However, the results show that the increase of IR falls to reduce the CPI significantly in Hong Kong and Japan.

(2) Compare the impacts of external and internal shocks on BCF

The results are based on the long-run impact matrix (Table A.2), impulse response function (not show here) and forecast error variance decomposition (FEVD) (Table A.3). The results from these three tools are consistent. Due to the space constraint, we exclude the results and discussion of IRF.

We analyze the long-run impacts of each shock on domestic variables (domestic GDP and domestic CPI) for each country. The coefficients of the upper triangular are zero, implying no impact of the variables below the specific variable. We observe that oil price shock does not have a significant impact on the domestic economies of Asia. However, the internal and external supply and demand shocks have important impacts on the economies of Asia (see Table A.2 Appendix A).

The impacts of external shocks on domestic variables differ across countries. By economic interpretation, an increase of external GDP or external supply shock implies that external supply is relatively larger than external demand. This leads to the drop in foreign price level, hence foreign price is cheaper than domestic price and the demand on domestic goods decline, the domestic production or GDP drops. On the other hand, domestic producer may lower the domestic price and the demand on domestic goods may increase, so the final impact of higher external supply shock can lead to higher domestic production (GDP). The results of long-run impact matrix show that an increase in the external GDP leads to higher CPI and GDP in Hong Kong. It leads to the increase of CPI in Singapore and the decline of CPI in Taiwan but the impact on GDP in both economies are not significant.

An increase in the external CPI could lead to the increase of domestic CPI (imitation action by domestic producers to raise the domestic price) or relatively lower domestic CPI compared to the external CPI. The impacts on domestic GDP could be higher or lower; it depends on the total impacts on the increase in production and lower demand on domestic products. The results show that the impacts of 1 % increase in the external CPI leads to 0.0349 % and 0.0028% in GDP and CPI in Hong Kong respectively. In Singapore, the impacts are negative, i.e. 0.0110% and 0.0266% decline in GDP and CPI respectively.

The increase of domestic GDP has positive impacts on the domestic supply or GDP, but a negative impact on domestic CPI. The increase of domestic CPI has positive impacts on domestic demand (CPI) and supply (GDP).

Table A.3 in Appendix A summarizes the results of FEVD for Q1 to Q4. The last two columns, i.e. total (F) and total (D) summarize the total impact of three external shocks on domestic variables and the total impact of two domestic shocks on domestic variables respectively. We observe that in general, domestic shocks have large effects on domestic economies or domestic business cycle fluctuations. Also we observe increasing impacts of external shocks but declining impacts of domestic shocks on domestic variables over time.

6. Conclusion

This paper investigate the impacts of the external shocks relative to that of domestic shocks on business cycle fluctuations in several developed Asian countries by using structural VAR model. Apart from this, analysis is conducted to identify factors that determine the volume of shocks on business cycle fluctuation in these economies. These economies include Hong Kong, Japan, Korea, Singapore and Taiwan. The foreign country is represented by U.S. This study differs from other studies that focus analysis on business cycle in emerging markets. We focus analysis on business cycle in developed Asian economies that have large exposure to external shocks.

The results suggested that all exogenous variables include in the analysis (exchange rate, government consumption expenditure, terms of trade, trade openness and domestic monetary policy/ interest rate) have a significant impact on the domestic economic variables except the foreign monetary policy variable. The results also suggest that the domestic shocks have greater significant effects on the domestic economies and business cycle fluctuations than the external shocks do. However, the impacts of the external shocks on the domestic variables should not be ignored because the impacts are increasing over time. The world oil price shock has no significant impact on the domestic economic variables of Asian countries in this study.

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Appendix A

Table A.1. Estimation of VAR

Variable	Impactetd by					
	TOT	TOP	GC	NER	MTP	IR
GDP-HK	-1.012**	-0.007	0.019	-0.011	0.003	-0.026
CPI-HK	-0.293**	-0.004	0.001	-0.017	0.002	0.042***
GDP-TW	-0.643***	0.048	0.204***	0.578***	0.001	-0.005**
CPI-TW	-0.070*	-0.011	0.008	0.039	0.001	0.001
GDP-SG	0.146	-0.026***	0.028	0.360**	0.004	0.002
CPI-SG	0.043**	0.002**	0.008**	0.033	-0.001	0.000
GDP-KO	0.310***	-0.137**	0.706***	0.032	0.007	-0.009***
CPI-KO	-0.026**	0.005	-0.018***	0.009	-0.000	0.002***
GDP-JP	0.300***	-0.014***	0.661***	0.290***	-0.003	0.006**
CPI-JP	-0.029**	-0.002**	0.005	0.011	-0.001*	0.001**

Notes: *denotes a 10% significant level; **denotes a 5% significant level; ***denotes a 1% significant level

Table A.2. Long-run impact matrix

Long-run impact matrix / Hong Kong

0.0937***	0.0000	0.0000	0.0000	0.0000
-0.0005	0.0104***	0.0000	0.0000	0.0000
0.0057**	-0.0058**	0.0057***	0.0000	0.0000
0.0094	-0.0583**	0.0349***	0.0286***	0.0000
0.0009	-0.0043**	0.0028***	0.0011**	0.0022***

Long-run impact matrix / Singapore

0.0983***	0.0000	0.0000	0.0000	0.0000
0.0048***	0.0083***	0.0000	0.0000	0.0000
0.0025***	-0.0003	0.0041***	0.0000	0.0000
0.0049	-0.0065	-0.0110**	0.0286***	0.0000
-0.0022	0.0183**	-0.0266***	-0.0110**	0.0271***

Long-run impact matrix / Taiwan

0.0688***	0.0000	0.0000	0.0000	0.0000
0.0000	0.0066***	0.0000	0.0000	0.0000
0.0018***	-0.0009**	0.0030***	0.0000	0.0000
0.0002	-0.0074	-0.0128***	0.0320***	0.0000
0.0010	-0.0037*	0.0050***	0.0013	0.0090***

Long-run impact matrix / Korea

0.1093***	0.0000	0.0000	0.0000	0.0000
0.0041**	0.0069***	0.0000	0.0000	0.0000
0.0018***	0.0008*	0.0026***	0.0000	0.0000
0.0078*	-0.0117*	0.0056*	0.0363***	0.0000
-0.0009	-0.0007	0.0010*	-0.0023***	0.0050***

Long-run impact matrix / Japan

0.0563***	0.0000	0.0000	0.0000	0.0000
0.0013*	0.0054***	0.0000	0.0000	0.0000
0.0024**	0.0017	0.0067***	0.0000	0.0000
0.0079*	0.0145***	0.0074*	0.0221***	0.0000
0.0023	-0.0262	-0.0994***	-0.0386***	0.0740***

Notes: *denotes a 10% significant level; **denotes a 5% significant level; ***denotes a 1% significant level

Table A.3. Forecast error variance decomposition (FEVD)

	Period	ε_t^{OP}	ε_t^{es}	ε_t^{ed}	ε_t^{ds}	ε_t^{dd}	Total (F)	Total (D)
	FEVD for the change in GDP- HK							
Hong Kong	Q1	0.00	0.36	0.12	0.52	0.00	0.48	0.52
	Q2	0.01	0.36	0.12	0.50	0.02	0.49	0.52
	Q3	0.01	0.43	0.11	0.41	0.04	0.55	0.45
	Q4	0.01	0.46	0.10	0.37	0.05	0.57	0.42
	FEVD for the change in GDP-TW							
Taiwan	Q1	0.04	0.00	0.01	0.91	0.04	0.05	0.95
	Q2	0.04	0.01	0.02	0.86	0.06	0.07	0.92
	Q3	0.04	0.02	0.06	0.81	0.07	0.12	0.88
	Q4	0.04	0.02	0.07	0.79	0.08	0.13	0.87
	FEVD for the change in GDP-SP							
Singapore	Q1	0.04	0.03	0.37	0.45	0.11	0.44	0.56
	Q2	0.05	0.03	0.34	0.44	0.14	0.42	0.58
	Q3	0.11	0.04	0.33	0.40	0.12	0.48	0.52
	Q4	0.12	0.05	0.32	0.39	0.12	0.49	0.51
	FEVD for the change in GDP-KO							
Korea	Q1	0.08	0.03	0.03	0.83	0.03	0.14	0.86
	Q2	0.07	0.05	0.04	0.72	0.11	0.16	0.83
	Q3	0.07	0.06	0.04	0.72	0.11	0.17	0.83
	Q4	0.07	0.06	0.04	0.72	0.11	0.17	0.83
	FEVD for the change in GDP-JP							
Japan	Q1	0.11	0.03	0.05	0.81	0.00	0.19	0.81
	Q2	0.10	0.06	0.07	0.72	0.06	0.23	0.78
	Q3	0.12	0.08	0.07	0.65	0.07	0.27	0.72
	Q4	0.13	0.08	0.08	0.64	0.08	0.29	0.72
	FEVD for the change in CPI -HK							
Hong Kong	Q1	0.01	0.17	0.06	0.01	0.76	0.24	0.77
	Q2	0.02	0.13	0.05	0.07	0.73	0.2	0.8
	Q3	0.05	0.12	0.06	0.09	0.69	0.23	0.78
	Q4	0.05	0.12	0.06	0.10	0.67	0.23	0.77
	FEVD for the change in CPI -TW							
Taiwan	Q1	0.00	0.10	0.18	0.00	0.73	0.28	0.73
	Q2	0.00	0.12	0.20	0.00	0.67	0.32	0.67
	Q3	0.00	0.12	0.19	0.01	0.67	0.31	0.68
	Q4	0.00	0.12	0.19	0.02	0.66	0.31	0.68
	FEVD for the change in CPI -SP							
Singapore	Q1	0.01	0.04	0.47	0.39	0.10	0.52	0.49
	Q2	0.00	0.16	0.38	0.25	0.21	0.54	0.46
	Q3	0.00	0.21	0.38	0.16	0.24	0.59	0.4
	Q4	0.01	0.20	0.37	0.14	0.28	0.58	0.42
	FEVD for the change in CPI -KO							
Korea	Q1	0.00	0.02	0.11	0.01	0.86	0.13	0.87
	Q2	0.00	0.07	0.12	0.05	0.76	0.19	0.81
	Q3	0.01	0.07	0.12	0.05	0.75	0.2	0.8
	Q4	0.01	0.07	0.12	0.05	0.75	0.2	0.8
	FEVD for the change in CPI -JP							
Japan	Q1	0.01	0.00	0.56	0.00	0.42	0.57	0.42
	Q2	0.00	0.01	0.47	0.04	0.48	0.48	0.52
	Q3	0.00	0.01	0.51	0.06	0.41	0.52	0.47
	Q4	0.00	0.02	0.53	0.07	0.37	0.55	0.44

Note: The column total (F) indicates the total FEVD for foreign shocks while total (D) as total FEVD for domestic shocks

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