Identifying Shocks in Regionally Integrated East Asian Economies with Structural VAR and Block Exogeneity

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Abstract

In this paper we use a structural VAR model with block exogeneity to investigate if external shocks originating from the USA played a dominant role in influencing the macroeconomic fluctuations in East Asia during the period 1978-2007. The empirical results show a dynamic effect of external shocks, implying that, even though regional integration appears to be deepening and accelerating, especially after the recent global financial crisis, the influence of US shocks on real output fluctuations in the East Asian region is still very strong. The effects of Chinese shocks show an increasing trend over time, but the impacts are still small and not comparable with those of US shocks. The world oil price shock has become increasingly important in influencing the stability of real output growth in the region. The results from variance decomposition and impulse response analysis confirm the findings. Even though Japanese firms have established production networks in East Asia through trade and investment, and China has also grown rapidly and become a key regional country, the results suggest that US influence in the region is still asymmetric and strong. Therefore, it is difficult to conclude that shocks to the East Asian economies have become more regionally oriented.

Keywords: Structural vector autoregression, Block exogeneity, Monetary union, External shocks, East Asia.

JEL classifications: F33, F36, F41.

1. INTRODUCTION

East Asia has enjoyed a remarkable record of high and sustained economic growth over three decades from 1965 to the early 1990s. Their ability to achieve speedy developments with equity has intrigued many economists who attempted to understand the drivers of economic growth. Most of this miraculous growth is believed to be due to a combination of fundamentally sound development policies, tailored interventions, and an unusually rapid accumulation of physical and human capital, as well as rapid intra-regional trade integration. Recovering from a severe economic downturn during the currency crisis in 1997, East Asian countries[1] have shown considerable economic growth again and regional integration appears to be accelerating.[2] Such a deepening integration process raises an interesting question as to whether a regional monetary union or a common currency unit can be established in East Asia. While the ongoing economic integration suggests the feasibility of regional monetary arrangements, a rigorous empirical investigation of this issue is essential.

Several studies have examined the feasibility of forming a monetary union in East Asia (see, for instance, Bayoumi and Eichengreen [1], Bayoumi et al. [2], Chow and Kim [6], and Sato et al. [17]). These studies have typically explored whether the countries in question meet some of the pre-conditions set in the theory of optimum currency area (see de Grauwe [8]). Recently, Cheung and Yuen [5] and Sato and Zhang [14] investigated the correlations in structural shocks and real output co-

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[1] In this paper, East Asia is defined as the following 10 economies: Japan, Korea, Taiwan, Hong Kong, Singapore, Malaysia, Indonesia, Thailand, the Philippines, and Mainland China.

[2] According to JETRO (2007), for instance, the share of intra-regional trade in total trade has grown in ASEAN+3 (Japan, China and Korea) from 35.4% in 1999 to 38.4% in 2006, while the corresponding share in NAFTA and EU25 has declined from 48.5% to 44.2%, and from 68.6% to 66.1%, respectively.

movements among the East Asian countries, and found that some sub-groups of countries were potential candidates for establishing a monetary union. However, these studies did not take account of whether the degree of correlation in structural shocks or real output co-movements had improved over time.

Zhang and Sato [16] examined the time-varying correlations in structural shocks to assess the viability of forming a monetary union in the Greater China area from a dynamic perspective. The advantage of this dynamic approach is that it allows not only an assessment of the dynamic process of shock correlations and convergence trends, but also a determination of the shock correlations not caused by the "outside" economies. This is especially important in assessing the feasibility of forming a monetary union in the East Asian region, given its unique dynamic integration process and business linkages with the USA. Indeed, the empirical findings also confirm the dynamic process and increasing correlations of both real output growth rates and structural shocks in the aftermath of the global financial crisis among some East Asian countries.

It remains an interesting issue whether or not the co-movements of macroeconomic variables in the region have been driven by external shocks, such as US shocks. The economic influence of the USA in the East Asian region is better reflected in the saying, "When America sneezes, Japan and Europe used to catch a cold", in order to determine if the US influence has important implications for establishing a regional monetary arrangement.

There has been a recent and growing literature analysing the effects of external shocks on the economic growth and the macroeconomic fluctuations in emerging economies. IMF [10], for instance, tackles the broad question of how far the emerging economies can decouple from the US economy, and investigates whether US shocks affect business cycle fluctuations in some major currency areas, including East Asia, Latin America, and Sub-Saharan Africa, using alternative methods, such as a panel data analysis, structural VAR estimation, and a dynamic factor model. Canova [4], Genberg [9] and Maćkowiak [12] have used the VAR technique to examine the effects of US monetary shocks and/or China's impact on the emerging economies in East Asia and Latin America. However, these studies have typically covered the period during the 1980s and 1990s, and hence preceded the effects of the global financial crisis in emerging economies.

The purpose of the paper is to identify the dynamic impacts of external and internal shocks, and to assess whether the co-movements of macroeconomic variables in the region are largely affected by external shocks or are driven by autonomous development in the regional economies. In particular, we investigate which shocks have a dominant effect, namely the shocks originating from the two regional key countries, Japan or China, or those from the USA, by using quarterly data spanning the period 1978Q1 to 2007Q4.

A correlation analysis of the real output growth and domestic inflation among these economies is used to investigate dynamic structural changes over time. We also assess the shock disturbances obtained by the Blanchard and Quah [3] structural decomposition method to determine the trends of the correlations in the shocks. Then we construct a structural VAR model with block exogeneity to examine to what extent US shocks influence macroeconomic fluctuations in the East Asian economies, and if the external shocks dominate the shock disturbances or the internal shocks. Finally, the variance decomposition test and impulse response function analysis are conducted to investigate the size of the shocks and the speed of adjustment to the shocks for various economies.

The results indicate that US shocks are still an important source of real output fluctuations in five East Asian countries, while the Japanese and Chinese shocks are comparatively less important. In addition, the impulse responses of real outputs to US shocks are positive, and are much larger in the five East Asian countries during the post-crisis period than the corresponding impulse responses to the Japanese and Chinese shocks. This outcome holds despite the fact that Japanese firms have been building a production network in East Asia over the past few decades, and China has emerged as a trading nation and the world's manufacturing centre since the late 1990s. These empirical findings have important implications for the feasibility of regional monetary arrangements in East Asia.

The remainder of the paper is organized as follows. In Section 2, we discuss the analytical framework and methodology used in the paper. Section 3 describes the data, and Section 4 presents the empirical results. Section 5 provides some concluding remarks.

2. ANALYTICAL FRAMEWORK

In order to allow for the effects of external shocks on regional economies, consider the following near-VAR model with block exogeneity:[3]

$$\sum_{s=0}^{p}\begin{bmatrix} A_{11}(s) & A_{12}(s) \\ A_{21}(s) & A_{22}(s) \end{bmatrix}\begin{bmatrix} y_{1,t-s} \\ y_{2,t-s} \end{bmatrix}=\begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix},$$

where $A_{12}(s)=0$ for each s = 0, 1,…, p , $y_{1,t}$ is a vector of variables external to the domestic country, and $y_{2,t}$ is a vector of macroeconomic variables in the domestic country. A vector of structural shocks, $\varepsilon_t=\left[\varepsilon_{1,t} \quad \varepsilon_{2,t}\right]'$, is uncorrelated with past y_{t-s} for $s>0$, and satisfies $E\left[\varepsilon_t\varepsilon_t' \mid y_{t-s}, s>0\right]=I$ and $E\left[\varepsilon_t \mid y_{t-s}, s>0\right]=0$, where $\varepsilon_{1,t}$ is a vector of structural shocks of external origin and $\varepsilon_{2,t}$ is a vector of structural shocks of domestic origin. The model is formulated separately for each East Asian economy that is assumed to be a small open economy. We impose the block exogeneity restriction, $A_{12}(s)=0$ for each s = 0, 1…p, which indicates that domestic shocks, $\varepsilon_{2,t}$, have neither contemporaneous nor lagged effects on the external variables, $y_{1,t}$.

A foreign block, $y_{1,t}$, includes three variables, namely world oil price changes, and the real output growth in the USA and Japan. We also include China's real output growth instead of Japanese real output growth to analyze the effect of the emerging Chinese economy on the rest of the region. In the foreign block, it is assumed that the US and Japanese (or Chinese) real output growth rates do not affect world oil price changes, either contemporaneously or intertemporally. It is further assumed that shocks to the

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[3] See Cushaman and Zha [7], Zha [15], and Maćkowiak [12] for an analysis using the near-VAR model with block exogeneity.

US real output growth (the US shock) affect contemporaneously the real output growth in Japan or China, but not vice-versa.

A country-specific block, $y_{2,t}$, includes two variables, namely the real output growth and domestic inflation. In the country-specific block, we impose the long-run zero restrictions, as in Blanchard and Quah (1989), where: (i) only a shock to the first variable (real output growth), that is, the domestic supply shock, affects the real output growth in the long run; and (ii) both the supply shock and the shock to the second variable (domestic inflation), that is, the domestic demand shock, affects domestic inflation in the long run. Thus, SUR estimation is used with the above block exogeneity assumption to identify structural shocks by imposing both contemporaneous and long-run restrictions. The RATS 6.0 econometric software program is used in for estimation, and one lag is chosen for the near-VAR system due to the small sample size.

3. DATA

The real GDP and consumer price index (CPI) series are used as proxies for real output and the domestic price, respectively. The world oil price index in terms of the US dollar is also included in a near-VAR model to allow for the effect of the world oil price shock on domestic real output and prices. All data are quarterly, and are expressed in natural logarithms. Seasonality is adjusted using the Census X12 method. The sample period covers 1978Q1-2007Q4, except for the Hong Kong CPI (1980Q4-2007Q4) and the Chinese CPI (1986Q1-2007Q4). The major data sources are IMF, *International Financial Statistics* (IFS), CD-ROM edition and the CEIC Global Database, as well as China Monthly Statistics.

The sample period is further divided into three sub-samples, namely 1978Q1-1987Q4, 1988Q1-1996Q4, and 1999Q1-2007Q4, to capture the dynamic evolutionary process of the shocks correlations throughout the sample period. Moreover, data for 1997-98 are excluded to eliminate the possible impact of the Asian currency crisis. Due to the small sample size, we do not perform cointegration analysis, but rather use a first-difference VAR model to ensure stationarity of the variables.

4. EMPIRICAL RESULTS

A correlation analysis of the variables across the economies is conducted, and the correlation coefficients of the identified structural shocks are calculated, following the Blanchard and Quah [3] structural decomposition method. Tables 1 and 2 report the empirical results. As can be seen from the tables, the correlation patterns of the real output growth and CPI inflation have been changing over time.[4] The results from the correlation analysis indicate that the real output variable and inflation rate are highly correlated and also significant at the 5% level, mostly among the Asian NIEs and during both the whole sample period and the period after the financial crisis. In particular, the correlation coefficients of real output growth among the economies of Hong Kong, Korea, Singapore and Taiwan range from 0.20 to 0.51 during the period 1978-2007, and from 0.34 to 0.71 during the post-crisis period from 1999-2007.

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[4] In Tables 1 and 2, we test the null hypothesis that a correlation coefficient is equal to zero. The critical values are computed based on Rodriguez [13].

Before the financial crisis, Japan's real output growth is found to be correlated only with that of Korea. During the post-crisis period, it is found to be correlated with that of the four East Asian Tigers, together with China and Malaysia, with the coefficient ranging from a low of 0.24 with Korea to a high of 0.36 with China. The change in the correlation pattern for the Chinese economy is not as notable as one might expect, increasing from an insignificant correlation before the crisis to only one significant correlation with Japan, while keeping a coefficient of 0.27 with Hong Kong and 0.16 with Singapore. The US real output growth was correlated significantly with those in Japan, Taiwan, Malaysia and Thailand during the period 1978-1987, but maintained a significant correlation only with that of Hong Kong, Singapore and Taiwan thereafter.

The evolutionary pattern of the correlation coefficients for the real output growth in the region is a reflection of the deepening regional integration through trade and investment and policy coordination during the post-crisis period. Although not presented, but available upon request, we have estimated a conventional 2-variable VAR, including the real GDP growth rate and the CPI inflation rate, and conducted the Blanchard and Quah [3] structural decomposition to identify the fundamental supply and demand shocks. Our results from the shocks correlations also confirm that the degree of correlation in supply shocks has increased substantially during the post-crisis period.

[Insert Tables 1-2 here]

It is interesting to note in Table 2 that the evolution of the inflation rates correlations shows a slightly different pattern from real output growth. All the economies except for China and the Philippines are significantly correlated in their domestic inflation rates during the period 1978-1987, and become less so from the late 1980s. In contrast, China and the Philippines have become increasingly correlated in inflation rates with the rest of the East Asian economies and the USA since the late 1980s. In particular, the number of significant correlations in the inflation rates for China has increased to six, with only one negative correlation coefficient with Indonesia, during the post-crisis period. This finding reflects the increasing influence of the emerging Chinese economy in the region.

As the correlations in real output growth and in supply shocks have improved after the financial crisis, the next issue is whether such improvements in the correlations are affected by the external shocks (such as US shocks and Japanese (Chinese) shocks), or are driven by autonomous regional development. We use variance decomposition and impulse response analysis to identify the dominant shock influences and the speed of adjustment. As the estimated structural shocks are assumed to have unit variances in the structural VAR method, their size and adjustment speed can be inferred by analyzing the associated impulse response functions (see, for example, Bayoumi and Eichengreen [1]).

In this paper, we use different horizons to investigate the effect of a unit shock on changes in real GDP and CPI as a measure of the size of different shocks. The speed of adjustment is measured by the response after a horizon average between one and four-quarters, and also between one and twelve-quarters. The larger is the size of the shocks, the more disruptive will be the effects on an economy. Tables 3-6 present, respectively, the results of variance decomposition on real output growth and the impulse response of real output to the oil price shock, and US and Japanese (Chinese) shocks.

[Insert Tables 3-4 here]

Regarding the variance decomposition of the real GDP growth rate in Tables 3 and 4, we find that the US and Japanese shocks are the dominant sources of disturbance in the region before the financial crisis, especially during the 1978-1987 period, both in the short and long run, The influence of the US shock is most visible in the economies of Taiwan, Thailand, and the Philippines, while the Japanese shock is most notable in Hong Kong, Indonesia, Korea, and Singapore. This finding seems to be consistent with these two countries' business and investment networks and locations in the region. It is also noted that after the financial crisis, the US shock seems to be the dominant source of the disturbance in most economies, with the exception of the Chinese economy, while the Japanese influence has decreased. Interestingly, the Chinese shock influence has been found to be increasingly important, with a clear and increasing trend over time, but the size is still very small compared with that of the US shock.

From Table 3, it is also noted that the world oil price shock has become increasingly important in influencing the stability of real output growth in the region, most notably in the economies of China, Hong Kong, Singapore and Thailand. This finding is consistent with our causal observation that, with their industrialization, these East Asian economies have become increasingly reliant on world oil supply. It is interesting to note that Indonesia and Thailand are less affected by external shocks, but the Philippines is more affected by the Chinese shock. The results of the variance decomposition for inflation show that the world oil price shock is an important source of price fluctuations in most economies, followed by the US shock. The Chinese influence on the domestic price level is persistent, and is mostly noted in Hong Kong, which is a clear reflection of the high degree of economic integration between the two economies.

[Insert Tables 5-6 here]

As the real output co-movements and business cycle synchronization are viewed as one of the most crucial preconditions for forming an optimum currency area, we now turn to the effect of external shocks on real output growth of the East Asian economies. Tables 5 and 6 show the impulse responses of real output growth, respectively, to the US, Japanese and Chinese shocks. It can be seen from the tables that most of the East Asian economies have positive impulse responses to the external shocks originating from the USA over the different time periods, with the only exception being Indonesia after the financial crisis. The impulse responses to the regional shocks originating from China and Japan show an increasing trend, especially during the post financial crisis period, but the sizes are much smaller, and hence not compatible, with that of the USA over all time horizons. These findings imply that, even though the regional integration appears to be deepening and accelerating, especially after the recent financial crisis, the influence of US shocks still plays a dominant role in real output fluctuations in the East Asian region.

5. CONCLUDING REMARKS

In this paper we used a structural VAR model with block exogeneity to investigate if external shocks originating from the USA played a dominant role in the macroeconomic fluctuations in East Asia during the period 1978 to 2007. We found that the real output variable and inflation rate were highly correlated and statistically significant among the Asian NIEs, and during both the whole sample period and the period after the financial crisis. The US real output growth was correlated significantly with Japan, Taiwan, Malaysia and Thailand during the period 1978-1987, but maintained significant correlations only with Hong Kong, Singapore and Taiwan during the post-crisis period. The real GDP growth in Japan had a significant correlation with the Asian NIEs and China during the post-crisis period, while the latter had only one significant correlation. This finding is consistent with the results from the correlation analysis of structural shocks using the conventional Blanchard and Quah [3] technique.

The results from the structural VAR model with block exogeneity showed that the US shock and the Japanese shock were the dominant sources of disturbances in the region before the financial crisis, especially during the 1978-1987 period, both in the short and long run. During the post-crisis period, it was found that the US shock had become the dominant source of the disturbance in most economies, with the exception of the Chinese economy, while the Japanese influence had decreased. The Chinese shock influence showed an increasing trend over time, but the size was still small and not comparable with the US shock. The world oil price shock had become increasingly important in influencing the stability of the real output growth in the region, most notably in the economies of China, Hong Kong, Singapore and Thailand.

This indicated an increasing reliance on the world oil supply associated with their respective industrialization.

The empirical results also indicated that most of the East Asian economies have positive impulse responses to the external shocks originating from the USA over different time periods, with the only exception being Indonesia during the post-crisis period. The impulse responses to the regional shocks originating from China and Japan showed an increasing trend, especially during the post-crisis period, but the sizes were smaller and not comparable with the USA across all time horizons. These findings implied that, even though regional integration appeared to be deepening and accelerating, especially after the recent financial crisis, the influence of US shocks still played a dominant role in real output fluctuations in the East Asian region.

It is often noted that Japanese firms have been building a production network in East Asia through trade and investment, and also that China has grown rapidly and become a candidate as a regional key country. However, our empirical result implied that the US influence in the region is still asymmetric and strong, and hence it is difficult to conclude that shocks to the East Asian economies have become more regional in origin.

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Table 1: Correlation of Real GDP Growth Rates

1. Whole Sample (1978Q1-2007Q4)

	Oil	US	JP	KR	TW	HK	SG	MY	ID	TH	PH	CH
Oil	1.00											
United States	-0.01	1.00										
Japan	**0.15**	0.09	1.00									
Korea	0.05	0.08	**0.31**	1.00								
Taiwan	0.10	**0.36**	0.10	**0.28**	1.00							
Hong Kong	0.13	-0.02	**0.19**	**0.36**	**0.38**	1.00						
Singapore	0.14	0.14	0.05	**0.20**	**0.51**	**0.39**	1.00					
Malaysia	**0.29**	0.14	**0.21**	**0.41**	**0.32**	**0.17**	**0.47**	1.00				
Indonesia	**0.17**	0.03	0.12	**0.32**	**0.16**	**0.25**	**0.30**	**0.55**	1.00			
Thailand	0.06	0.13	**0.18**	**0.35**	0.14	0.08	**0.32**	**0.42**	**0.46**	1.00		
Philippines	0.12	-0.14	0.04	0.15	0.08	**0.19**	0.14	**0.20**	**0.21**	0.00	1.00	
China	-0.01	0.06	0.01	0.05	0.00	**0.17**	0.02	-0.15	-0.04	0.04	-0.26	1.00

2. Sub-Sample I (1978Q1-1987Q4)

	Oil	US	JP	KR	TW	HK	SG	MY	ID	TH	PH	CH
Oil	1.00											
United States	-0.02	1.00										
Japan	0.26	**0.31**	1.00									
Korea	-0.07	0.22	**0.28**	1.00								
Taiwan	-0.05	**0.49**	-0.07	0.23	1.00							
Hong Kong	0.03	-0.11	0.08	**0.35**	**0.31**	1.00						
Singapore	0.08	0.07	0.04	-0.06	0.26	**0.29**	1.00					
Malaysia	0.19	**0.35**	0.06	0.04	**0.28**	-0.09	**0.53**	1.00				
Indonesia	-0.04	0.15	-0.23	-0.16	0.26	0.10	0.19	**0.41**	1.00			
Thailand	-0.16	**0.33**	0.22	0.09	0.10	-0.26	0.24	**0.39**	-0.05	1.00		
Philippines	0.16	-0.21	-0.07	0.02	0.10	0.21	0.06	0.13	**0.31**	-0.22	1.00	
China	0.13	0.05	0.16	0.12	-0.15	0.12	-0.22	-0.37	-0.36	-0.13	-0.38	1.00

3. Sub-Sample II (1988Q1-1996Q4)

	Oil	US	JP	KR	TW	HK	SG	MY	ID	TH	PH	CH
Oil	1.00											
United States	0.04	1.00										
Japan	0.02	-0.12	1.00									
Korea	-0.27	-0.27	0.06	1.00								
Taiwan	**0.32**	0.03	-0.26	-0.03	1.00							
Hong Kong	-0.28	0.01	0.04	-0.04	-0.09	1.00						
Singapore	-0.11	0.08	-0.36	-0.17	0.23	-0.10	1.00					
Malaysia	0.22	-0.09	0.04	0.02	-0.06	-0.06	0.01	1.00				
Indonesia	0.10	0.21	0.00	-0.07	-0.05	-0.20	-0.15	-0.20	1.00			
Thailand	0.06	0.01	-0.06	0.00	**0.29**	0.00	0.06	-0.10	0.15	1.00		
Philippines	0.01	0.23	0.24	0.19	0.17	0.01	0.06	-0.01	-0.03	0.08	1.00	
China	-0.22	0.14	-0.33	-0.25	0.13	0.27	0.10	-0.15	0.11	0.03	-0.23	1.00

4. Post-Crisis (1999Q1-2007Q4)

	Oil	US	JP	KR	TW	HK	SG	MY	ID	TH	PH	CH
Oil	1.00											
United States	0.22	1.00										
Japan	0.17	-0.01	1.00									
Korea	**0.44**	0.15	0.24	1.00								
Taiwan	**0.33**	**0.45**	**0.28**	**0.48**	1.00							
Hong Kong	**0.55**	**0.44**	**0.36**	**0.34**	**0.63**	1.00						
Singapore	**0.39**	**0.43**	0.25	**0.36**	**0.75**	**0.69**	1.00					
Malaysia	**0.46**	0.24	**0.33**	**0.58**	**0.59**	**0.41**	**0.48**	1.00				
Indonesia	0.07	0.06	-0.04	-0.03	-0.01	0.09	0.25	**0.34**	1.00			
Thailand	0.27	0.08	0.00	0.01	-0.06	0.14	0.25	0.15	**0.34**	1.00		
Philippines	0.11	0.09	0.09	0.24	**0.42**	**0.36**	**0.44**	**0.43**	0.16	0.04	1.00	
China	0.13	0.00	**0.36**	-0.28	0.08	0.27	0.16	-0.12	-0.20	0.10	0.19	1.00

Note: The growth rate is calculated as the log-difference. Bold figures denote the correlation coefficient is statistically significant at the 5% level (one-tail).

Table 2: Correlation of CPI Inflation Rates

1. Whole Sample (1978Q1-2007Q4)

	Oil	US	JP	KR	TW	HK	SG	MY	ID	TH	PH	CH
Oil	1.00											
United States	**0.34**	1.00										
Japan	-0.04	**0.70**	1.00									
Korea	0.03	**0.77**	**0.66**	1.00								
Taiwan	0.14	**0.68**	**0.55**	**0.75**	1.00							
Hong Kong	-0.11	**0.49**	**0.53**	**0.51**	**0.43**	1.00						
Singapore	0.15	**0.66**	**0.60**	**0.56**	**0.48**	**0.50**	1.00					
Malaysia	-0.11	**0.44**	**0.49**	**0.51**	**0.49**	**0.47**	**0.55**	1.00				
Indonesia	-0.08	0.02	-0.01	0.15	0.12	-0.05	-0.07	**0.26**	1.00			
Thailand	0.07	**0.67**	**0.59**	**0.67**	**0.62**	**0.52**	**0.62**	**0.52**	**0.21**	1.00		
Philippines	-0.02	**0.30**	**0.38**	**0.22**	0.14	**0.31**	**0.25**	**0.27**	0.10	0.11	1.00	
China	-0.04	**0.23**	**0.18**	**0.23**	**0.30**	**0.57**	**0.33**	**0.22**	-0.17	0.17	0.09	1.00

2. Sub-Sample I (1978Q1-1987Q4)

	Oil	US	JP	KR	TW	HK	SG	MY	ID	TH	PH	CH
Oil	1.00											
United States	**0.46**	1.00										
Japan	0.10	**0.79**	1.00									
Korea	0.25	**0.86**	**0.76**	1.00								
Taiwan	0.18	**0.76**	**0.69**	**0.81**	1.00							
Hong Kong	0.07	**0.68**	**0.55**	**0.58**	**0.55**	1.00						
Singapore	0.14	**0.70**	**0.65**	**0.61**	**0.49**	**0.65**	1.00					
Malaysia	0.04	**0.57**	**0.62**	**0.55**	**0.58**	**0.78**	**0.71**	1.00				
Indonesia	**0.43**	**0.40**	**0.32**	**0.38**	**0.47**	**0.25**	**0.39**	**0.34**	1.00			
Thailand	0.16	**0.81**	**0.78**	**0.71**	**0.73**	**0.62**	**0.72**	**0.51**	**0.42**	1.00		
Philippines	0.17	0.15	0.23	0.03	0.02	0.08	0.19	0.16	0.17	-0.09	1.00	
China	-	-	-	-	-	-	-	-	-	-	-	-

3. Sub-Sample II (1988Q1-1996Q4)

	Oil	US	JP	KR	TW	HK	SG	MY	ID	TH	PH	CH
Oil	1.00											
United States	**0.47**	1.00										
Japan	-0.05	**0.50**	1.00									
Korea	-0.32	0.23	**0.39**	1.00								
Taiwan	0.23	0.20	-0.07	**0.42**	1.00							
Hong Kong	0.01	**0.46**	**0.34**	**0.33**	0.14	1.00						
Singapore	0.04	**0.41**	**0.60**	0.26	-0.09	**0.47**	1.00					
Malaysia	-0.39	-0.23	0.20	0.12	-0.23	-0.01	0.17	1.00				
Indonesia	**0.34**	0.15	0.10	0.04	0.22	0.09	0.14	-0.21	1.00			
Thailand	0.11	0.03	0.11	0.00	-0.32	0.04	0.21	0.17	0.04	1.00		
Philippines	-0.25	0.19	**0.39**	**0.51**	-0.06	**0.37**	**0.38**	0.19	-0.18	**0.30**	1.00	
China	-0.09	-0.08	-0.20	-0.24	0.03	-0.06	-0.14	0.16	0.08	-0.17	-0.42	1.00

4. Post-Crisis (1999Q1-2007Q4)

	Oil	US	JP	KR	TW	HK	SG	MY	ID	TH	PH	CH
Oil	1.00											
United States	**0.54**	1.00										
Japan	0.22	**0.30**	1.00									
Korea	0.14	0.20	0.23	1.00								
Taiwan	**0.37**	**0.36**	0.15	0.15	1.00							
Hong Kong	0.11	0.28	**0.49**	**0.36**	**0.54**	1.00						
Singapore	**0.40**	**0.37**	**0.39**	0.25	**0.54**	**0.49**	1.00					
Malaysia	0.25	0.30	**0.39**	-0.19	**0.31**	**0.40**	0.22	1.00				
Indonesia	-0.33	-0.01	-0.17	0.08	-0.15	0.24	-0.01	0.18	1.00			
Thailand	**0.28**	**0.50**	0.21	**0.32**	**0.57**	**0.59**	**0.35**	**0.43**	0.11	1.00		
Philippines	-0.14	0.04	0.27	**0.42**	0.06	0.31	-0.04	**0.30**	0.21	0.18	1.00	
China	0.19	0.12	**0.31**	**0.31**	**0.50**	**0.64**	**0.64**	0.02	-0.04	**0.34**	0.06	1.00

Note: See footnote to Table 1.

Table 3: Decomposition of Variance due to US and Japanese Shocks

1. Real GDP Growth Rate

		Horizon (Quarters)	KR	TW	HK	SG	MY	ID	TH	PH	CH
A. 1978Q1-1987Q4											
	Oil shock	1-12	5.8	1.7	3.0	1.8	9.0	5.1	2.0	3.0	-
		13-24	6.5	1.9	2.9	2.0	10.7	5.6	2.1	3.1	-
	US shock	1-12	2.8	17.0	10.4	0.5	7.8	5.6	16.8	11.9	-
		13-24	3.0	18.2	11.6	0.6	7.8	6.0	16.7	12.8	-
	Jp shock	1-12	10.2	7.5	31.2	11.6	0.6	11.0	6.7	3.5	-
		13-24	10.6	7.5	33.4	12.7	0.6	11.2	7.0	3.8	-
B. 1988Q1-1996Q4											
	Oil shock	1-12	8.9	11.3	10.9	15.6	6.9	6.5	0.7	5.8	2.0
		13-24	9.1	11.4	11.1	16.1	6.9	6.6	0.7	6.3	2.1
	US shock	1-12	11.6	2.0	8.8	2.9	1.2	9.4	1.3	10.1	3.5
		13-24	12.4	2.1	8.5	3.1	1.2	9.4	1.5	11.2	3.6
	Jp shock	1-12	5.0	5.0	16.8	18.6	0.3	6.1	1.3	2.1	21.5
		13-24	5.2	5.1	18.0	19.7	0.4	6.7	1.3	2.1	22.0
C. 1999Q1-2007Q4											
	Oil shock	1-12	3.1	4.3	23.8	17.7	6.5	7.1	17.0	8.5	10.1
		13-24	3.4	4.7	23.6	17.9	6.9	7.0	16.7	9.3	10.0
	US shock	1-12	23.6	45.3	28.2	25.4	31.1	3.7	3.2	13.5	2.0
		13-24	25.8	46.2	28.7	25.4	33.5	4.2	3.2	15.1	2.1
	Jp shock	1-12	4.1	3.0	9.4	4.5	8.1	9.4	0.1	8.9	3.7
		13-24	4.0	3.0	9.6	5.0	8.0	9.3	0.1	9.8	3.8

2. CPI Inflation Rate

		Horizon (Quarters)	KR	TW	HK	SG	MY	ID	TH	PH	CH
A. 1978Q1-1987Q4											
	Oil shock	1-12	10.9	13.6	1.7	14.4	7.0	26.0	31.6	7.1	-
		13-24	12.8	18.2	1.6	17.8	8.9	28.3	41.6	8.6	-
	US shock	1-12	2.2	7.8	4.8	3.6	1.6	5.5	1.5	11.3	-
		13-24	1.8	7.8	4.6	3.3	1.8	5.9	1.4	13.1	-
	Jp shock	1-12	7.6	1.5	10.7	4.0	2.8	2.8	1.9	1.1	-
		13-24	9.0	1.7	12.1	4.5	3.2	2.8	1.4	1.1	-
B. 1988Q1-1996Q4											
	Oil shock	1-12	20.8	8.1	9.9	31.9	19.9	10.4	11.1	22.9	16.2
		13-24	20.6	8.3	10.3	34.4	20.1	10.4	11.5	25.8	17.4
	US shock	1-12	20.3	10.8	8.0	3.9	0.1	22.4	5.6	34.0	9.8
		13-24	20.2	10.8	9.7	4.2	0.1	22.2	6.1	36.2	12.3
	Jp shock	1-12	8.4	20.2	18.3	0.8	3.8	1.0	6.1	1.6	4.2
		13-24	8.9	22.7	16.9	0.9	3.8	1.1	6.5	1.7	4.0
C. 1999Q1-2007Q4											
	Oil shock	1-12	8.8	13.7	13.3	8.5	5.9	11.8	21.7	0.4	6.1
		13-24	8.9	13.9	11.1	8.3	5.9	12.3	21.6	0.4	6.1
	US shock	1-12	12.3	2.6	20.0	7.3	3.4	7.2	5.7	12.0	8.6
		13-24	12.7	2.8	26.1	8.4	3.4	7.2	6.2	12.6	9.4
	Jp shock	1-12	5.3	0.3	2.6	1.4	0.8	4.3	4.6	6.9	1.4
		13-24	5.3	0.3	2.0	1.5	0.9	4.3	5.0	6.8	1.5

Note: "1-12" denotes the average between 1 quarter after a shock and 12 quarters after a shock. "13-24" denotes the average between 13 quarters after a shock and 24 quarters after a shock.

Table 4: Decomposition of Variance due to US and Chinese Shocks

1. Real GDP Growth Rate

		Horizon (Quarters)	KR	TW	HK	SG	MY	ID	TH	PH	CH
A. 1978Q1-1987Q4											
	Oil shock	1-12	5.5	2.1	2.1	3.9	9.3	6.3	1.7	2.2	-
		13-24	6.2	2.4	2.3	4.6	10.7	6.9	1.8	2.3	-
	US shock	1-12	3.4	16.6	7.7	1.5	7.5	5.5	14.9	10.8	-
		13-24	3.6	18.2	8.4	1.5	7.5	5.9	15.0	11.7	-
	Ch shock	1-12	2.5	8.6	4.8	19.8	7.9	13.2	2.6	10.4	-
		13-24	2.7	9.0	5.4	22.2	7.8	13.2	2.7	10.8	-
B. 1988Q1-1996Q4											
	Oil shock	1-12	9.2	14.9	15.8	10.1	4.8	1.3	0.3	7.0	-
		13-24	9.6	15.1	15.9	10.7	4.7	1.3	0.4	7.6	-
	US shock	1-12	11.0	1.8	11.1	3.6	1.6	7.3	1.3	10.6	-
		13-24	11.8	1.9	11.1	3.7	1.5	7.2	1.4	11.7	-
	Ch shock	1-12	8.9	4.5	6.0	0.4	1.8	13.8	12.5	6.1	-
		13-24	9.2	4.7	7.0	0.5	1.9	14.3	13.4	6.2	-
C. 1999Q1-2007Q4											
	Oil shock	1-12	2.4	2.8	24.8	16.3	7.4	8.3	16.5	4.0	-
		13-24	2.6	3.1	24.5	16.5	7.9	8.2	16.2	4.4	-
	US shock	1-12	24.3	47.3	29.6	28.3	29.1	3.6	2.9	9.8	-
		13-24	26.5	48.2	30.2	28.5	31.3	4.0	2.8	10.7	-
	Ch shock	1-12	4.8	3.5	2.9	1.2	5.1	7.1	1.2	16.3	-
		13-24	4.7	3.9	3.0	1.3	5.4	7.8	1.2	16.1	-

2. CPI Inflation Rate

		Horizon (Quarters)	KR	TW	HK	SG	MY	ID	TH	PH	CH
A. 1978Q1-1987Q4											
	Oil shock	1-12	10.2	13.1	1.2	17.1	7.1	24.7	35.7	6.6	-
		13-24	12.1	17.3	1.3	22.2	9.0	27.1	47.1	7.7	-
	US shock	1-12	1.3	9.0	7.2	2.0	2.3	5.4	1.3	10.7	-
		13-24	1.2	9.5	7.1	1.7	2.7	5.9	1.1	12.6	-
	Ch shock	1-12	5.5	11.5	2.7	9.5	18.9	4.9	2.5	2.0	-
		13-24	6.2	12.4	3.4	11.0	19.8	5.0	2.5	2.5	-
B. 1988Q1-1996Q4											
	Oil shock	1-12	17.5	15.1	6.8	32.7	16.9	14.1	8.7	18.5	-
		13-24	17.2	15.5	6.9	35.1	17.0	14.1	9.2	20.8	-
	US shock	1-12	17.5	7.2	13.5	3.6	0.1	20.4	5.9	35.9	-
		13-24	17.5	7.5	15.4	3.9	0.1	20.2	6.3	38.1	-
	Ch shock	1-12	5.7	0.1	8.2	0.9	7.3	4.9	17.7	3.8	-
		13-24	6.2	0.1	8.2	0.9	8.1	5.3	17.5	3.6	-
C. 1999Q1-2007Q4											
	Oil shock	1-12	8.3	13.5	13.2	8.5	5.4	12.0	27.4	0.5	-
		13-24	8.4	13.7	12.2	8.3	5.5	12.4	27.6	0.6	-
	US shock	1-12	13.0	4.2	15.6	9.1	3.0	7.4	2.5	13.0	-
		13-24	13.4	4.5	17.8	10.2	3.1	7.5	2.6	13.7	-
	Ch shock	1-12	0.9	5.5	14.6	2.2	0.7	1.1	2.1	0.1	-
		13-24	0.9	5.7	17.5	2.5	0.7	1.1	2.3	0.1	-

Note: "1-12" denotes the average between 1 quarter after a shock and 12 quarters after a shock. "13-24" denotes the average between 13 quarters after a shock and 24 quarters after a shock.

Table 5: Results of Impulse Responses of Domestic Output to External Shocks of One Standard Deviation: US and Japanese Shocks

		Horizon	KR	TW	HK	SG	MY	ID	TH	PH	CH
A. 1980Q1-1988Q4											
	Oil shock	1-4	-0.23	0.05	-0.08	-0.02	0.52	0.05	-0.30	0.58	-
		1-12	-0.55	0.07	-0.03	0.09	0.94	0.18	-0.27	0.60	-
		13-24	-0.82	0.04	0.00	0.10	1.23	0.25	-0.16	0.55	-
	US shock	1-4	0.09	0.53	0.06	0.10	0.52	0.30	0.50	-1.18	-
		1-12	0.12	0.73	0.00	0.18	0.53	0.39	0.48	-1.66	-
		13-24	0.13	0.86	-0.03	0.22	0.52	0.43	0.48	-1.96	-
	Jp shock	1-4	0.35	-0.33	-0.32	-0.25	0.09	-0.41	0.48	-0.51	-
		1-12	0.52	-0.33	-0.53	-0.55	0.02	-0.44	0.53	-0.63	-
		13-24	0.68	-0.32	-0.67	-0.72	-0.03	-0.45	0.55	-0.68	-
B. 1989Q1-1996Q4											
	Oil shock	1-4	-0.19	0.22	-0.39	-0.28	0.28	0.28	0.17	-0.36	-0.05
		1-12	-0.14	0.23	-0.51	-0.33	0.30	0.33	0.18	-0.46	0.05
		13-24	-0.12	0.24	-0.58	-0.36	0.30	0.35	0.18	-0.51	0.12
	US shock	1-4	-0.32	0.00	-0.27	0.06	-0.14	0.29	0.08	0.36	0.25
		1-12	-0.40	-0.01	-0.23	0.09	-0.16	0.24	0.11	0.49	0.21
		13-24	-0.44	-0.02	-0.18	0.10	-0.17	0.22	0.12	0.56	0.17
	Jp shock	1-4	0.17	-0.07	-0.44	-0.02	-0.06	-0.21	-0.21	0.17	-0.70
		1-12	0.17	-0.06	-0.57	0.02	-0.06	-0.23	-0.22	0.19	-0.81
		13-24	0.17	-0.05	-0.62	0.04	-0.07	-0.25	-0.22	0.20	-0.87
C. 1999Q1-2006Q4											
	Oil shock	1-4	-0.07	-0.17	0.60	-0.13	0.30	0.19	0.39	-0.21	0.12
		1-12	-0.13	-0.22	0.73	-0.27	0.37	0.20	0.41	-0.23	0.12
		13-24	-0.16	-0.25	0.84	-0.31	0.41	0.21	0.42	-0.24	0.11
	US shock	1-4	0.37	1.15	0.97	1.29	0.48	-0.08	0.10	0.29	0.05
		1-12	0.49	1.35	1.23	1.38	0.55	-0.08	0.09	0.42	0.07
		13-24	0.56	1.46	1.47	1.40	0.58	-0.08	0.08	0.49	0.07
	Jp shock	1-4	0.19	0.30	0.53	0.47	0.16	0.23	-0.02	0.22	0.10
		1-12	0.22	0.37	0.62	0.60	0.15	0.23	-0.03	0.31	0.11
		13-24	0.24	0.41	0.68	0.64	0.15	0.23	-0.03	0.35	0.12

Note: The impulse responses are percentage deviations. "1-4" denotes the average between 1 quarter after a shock and 4 quarters after a shock. "1-12" denotes the average between 1 quarter after a shock and 12 quarters after a shock. "13-24" denotes the average between 13 quarters after a shock and 24 quarters after a shock.

Table 6: Results of Impulse Responses of Domestic Output to External Shocks of One Standard Deviation: US and Chinese Shocks

		Horizon	KR	TW	HK	SG	MY	ID	TH	PH	CH
A. 1980Q1-1988Q4											
	Oil shock	1-4	-0.23	0.07	-0.29	-0.06	0.53	0.01	-0.27	0.49	-
		1-12	-0.52	0.04	-0.43	0.18	0.88	0.15	-0.37	0.70	-
		13-24	-0.78	-0.02	-0.52	0.32	1.10	0.22	-0.44	0.84	-
	US shock	1-4	0.02	0.52	0.77	0.18	0.50	0.27	0.41	-1.11	-
		1-12	0.08	0.78	1.11	0.13	0.53	0.35	0.38	-1.57	-
		13-24	0.13	0.93	1.31	0.08	0.54	0.39	0.37	-1.87	-
	Ch shock	1-4	-0.18	-0.08	-0.27	-0.65	-0.48	-0.40	0.01	-1.10	-
		1-12	-0.01	0.10	-0.15	-1.04	-0.58	-0.39	0.04	-1.43	-
		13-24	0.12	0.21	-0.06	-1.24	-0.64	-0.39	0.06	-1.64	-
B. 1989Q1-1996Q4											
	Oil shock	1-4	-0.19	0.26	-0.46	-0.13	0.22	0.05	-0.07	-0.40	-
		1-12	-0.16	0.29	-0.56	-0.15	0.22	0.04	-0.14	-0.54	-
		13-24	-0.14	0.30	-0.61	-0.15	0.22	0.04	-0.17	-0.61	-
	US shock	1-4	-0.31	-0.01	-0.26	0.10	-0.14	0.29	0.09	0.38	-
		1-12	-0.39	-0.02	-0.16	0.09	-0.15	0.28	0.15	0.53	-
		13-24	-0.43	-0.03	-0.10	0.08	-0.16	0.28	0.18	0.61	-
	Ch shock	1-4	-0.31	0.16	0.15	-0.04	-0.17	0.06	-0.14	-0.37	-
		1-12	-0.38	0.20	0.30	-0.06	-0.22	-0.07	-0.38	-0.45	-
		13-24	-0.43	0.22	0.37	-0.07	-0.25	-0.14	-0.51	-0.50	-
C. 1999Q1-2006Q4											
	Oil shock	1-4	-0.03	-0.10	0.75	0.04	0.32	0.22	0.38	-0.07	-
		1-12	-0.06	-0.16	0.83	-0.22	0.40	0.22	0.40	-0.10	-
		13-24	-0.07	-0.20	0.87	-0.33	0.44	0.22	0.41	-0.12	-
	US shock	1-4	0.36	1.13	0.91	1.21	0.48	-0.06	0.10	0.23	-
		1-12	0.46	1.29	1.03	1.15	0.56	-0.06	0.09	0.31	-
		13-24	0.51	1.38	1.11	1.10	0.61	-0.06	0.09	0.35	-
	Ch shock	1-4	-0.22	0.30	0.26	0.22	0.26	0.17	0.04	0.42	-
		1-12	-0.25	0.44	0.37	0.13	0.34	0.23	0.03	0.49	-
		13-24	-0.26	0.51	0.45	0.07	0.38	0.26	0.03	0.52	-

Note: See footnote to Table 5.