The Impact of Global Financial Crisis on the Monetary Integration in East Asia

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Abstract

The paper casts on the question of whether the global financial crisis is a catalyst or hindrance for the monetary integration in East Asia. Since the theory of Optimum Currency Areas (OCA) has long stressed the importance of the synchronization in cyclical economic activity among the members of a currency union. We disentangle the question by investigating the business cyclical synchronization before and after encountering the global financial crisis.

A Structural Dynamic Factor Model (SDFM) is applied in the paper to find the business cycle synchronization within East Asia. The model accommodates large-panel variables and extracts common factors to characterize the comovement among variables. Then variance decomposition analysis contained in SDFM is performed to examine the role of each common factor in each variable variance. Finally, the impulse response analysis is employed to investigate the degree of unexpected US shock on East Asian economies and to compare the degree of synchronization before and after global recession in 2008 occurred.

Keywords: currency union, global financial crisis, synchronization, structural dynamic factor model

1. Introduction

Prior to the 1997 financial crisis, the official exchange rate policy of many East Asian economies adopted U.S. dollar peg systems. While the Asian financial crisis in 1997-1998 arose from structural weaknesses in financial and monetary systems at home and experienced a sudden reversal of international capital outflow in many countries. As the region considered the crisis as an opportunity to deepen financial cooperation and integration at the regional level, the European monetary integration attracts Asian attention. Mundell (2005) argues that there are many benefits from Asian monetary integration, including: greater trade and investment; alternatives for countries forced out of the US dollar area; stronger voice in world affairs; cushion in crises; avoidance of exchange rate conflict; better monetary policy; reduced destabilizing speculation; regional decision making; and a more efficient Asian economy.

The theory of "optimum currency areas" (OCA) developed by Mundell (1961) includes: openness to the area members; product, factor and financial market integration; symmetry of shocks affecting the area members; similarity of preferences over output-inflation tradeoffs; and willingness to coordinate on supporting policies such as fiscal policies. OCA has long stressed the importance of the synchronization in cyclical economic activity for members of a monetary union. (Furceri and Karras, 2008) In particular, the higher the correlation of business cycles, the lower the stabilization cost of giving up an independent monetary policy. If a member economy's business cycle is very highly correlated with the union-wide cyclical output, then monetary policy conducted by the common central bank will be a very close substitute for the country's own independent monetary policy.

So far Asian economies have taken various steps to improve domestic financial systems and to promote capital account liberalization. There have been several

important regional initiatives, such as the ASEAN Surveillance Process, the Chiang Mai Initiative, and the Asian Bond Markets Initiative, and Asian Bond Fund. However, as pointed out by Asian Development Bank (2009), the hit of global financial crisis on Asian economies is much broader and deeper than the Asian financial crisis of 1997–1998. The US subprime mortgage collapse, shattered confidence in major global financial institutions and instruments, massive de-leveraging, crashing equity prices, and frozen credit markets reversed credit and investment flows to Asia, wounded Asian stock prices and exchange rates, and interrupted a decade of record economic expansion.

The paper casts on the question of whether the global financial crisis is a catalyst or hindrance for forming the currency union in East Asia. We disentangle the question by investigating the business cyclical synchronization before and after encountering the global financial crisis. Our findings imply that there has been a remarkably increase in the degree of cyclical synchronization.

The article is organized as follows. In the next section we discuss the data which we use in the study. In Section III we compute various measures of cyclical correlations with 12 Asia and Asian related economies and compare their values for the pre-global financial crisis and post-crisis periods. Section IV contains the conclusions and main policy implications.

2. The Data

In this paper, we rely on a large data set with 111 variables and the obscuration of 115 months from 2000M1 through 2009M7. The data covers 13 countries (or economies), namely United States, China, Hong Kong , Taiwan , Indonesia, Malaysia, Philippines, Singapore, Japan, South Korea, Thailand, Vietnam, and Euro. Each economy contains a set of macroeconomic variables is studied, such as industrial

production, merchandise export and import, unemployment rate, consumer price index, money supply (M1), policy interest rate (determined by central bank), the real effective exchange index, and stock market price. [1]

To examine whether the phenomenon of synchronization increase across countries after global financial crisis, we divide our sample into two periods, including the same number of variables. Two sample contain observations for the period from 2000M1 to 2007M6 (before US subprime mortgage event, called sub- sample period) and from 2000M1 to 2009M7 (called full sample period) respectively. In aspect of data treatment, the persistence properties of the data set is assessed by means of ADF unit root tests carried out directly on the series used in the empirical analysis. For details on the data we refer to Appendix A.

3. Model

This section briefly discusses the framework of dynamic factor model methodology. Following Stock and Watson (2005), consider a dynamic factor model:

$$X_t = \Lambda F_t + D(L)X_{t-1} + \nu_t \quad (1)$$

$$F_t = \Phi(L)F_{t-1} + \eta_t \quad (2)$$

let X_t is a $n \times 1$ vector of stationary and observed time series variables of interest, F_t is a $r \times 1$ vector of unobserved common factors, with $n \times r$ factor loadings in matrix Λ, ν_t is a $n \times 1$ idiosyncratic disturbance vector and η_t is a $r \times 1$ disturbance vector of common factor with $E[\eta_{jt}\nu_{it}] = 0$ for all i, j, t, s. $D(L)$ and $\Phi(L)$ are the matrices of polynomials in the lag operator of order p. By substituting

[1] All data in this paper are from Global Insight Database and the Website of Bank for International Settlements. In addition, because of China, Malaysia, Indonesia, Thailand, Vietnam do not publish monthly unemployment rate but only the annual unemployment rate, we exclude unemployment rate of these five countries from our data set. Moreover, the real effective exchange index of Vietnam is not collected by the database of Bank for International Settlements; therefore, this variable in our data set is also not included.

equation (2) into equation (1), the vector autoregressive form of the factor model can be represented as

$$\begin{bmatrix} F_t \\ X_t \end{bmatrix} = \begin{bmatrix} \Phi(L) & 0 \\ \Lambda\Phi(L) & D(L) \end{bmatrix} \begin{bmatrix} F_{t-1} \\ X_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{Ft} \\ \varepsilon_{Xt} \end{bmatrix} \quad (3)$$

where

$$\begin{bmatrix} \varepsilon_{Ft} \\ \varepsilon_{Xt} \end{bmatrix} = \begin{bmatrix} I \\ \Lambda \end{bmatrix} \eta_t + \begin{bmatrix} 0 \\ \nu_t \end{bmatrix} \quad (4)$$

Inverting the VAR form of equation (3) and equation (4) yields the vector moving average representation for X_t process

$$X_t = B(L)\eta_t + u_t \quad (5)$$

where $B(L) = [I - D(L)L]^{-1}\Lambda[I - \Phi(L)L]^{-1}$ and $u_t = [I - D(L)L]^{-1}\nu_t$. This vector moving average representation delivers impulse response functions and forecast error variance decompositions for X_{t+h} as a function of the horizon *h*. [2]

Identification of structural shocks

The vector moving average form of the dynamic factor model in structural form can be written as

$$X_t = B^*(L)\xi_t + C(L)\nu_t \quad (7)$$

where ξ_t is the r structural global shocks in Structural factor VAR, $B^*(L) = B(L)H^{-1}$ and the linkage of reduced form and structural form disturbances can be represented as $\xi_t = H\eta_t$, where H is invertible matrix and can be written as

$$H = \begin{bmatrix} h_{11} & & \\ \vdots & \ddots & \\ h_{r1} & \dots & h_{rr} \end{bmatrix} \quad (8)$$

and estimated by the Choleski decomposition of $\hat{\Sigma}_\eta$. η_t is achieved by assuming a lower triangular structure for the H matrix, with the ordering condition on plausible assumptions of the relative speed of adjustment to shocks.[3]

[2] In order to determine the number of dynamic factor, we applied the information criteria of Bai and Ng (2002) approach.

[3] In this paper, we partition variables into three groups, structural shocks, slow variables, and fast

4. Empirical Results

4.1 Estimation

The first step of dynamic factor modeling is the determination of the number of common factors. We apply Bai and Ng (2002) IC_{P2} information criteria approach to determinate how many factors we need to employ. According to the result of IC_{P2} information criteria of full sample period (2000M1-2009M7), we employ 2 dynamic factors (i.e., two global factors) in our factor model. The details of IC_{P2} information criteria results reported in the Appendix B.[4]

4.2 Variance Decomposition

In this paper, we follow the framework of Kose, Otrok and Whiteman (2008), to measure the relative contributions of the global factors and the idiosyncratic factor to the variations in macroeconomic variables of each country (or economy).[5] Moreover, in order to investigate the impact of global financial crisis on the comovement in each macroeconomic variable, we estimate variance decomposition over two periods: sub-sample period (2000M1-2007M6) and full sample period (2000M1-2009M7). It helps us to evaluate the difference of the variation of each variable explained by the global factors.[6] If global factors are able to account for sizeable fraction of variation of specific variable (e.g., industrial production, CPI, import, export and so on) across countries, we infer that the global factors may drive the dynamic of fluctuation in specific variable across economies, and comovement of macroeconomic variables

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variables. In the H matrix, slow variables are in the upper position and followed by the fast moving variables. The slow variables such as output and the trade variables assumed to be unaffected by structural shock within a month. It means that structural shocks have no contemporaneous impact on slow variables. In contrary to the previous case, the fast variables such as interest rate, real effective exchange rate, and stock market price have the contemporaneous relation with structure shocks. For detail on data list we refer in Appendix A.

[4] For the purpose of comparison, we apply the same number of dynamic factor to reduced sample period.

[5] Kose, Otrok and Whiteman (2008) quantify the relative importance of the global, region and country factors in explaining comovement in each observable aggregate over three distinct time periods.

[6] The global financial crisis resulted from the turbulence of US financial market in the summer of 2007 (Eichengreen, Mody, Nedeljkovic and Sarno (2009)).

among countries have increased. The following tables are the empirical results of variance decompositions.

4.2.1 Variance decomposition for the sub-sample period (2000M1-2007M6)

Table 1 displays the 12-month ahead forecast error variance of each variable among four giant economies: United States, Euro, Japan and China (G4) for sub-sample period. [7] In general, global factors are less important than idiosyncratic factor in explaining the variation of each variable in G4 countries. For example, global factors on average explain 18% of CPI variation while idiosyncratic factor is able to account for more than 80% of CPI volatility across G4 countries. In particular, global factors account for approximately 8 and 9% of export variations in United States and China respectively. In addition, the variation of Japanese CPI only captured 6% by global factors; in other words, idiosyncratic factors are the main source to drive the volatility in the Japanese CPI.

Table 2 shows the variance decomposition of each variable among Asian Newly Industrialized Economies (NIES including: Hong Kong, South Korea, Singapore, and Taiwan). Roughly 43% and 40% of the real effective exchange rate variations and policy interest rate are on average explained by global factors, respectively, while on average more than 80% of the variances of trade variables are captured by idiosyncratic factor. It implies that idiosyncratic factor seems to be playing a more important role than global factors in driving the dynamics of fluctuation in trade variables.

Another important observation is that the global factors differ quite a bit among Four Asian NIES. For instance, global factors account for approximately 54% of money supply variation in Taiwan; while the share of money supply variance

[7] Because of the unbalanced data of stock market price and unemployment rate across countries, the variance decompositions of these two variables are presented in Appendix C.

attributable to global factors is less than 20% in South Korea.

The last part of this section is that the variance decomposition of each macro time series data across ASEAN 5 economies (i.e., Indonesia, Malaysia, Philippines, Thailand and Vietnam) reported in Table 3. The empirical results of Table 3 are similar to Table 1. As we can see that the idiosyncratic factor on average accounts for a larger share of macro variables across ASEAN 5 economies. For example, the idiosyncratic factor on average capture roughly 82 and 72% of export and import variances, respectively; while it on average accounts for 79% of policy interest rate across ASEAN 5 economies.

This subsection shows the differences of impact of the global and idiosyncratic factors on macroeconomic variables across countries. However, what are their roles in explaining the volatility of these macroeconomic data change during global financial crisis? The next section will address this question.

Table 1 Variance decompositions of Four Large Economies (G4)

Country/Economy	Factors	CPI	Exchange Rate	Export	Import	Interest Rate	Industrial Production	Money Supply
China	Global	15.2	24.1	9.4	19.0	25.4	5.8	33.7
	Idiosyncratic	84.8	75.9	90.6	81.0	74.6	94.2	66.3
Euro	Global	22.2	55.7	29.7	29.7	41.9	27.5	18.2
	Idiosyncratic	77.8	44.3	70.3	70.3	58.1	72.5	81.8
Japan	Global	6.1	27.8	36.9	25.3	46.0	15.5	18.2
	Idiosyncratic	93.9	72.2	63.1	74.7	54.0	84.5	81.8
United States	Global	30.0	48.9	7.8	40.0	16.4	36.5	53.9
	Idiosyncratic	70.0	51.1	92.2	60.1	83.6	63.5	46.1
Average	Global	18.4	39.1	21.0	28.5	32.5	21.3	31.0
	Idiosyncratic	81.6	60.9	79.0	71.5	67.5	78.7	69.0

Note: estimated period: 2000M1 - 2007M6; in percent.

Table 2 Variance decompositions of Four Asian NIES

Country/Economy	Factors	CPI	Exchange Rate	Export	Import	Interest Rate	Industrial Production	Money Supply
Hong Kong	Global	22.6	48.7	9.1	12.2	33.2	3.8	19.5
	Idiosyncratic	77.4	51.3	90.9	87.8	66.8	96.2	80.5
Singapore	Global	3.8	58.9	20.9	13.3	78.3	21.6	52.2
	Idiosyncratic	96.2	41.1	79.1	86.7	21.7	78.4	47.8
South Korea	Global	19.2	26.3	12.5	25.8	36.2	18.4	18.4
	Idiosyncratic	80.8	73.7	87.5	74.2	63.8	81.6	81.6
Taiwan	Global	10.6	39.4	17.9	14.9	12.3	16.1	54.3
	Idiosyncratic	89.4	60.6	82.1	85.1	87.7	83.9	45.7
Average	Global	14.0	43.3	15.1	16.5	40.0	15.0	36.1
	Idiosyncratic	86.0	56.7	84.9	83.5	60.0	85.0	63.9

Note: estimated period: 2000M1 - 2007M6; in percent.

Table 3 Variance decompositions of ASEAN 5

Country/Economy	Factors	CPI	Exchange Rate	Export	Import	Interest Rate	Industrial Production	Money Supply
Indonesia	Global	16.4	36.8	19.5	35.2	9.6	43.6	19.1
	Idiosyncratic	83.6	63.2	80.5	64.8	90.4	56.4	80.9
Malaysia	Global	34.3	45.5	9.6	12.5	27.0	11.2	52.0
	Idiosyncratic	65.7	54.5	90.4	87.5	73.0	88.8	48.0
Philippines	Global	43.4	62.0	16.9	27.7	27.9	45.3	48.8
	Idiosyncratic	56.6	38.0	83.1	72.3	72.1	54.7	51.2
Thailand	Global	29.9	75.3	17.7	22.5	33.0	27.6	12.0
	Idiosyncratic	70.1	24.7	82.3	77.5	67.0	72.4	88.0
Vietnam	Global	7.3	-	24.6	41.8	8.8	13.4	45.5
	Idiosyncratic	92.7	-	75.4	58.2	91.2	86.6	54.5
Average	Global	26.3	54.9	17.6	27.9	21.3	28.2	35.5
	Idiosyncratic	73.7	45.1	82.4	72.1	78.7	71.8	64.5

Note: estimated period: 2000M1 - 2007M6; in percent. The real effective exchange rate of Vietnam is not available in our data set.

4.2.2 Variance decomposition for the full sample period (2000M1-2009M7)

To investigate the evolution of the roles played by the global factors and idiosyncratic factor in driving the dynamics of volatility in all macro series data across countries. We estimate the variance decompositions for the full sample period which contain the period of global financial crisis which was started in the summer of 2007. The results of variance decompositions for full sample period across countries (or economies) are presented in Table 4, Table5 and Table 6.[8]

Do the roles played by global factors among the economies alter after global financial crisis? There are three major findings: First, global factors on average explain a larger fraction of variations of CPI and industrial production in the full sample period than in the sub-sample period. For instance, on average, the percentage

[8] See footnote 4.

of industrial production variances across G4 economies can be explained by global factors increase 48% in full sample period, from 21% rise to 69%. In the mean time, the volatility of CPI in *NIES*s and ASEAN 5 economies on average captured by global factors increases from 14% and 26% to 57% and 63%, respectively.

Second, global factors explain larger share of the trade variables variations in full sample period than it does during the sub-sample period. For G4 economies, the percentage of global factors on average account for export variation rises from 21% to 77%. Moreover, the volatility of export in Four Asian NIES on average explained by global factors soars from 15% to 78%.

Third, for most Asian economies (e.g., Singapore, Taiwan , Philippines, Malaysia, Thailand), the global factors account for a smaller portion of the variance of real effective exchange rate during the full sample period than it does during the sub-sample period. It means that the impact of global factors shocks on the real effective exchange rate of these countries become insignificant after global financial crisis. In particular, global factors account for the variation of Singapore real effective exchange rate drops a total of 45%, from 59% to 14%. Moreover, the variance of Malaysia real effective exchange rate captured by global factor decline by 41%, from 45% to 4%.

Table 4 Variance decompositions of Four Large Economies (G4)

Country/Economy	Factors	CPI	Exchange Rate	Export	Import	Interest Rate	Industrial Production	Money Supply
China	Global	63.1	34.9	64.0	78.8	70.7	49.3	59.7
	Idiosyncratic	36.9	65.1	36.0	21.2	29.3	50.7	40.3
Euro	Global	87.4	13.4	74.5	74.4	67.0	88.0	14.9
	Idiosyncratic	12.6	86.6	25.5	25.6	33.0	12.0	85.1
Japan	Global	74.4	55.1	85.9	87.5	43.8	87.6	11.4
	Idiosyncratic	25.6	44.9	14.1	12.5	56.2	12.4	88.6
United States	Global	82.0	69.5	85.4	92.5	29.1	51.7	62.4
	Idiosyncratic	18.0	30.5	14.6	7.5	70.9	48.3	37.6
Average	Global	76.7	43.2	77.4	83.3	52.6	69.1	37.1
	Idiosyncratic	23.3	56.8	22.6	16.7	47.4	30.9	62.9

Note: estimated period: 2000M1 - 2009M7; in percent.

Table 5 Variance decompositions of Four Asian NIES

Country/Economy	Factors	CPI	Exchange Rate	Export	Import	Interest Rate	Industrial Production	Money Supply
Hong Kong	Global	45.4	57.2	65.6	65.0	51.9	0.8	29.0
	Idiosyncratic	54.6	42.8	34.4	35.0	48.1	99.2	71.0
Singapore	Global	67.4	13.7	85.0	85.3	6.0	32.1	36.3
	Idiosyncratic	32.6	86.3	15.0	14.7	94.0	67.9	63.7
South Korea	Global	69.9	54.9	79.2	88.0	75.4	83.5	9.5
	Idiosyncratic	30.1	45.1	20.8	12.0	24.6	16.5	90.5
Taiwan	Global	46.4	14.3	80.1	68.3	71.6	78.5	53.1
	Idiosyncratic	53.6	85.7	19.9	31.7	28.4	21.5	46.9
Average	Global	57.3	35.0	77.5	76.7	51.2	48.7	32.0
	Idiosyncratic	42.7	65.0	22.5	23.3	48.8	51.3	68.0

Note: estimated period: 2000M1 - 2009M7; in percent.

Table 6 Variance decompositions of ASEAN 5

Country/Economy	Factors	CPI	Exchange Rate	Export	Import	Interest Rate	Industrial Production	Money Supply
Indonesia	Global	30.1	11.2	68.2	56.1	23.8	3.8	53.5
	Idiosyncratic	69.9	88.8	31.8	43.9	76.2	96.2	46.5
Malaysia	Global	66.3	4.2	83.8	79.6	62.9	67.3	54.2
	Idiosyncratic	33.7	95.8	16.2	20.4	37.1	32.7	45.8
Philippines	Global	64.7	4.8	72.9	76.3	41.7	31.2	18.0
	Idiosyncratic	35.3	95.2	27.1	23.7	58.3	68.8	82.0
Thailand	Global	88.8	36.9	80.3	77.4	41.6	82.0	11.6
	Idiosyncratic	11.2	63.1	19.7	22.6	58.4	18.0	88.4
Vietnam	Global	66.1	-	55.1	54.5	53.9	39.3	34.2
	Idiosyncratic	33.9	-	44.9	45.5	46.1	60.7	65.8
Average	Global	63.2	14.3	72.1	68.8	44.8	44.7	34.3
	Idiosyncratic	36.8	85.7	27.9	31.2	55.2	55.3	65.7

Note: estimated period: 2000M1 - 2009M6; in percent. The real effective exchange rate of Vietnam is not available in our data set.

4.3 Impulse Response Function Analysis

In this section, there are two questions of interest: First, what is the impact of US financial turbulence on international macroeconomic dynamics after global financial crisis? Second, which country would lead the global economy recover significantly among G4 economies?

We address these questions by designing five external economic shocks such as market volatility index (VIX) shock (as proxy variable for US financial turbulence), and industrial production shocks from G4 economies (as proxy variable for economic recovery). To examine the extent of the impact on macroeconomic variables across countries when each external shock rise by 1% which is assessed by means of the impulse response functions.[9]

[9] In this paper, we use the VIX as the proxy variable for the turbulence in US financial market. The VIX is the daily closing values of the CBOE Market Volatitity Index calculated by option price which base on S&P500 index. It is commonly used as the measure of market uncertainty, and it often referred

The impulse responses of different countries to VIX shock over 12-month horizon are reported in the Fig. 1, Fig. 2 and Fig. 3. By impulse response function, there are three main interesting findings: First, except for Hong Kong and Indonesia, the dynamic response of the industrial production in each country is decreased by VIX shock immediately. It means that the disturbance from US financial market has a negative effect on industrial production activity in most countries. If we focus on the dynamic reaction in region level, we can find that Japan, Taiwan, and Malaysia are influenced most among G4, NIES, and ASEAN 5 respectively.

Second, the dynamic reactions of different countries to VIX shock are consistent. For example, the impulse response of CPI in China, Japan, Taiwan , Singapore, Vietnam and Malaysia are made lower by VIX shock significantly while the other countries have positive reactions. Third, despite there exists time lag and different response extent, US financial disturbance lower the trade variables permanently in all economies, except for Euro. For instance, the trade of Japan and US are affected most in G4 economies; the import of Taiwan, the export of South Korea and Singapore influenced most in NIES; moreover, on average, the trade variables of Thailand are decreased most in ASEAN 5.

To shed light on the question of which country among G4 can lead the global economy recover effectively, we investigate the impulse responses of key variables such as industrial production, CPI, export and import, to G4 economy IP rise shocks. The Fig. 4 through Fig. 7 depict the impulse responses of key variables to G4's IP shocks. A number of interesting findings revealed from the impulse response analysis: First, the order of the effect strength of IP shocks among G4 economies are US, Japan, Euro and China. This result shows that US still plays an important role in leading the

to as the fear index. As a result, the VIX is always used to as investor sentiment (Graham, Nikkinen, and Sahlström (2003), Pedersen (2009)). A high value of VIX corresponds to a more volatile market; therefore it means that investor consider the situation of financial market will become worse.

global economy recovery. Second, the directions of impulse responses of key variables to IP shocks are analogous; the only difference is the degree of reaction. For example, Japan, Taiwan and Thailand are boosted most by G4's IP shocks in different regions, respectively. In the aspect of trade variables, the export of Euro, Singapore and Malaysia are increased most while the import of China, Taiwan and Vietnam are boosted most in G4, Four Asian NIES, ASEAN 5 respectively.

From the results of this paper, the synchronization increases after global financial crisis. In particular, the disturbance from US financial market lowers the trade activity among Asian countries. In addition, from the evidence of impulse response to G4's IP shocks, it shows that US still plays an important role in boosting global economy.

5. Conclusion

In this paper, we have investigated the impact of the global financial crisis on the monetary integration in East Asia by means of a large-scale structural dynamic factor model. This framework allows us to simultaneously assess the responses of a large set of real and nominal variables and investigate the role of many transmission channels, including industrial production and market volatility.

The impulse responses of different economies to US financial disturbance over 12-month horizon show a negative effect on industrial production activity in most countries. Despite there exists time lag and different response extent, VIX shock lowers the trade variables permanently in all economies, except for Euro. In addition, the rank of the effect strength of industrial production shocks among G4 economies are US, Japan, Euro and China. This result shows that US still plays an important role in leading the global economy recovery.

From the variance decomposition analysis, we find that the global factors on average explain a larger fraction of variations in the period covering the crisis than in

the period before the crisis. However, the global factor plays smaller role after the global crisis on the real effective exchange rate in most Asian emerging economy except China, Hong Kong and Korea. The global factor also plays smaller role on money supply on Euro, Japan, and six out of nine Asian emerging economies.

Although the theory of "optimum currency areas" (OCA), developed by Mundell (1961) and McKinnon (1963), predicts that the economies are better off adopting permanently fixed exchange rates through international trade and factor movement. Our empirical results show there exists decoupling on some variables in East Asian. Therefore the single currency is too early to adopt in East Asia. However, Mundell (2005), Kawai (2008), and Duan 2009) suggest that multiple-currency monetary union is most politically feasible at this stage of integration. And the European Monetary Unit (EMU) 1999-2002, before the abolition of national currencies is the model Asian region can follow. The single currency is only possible at a later stage of political integration in East Asia.

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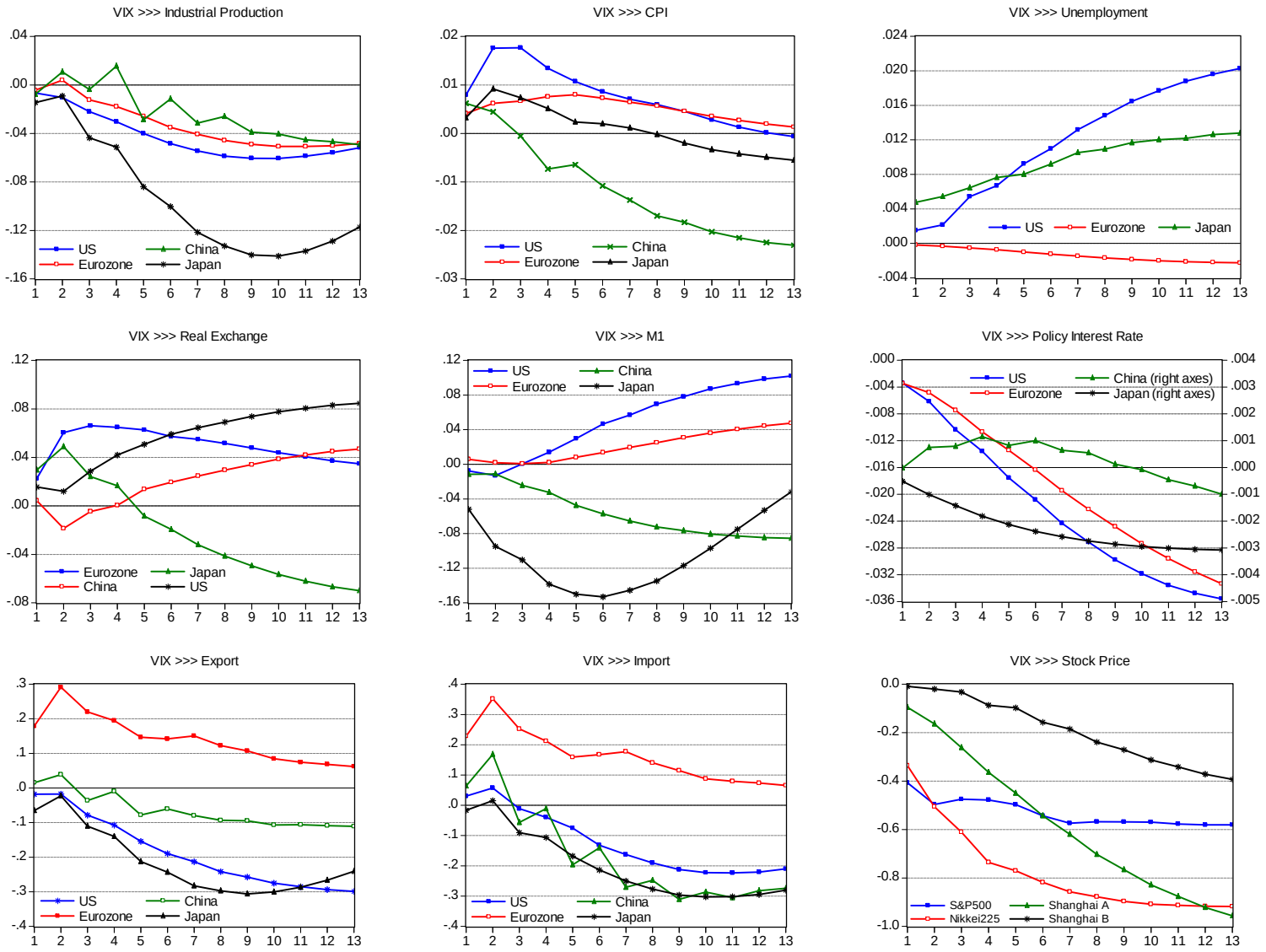

Fig. 1 VIX Shock to G4 economies

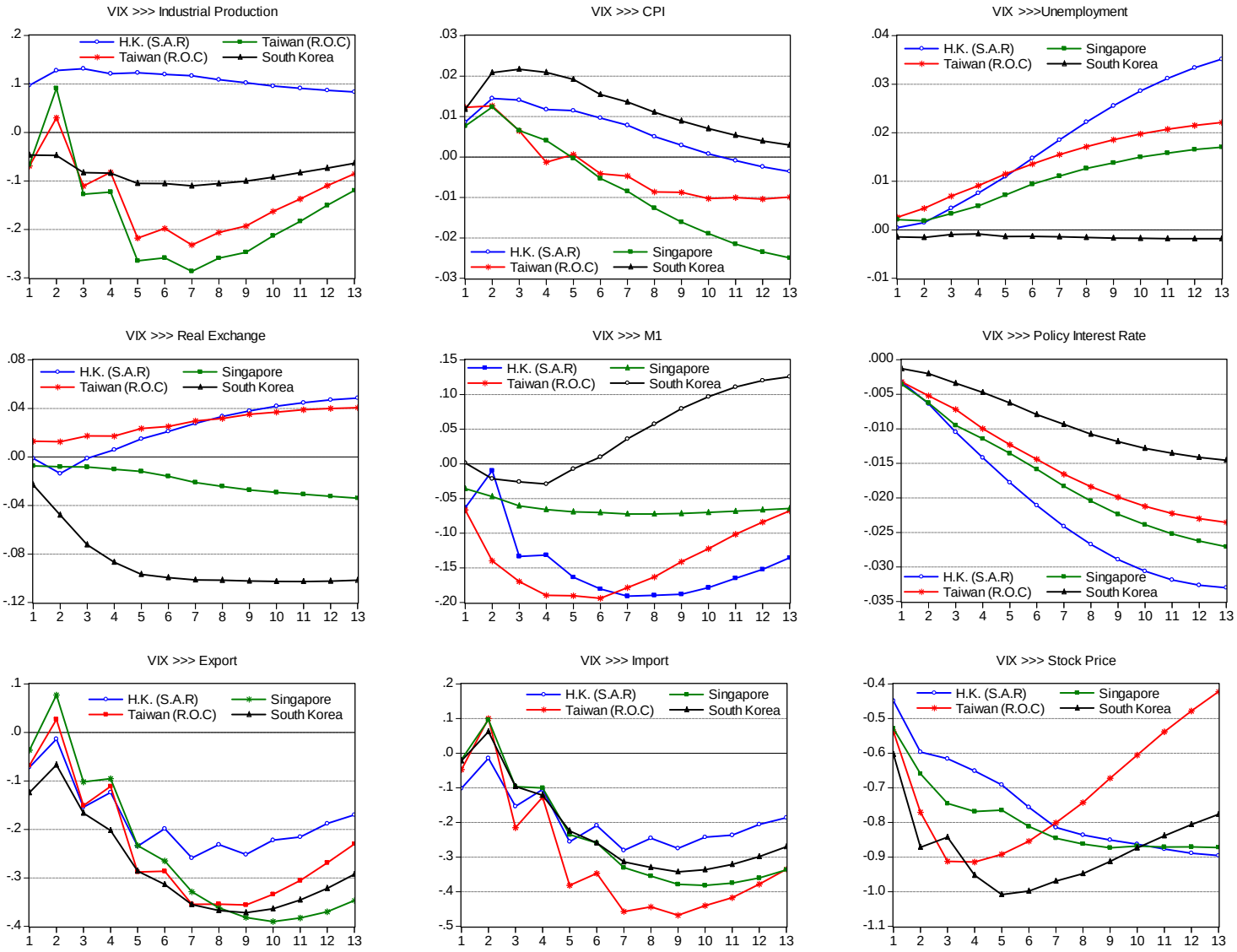

Fig. 2 VIX Shock to Four Asian NIES

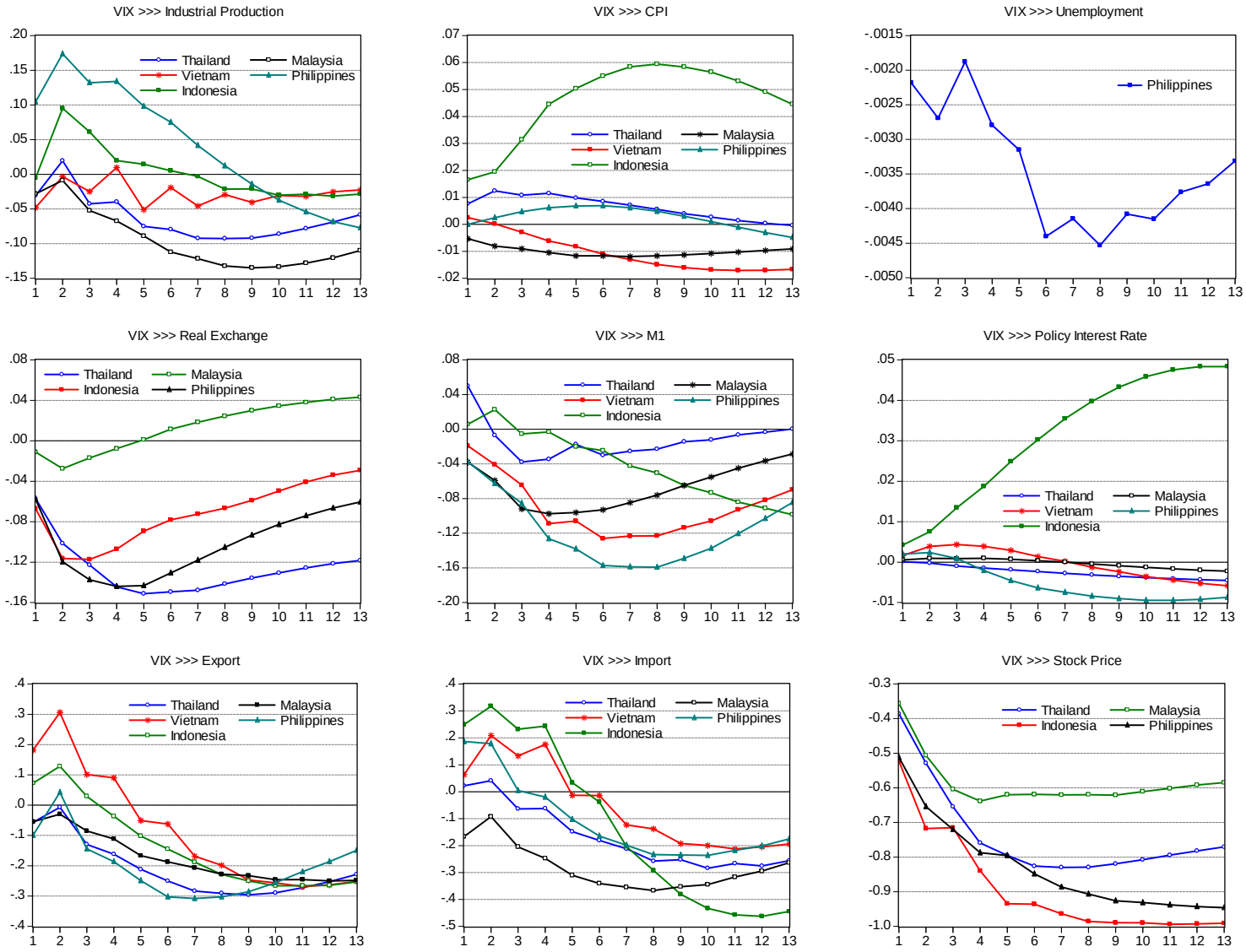

Fig. 3 VIX Shock to ASEAN 5 economies

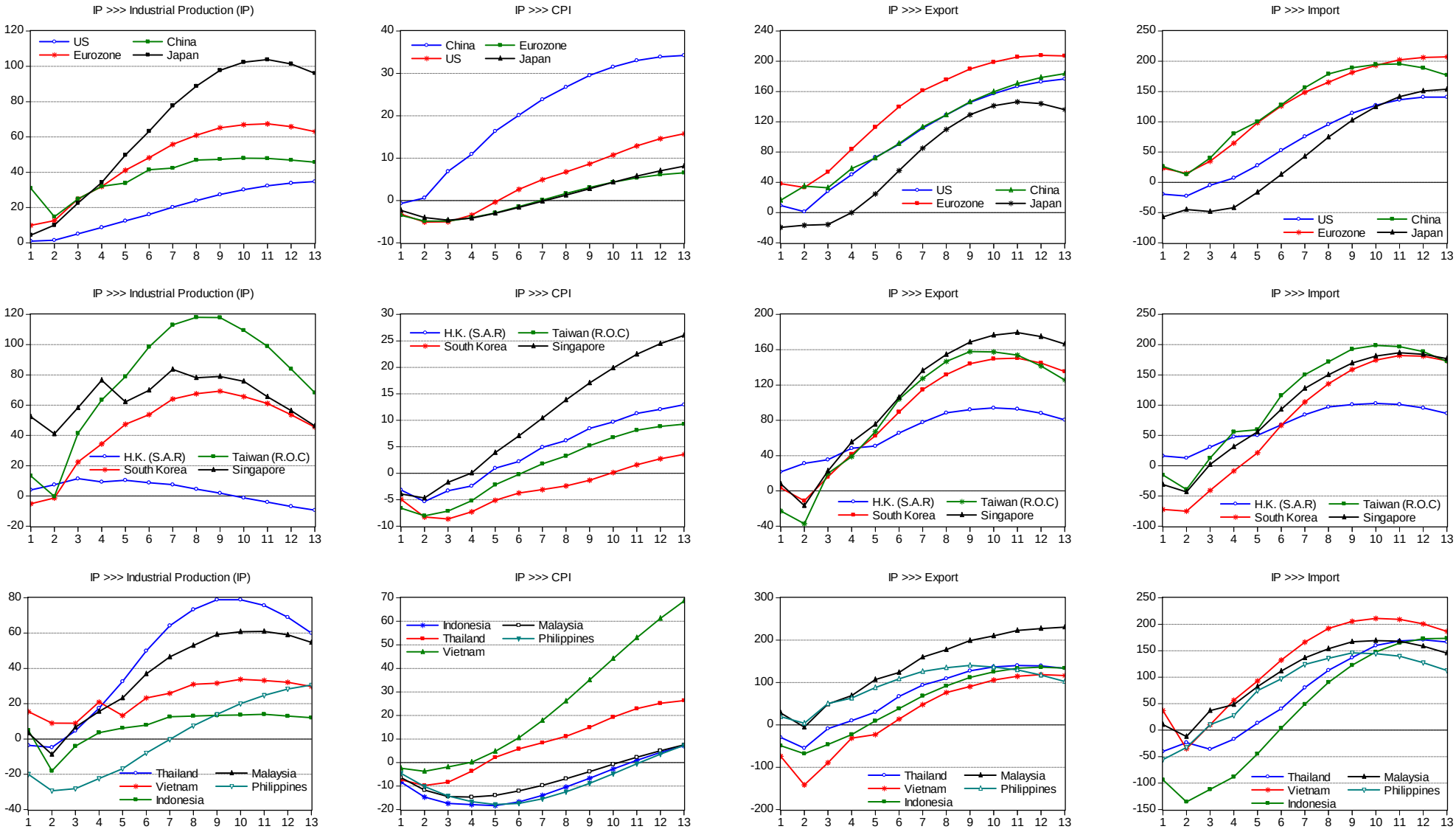

Fig. 4 US Industrial Production Shock to each country (economies)

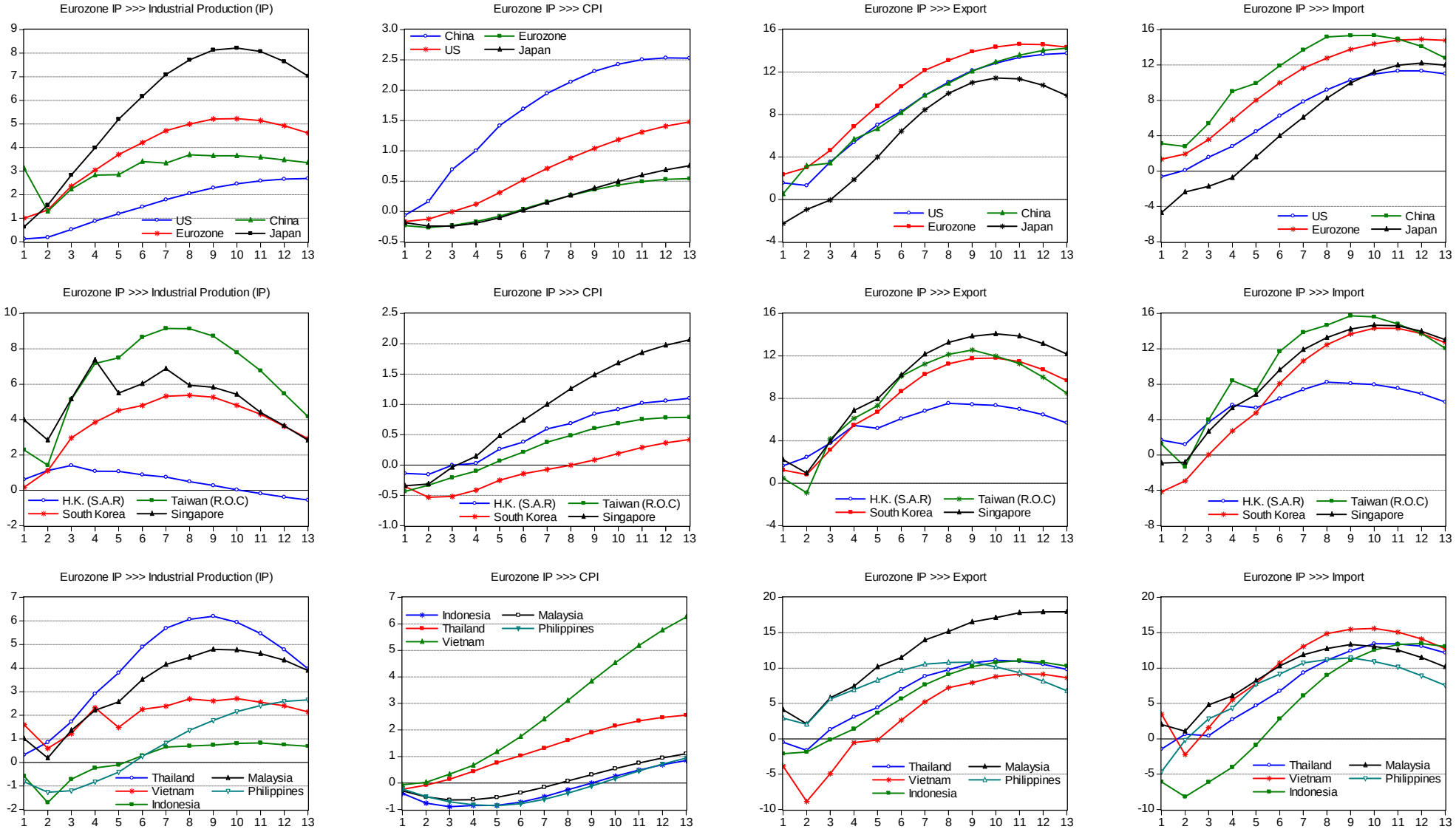

Fig. 5 Euro Industrial Production Shock to each county (economies)

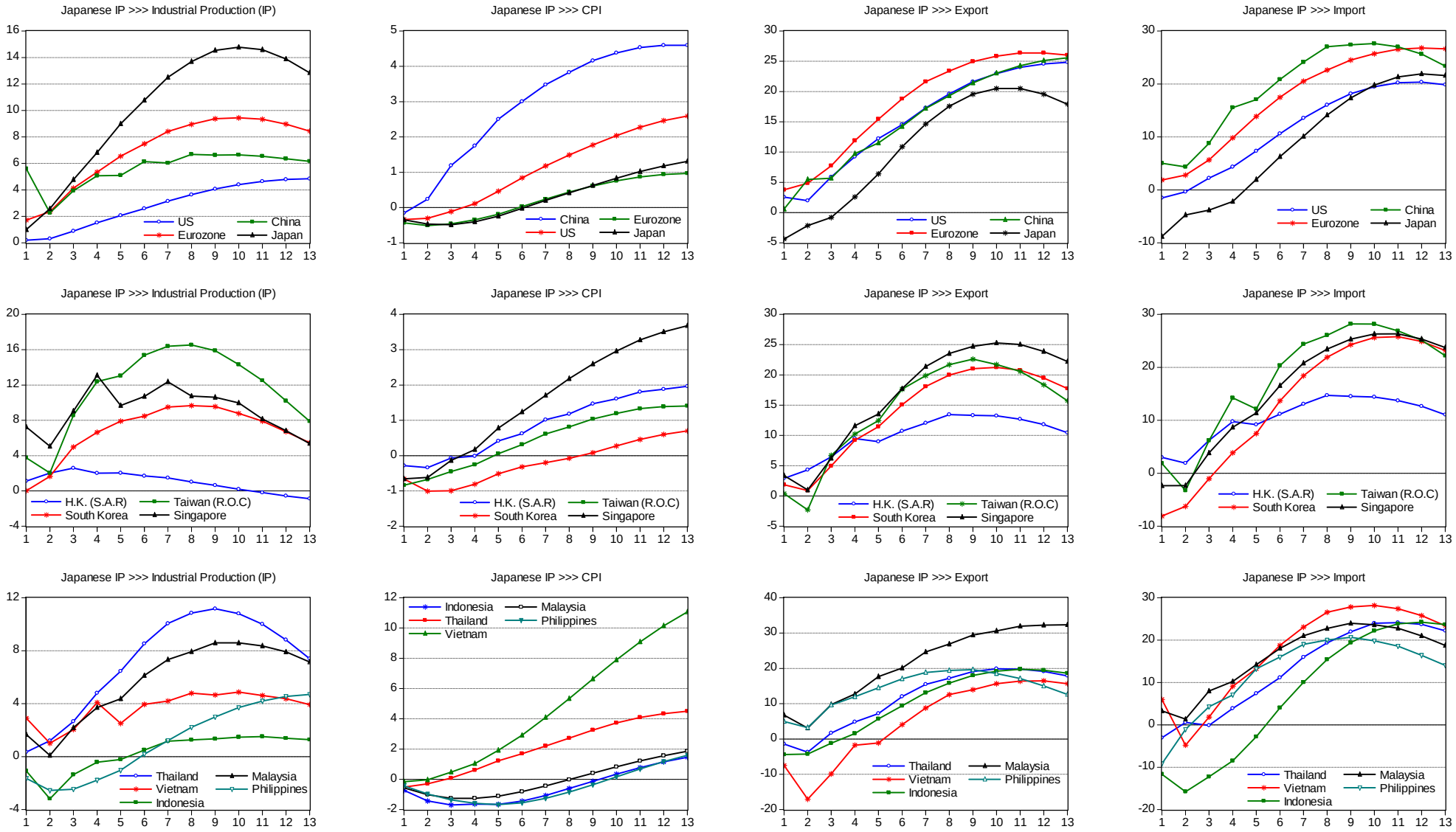

Fig. 6 Japanese Industrial Production Shock to each county (economies)

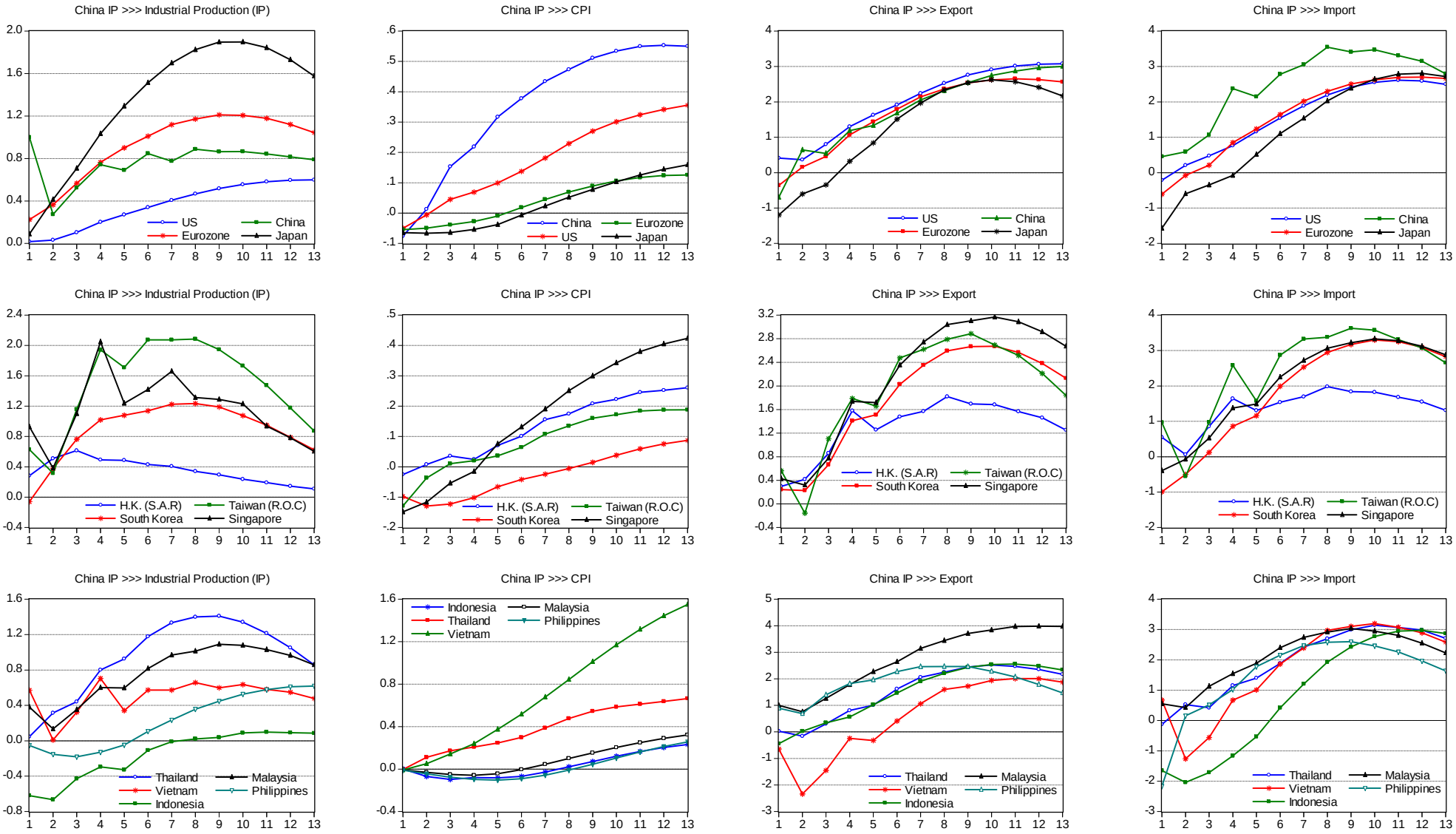

Fig. 7 China Industrial Production Shock to each country (economies)

Appendix A

Table A1 lists the name of each variable, sample period, the transformation applied to the series and definition of slow or fast for response speed. All data in this paper are taken from Global Insight Database and the Website of Bank for International Settlements. In the treatment column, "1" donates level value, "2" donates first difference of level value, "3" donates second difference of level value, "4" donates logarithm and "5" donates first difference of the logarithm. In the last column, "F" donates fast variable and "S" donates slow variable.

Table A1 Data transformations and definitions

Country/Economy	Variable Name	Period	Treatment	Slow/Fast
China	Shanghai A Stock Index	2000M1:2009M7	5	F
China	Shanghai B Stock Index	2000M1:2009M7	5	F
China	Consumer Price Index (annual growth rate)	2000M1:2009M7	2	S
China	Real effective exchange rate	2000M1:2009M7	2	F
China	Merchandise Exports - Growth	2000M1:2009M7	2	S
China	Merchandise Imports - Growth	2000M1:2009M7	1	S
China	Policy Interest Rate	2000M1:2009M7	2	F
China	Industrial Production - Growth	2000M1:2009M7	2	S
China	Money Supply, M1 - Growth	2000M1:2009M7	2	F
Euro	Consumer Price Index (annual growth rate)	2000M1:2009M7	1	S
Euro	Real effective exchange rate	2000M1:2009M7	2	F
Euro	Merchandise Exports - Growth	2000M1:2009M7	2	S
Euro	Merchandise Imports - Growth	2000M1:2009M7	2	S
Euro	Policy Interest Rate	2000M1:2009M7	2	F
Euro	Industrial Production - Growth	2000M1:2009M7	1	S
Euro	Money Supply, M1 - Growth	2000M1:2009M7	2	F
Euro	Unemployment Rate	2000M1:2009M7	1	S
Hong Kong	Hang Seng Index	2000M1:2009M7	5	F
Hong Kong	Consumer Price Index (annual growth rate)	2000M1:2009M7	1	S
Hong Kong	Real effective exchange rate	2000M1:2009M7	1	F
Hong Kong	Merchandise Exports - Growth	2000M1:2009M7	1	S
Hong Kong	Merchandise Imports - Growth	2000M1:2009M7	1	S
Hong Kong	Policy Interest Rate	2000M1:2009M7	1	F
Hong Kong	Industrial Production - Growth	2000M1:2009M7	5	S

Hong Kong	Money Supply, M1 - Growth	2000M1:2009M7	1	F
Hong Kong	Unemployment Rate	2000M1:2009M7	2	S
Indonesia	Indonesia JSX Index	2000M1:2009M7	5	F
Indonesia	Consumer Price Index (annual growth rate)	2000M1:2009M7	1	S
Indonesia	Real effective exchange rate	2000M1:2009M7	2	F
Indonesia	Merchandise Exports - Growth	2000M1:2009M7	1	S
Indonesia	Merchandise Imports - Growth	2000M1:2009M7	1	S
Indonesia	Policy Interest Rate	2000M1:2009M7	1	F
Indonesia	Industrial Production - Growth	2000M1:2009M7	1	S
Indonesia	Money Supply, M1 - Growth	2000M1:2009M7	2	F
Japan	NK-225 Index	2000M1:2009M7	5	F
Japan	Consumer Price Index (annual growth rate)	2000M1:2009M7	2	S
Japan	Real effective exchange rate	2000M1:2009M7	2	F
Japan	Merchandise Exports - Growth	2000M1:2009M7	1	S
Japan	Merchandise Imports - Growth	2000M1:2009M7	1	S
Japan	Policy Interest Rate	2000M1:2009M7	2	F
Japan	Industrial Production - Growth	2000M1:2009M7	1	S
Japan	Money Supply, M1 - Growth	2000M1:2009M7	2	F
Japan	Unemployment Rate	2000M1:2009M7	2	S
Malaysia	Kuala Lumpur-Stock Index	2000M1:2009M7	5	F
Malaysia	Consumer Price Index (annual growth rate)	2000M1:2009M7	1	S
Malaysia	Real effective exchange rate	2000M1:2009M7	2	F
Malaysia	Merchandise Exports - Growth	2000M1:2009M7	2	S
Malaysia	Merchandise Imports - Growth	2000M1:2009M7	1	S
Malaysia	Policy Interest Rate	2000M1:2009M7	2	F
Malaysia	Industrial Production - Growth	2000M1:2009M7	1	S
Malaysia	Money Supply, M1 - Growth	2000M1:2009M7	1	F
Philippines	Manila-Stock Index	2000M1:2009M7	5	F
Philippines	Consumer Price Index (annual growth rate)	2000M1:2009M7	1	S
Philippines	Real effective exchange rate	2000M1:2009M7	2	F
Philippines	Merchandise Exports - Growth	2000M1:2009M7	1	S
Philippines	Merchandise Imports - Growth	2000M1:2009M7	1	S
Philippines	Policy Interest Rate	2000M1:2009M7	2	F
Philippines	Industrial Production - Growth	2000M1:2009M7	1	S
Philippines	Money Supply, M1 - Growth	2000M1:2009M7	1	F
Philippines	Unemployment Rate	2000M1:2009M7	2	S
Singapore	Strait Times Index	2000M1:2009M7	5	F
Singapore	Consumer Price Index (annual growth rate)	2000M1:2009M7	2	S

Singapore	Real effective exchange rate	2000M1:2009M7	2	F
Singapore	Merchandise Exports - Growth	2000M1:2009M7	1	S
Singapore	Merchandise Imports - Growth	2000M1:2009M7	1	S
Singapore	Policy Interest Rate	2000M1:2009M7	2	F
Singapore	Industrial Production - Growth	2000M1:2009M7	1	S
Singapore	Money Supply, M1 - Growth	2000M1:2009M7	1	F
Singapore	Unemployment Rate	2000M1:2009M7	2	S
South Korea	South Korea-Stock Index	2000M1:2009M7	4	F
South Korea	Consumer Price Index (annual growth rate)	2000M1:2009M7	2	S
South Korea	Real effective exchange rate	2000M1:2009M7	2	F
South Korea	Merchandise Exports - Growth	2000M1:2009M7	1	S
South Korea	Merchandise Imports - Growth	2000M1:2009M7	1	S
South Korea	Policy Interest Rate	2000M1:2009M7	2	F
South Korea	Industrial Production - Growth	2000M1:2009M7	1	S
South Korea	Money Supply, M1 - Growth	2000M1:2009M7	1	F
South Korea	Unemployment Rate	2000M1:2009M7	1	S
Taiwan	TSE Weighted Stock Index	2000M1:2009M7	4	F
Taiwan	Consumer Price Index (annual growth rate)	2000M1:2009M7	1	S
Taiwan	Real effective exchange rate	2000M1:2009M7	1	F
Taiwan	Merchandise Exports - Growth	2000M1:2009M7	1	S
Taiwan	Merchandise Imports - Growth	2000M1:2009M7	1	S
Taiwan	Policy Interest Rate	2000M1:2009M7	1	F
Taiwan	Industrial Production - Growth	2000M1:2009M7	1	S
Taiwan	Money Supply, M1 - Growth	2000M1:2009M7	2	F
Taiwan	Unemployment Rate	2000M1:2009M7	2	S
Thailand	Bangkok Set Stock Index	2000M1:2009M7	5	F
Thailand	Consumer Price Index (annual growth rate)	2000M1:2009M7	2	S
Thailand	Real effective exchange rate	2000M1:2009M7	2	F
Thailand	Merchandise Exports - Growth	2000M1:2009M7	1	S
Thailand	Merchandise Imports - Growth	2000M1:2009M7	1	S
Thailand	Policy Interest Rate	2000M1:2009M7	2	F
Thailand	Industrial Production - Growth	2000M1:2009M7	1	S
Thailand	Money Supply, M1 - Growth	2000M1:2009M7	1	F
United States	VIX Index	2000M1:2009M7	5	F
United States	N.Y. S&P 500 Stock Index	2000M1:2009M7	5	F
United States	Consumer Price Index (annual growth rate)	2000M1:2009M7	2	S
United States	Real effective exchange rate	2000M1:2009M7	2	F
United States	Merchandise Exports - Growth	2000M1:2009M7	2	S

United States	Merchandise Imports - Growth	2000M1:2009M7	1	S
United States	Policy Interest Rate	2000M1:2009M7	1	F
United States	Industrial Production - Growth	2000M1:2009M7	1	S
United States	Money Supply, M1 - Growth	2000M1:2009M7	2	F
United States	Unemployment Rate	2000M1:2009M7	2	S
Vietnam	Consumer Price Index (annual growth rate)	2000M1:2009M7	1	S
Vietnam	Merchandise Exports - Growth	2000M1:2009M7	1	S
Vietnam	Merchandise Imports - Growth	2000M1:2009M7	1	S
Vietnam	Policy Interest Rate	2000M1:2009M7	2	F
Vietnam	Industrial Production - Growth	2000M1:2009M7	1	S
Vietnam	Money Supply, M1 - Growth	2000M1:2009M7	1	F

Appendix B

Table B1 Estimation of Number of Dynamic Factors *r*

Number of dynamic factors (*r*)	q=1	q=2	q=3	q=4	q=5	q=6	q=7
r=1	-0.776	-0.846	-0.873	-0.918	-0.952	-0.984	-1.022
r=2		-0.867	-0.897	-0.934	-0.968	-1.006	**-1.046**
r=3			-0.904	-0.934	-0.974	-1.004	-1.044
r=4				-0.916	-0.957	-0.986	-1.030
r=5					-0.929	-0.960	-1.006
r=6						-0.935	-0.983
r=7							-0.961

Notes: The sample period is from 2000M1 through 2009M7; each IC_{P2} criteria for the number of static factors *q* given in the column and the number of dynamic factors *r* given in the row.

Appendix C

Table C1 Variance decompositions of Stock Price

Stock Market Index	Global	Idiosyncratic	Global	Idiosyncratic
	2000M1-2007M6		2000M1-2009M7	
S&P 500 Index	55	45	77	23
Shanghai A Stock Index	78	22	83	17
Shanghai B Stock Index	75	25	79	21
TSE Weighted Stock Index	75	25	78	22
Indonesia JSX Index	48	52	73	27
Kuala Lumpur-Stock Index	82	18	86	14
NK-225 Index	39	61	65	35
South Korea-Stock Index	42	58	72	28
Hang Seng Index	54	46	87	13
VIX Index	9	91	41	59
Manila-Stock Index	53	47	68	32
Bangkok Set Stock Index	35	65	76	24
Strait Times Index	66	34	83	17
Average	55	45	74	26

Note: estimated period: 2000M1 - 2007M6; in percent.

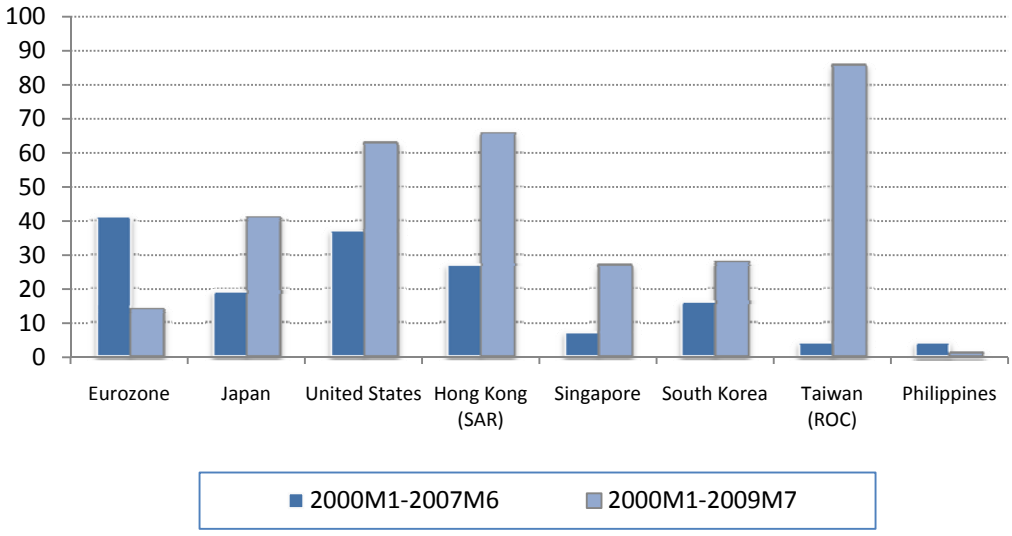

Fig. C1 Variance of Unemployment rate Explained by the Global Factors (%)