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Managing Economic Shocks and Macroeconomic Coordination in an Integrated Region: ASEAN Beyond 2015[1]

Ruperto MAJUCA
De La Salle University, Manila

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Abstract: We examine the transmission of economic shocks both from the rest of the world into the ASEAN region, as well as the transmission of such shocks from the rest of the row and ASEAN into a typical AMS. The approach we take is three-pronged. First, we will look into the trade and financial linkages of a "typical" AMS. By "typical", we mean representative AMSs, e.g., Singapore for a developed country, Philippines or Indonesia for ASEAN5 economies and Vietnam for the CLMV (Cambodia, Lao, Myanmar, Vietnam) economies. We look at trade and financial linkages between these typical AMSs, the ASEAN as a whole, and the rest of the world. Second, we employ a specialized type of vector autoregression (VAR) model to decompose the shocks into trade shocks, financial shocks, and commodity price shocks. This we do for the typical AMS in relation to ASEAN and the rest of the world. By decomposing the shocks into their constituent components, we hope to glean important insights on, among others, which component shocks are more important for the typical AMS. Third, we estimate a global projection model in order to analyze how key macroeconomic variables (GDP, inflation, unemployment rate, interest rate, and exchange rate) are interrelated across regions (e.g., U.S., EU, Japan, China) and how these shocks are transmitted across these regions, and from these regions into ASEAN and a typical AMS. This way, we hope to trace how a shock originating from the U.S., for example, will impact EU's, Japan's, China's, and eventually ASEAN's, and a typical AMS's GDP, inflation, unemployment, interest rate, and exchange rates. We then conclude with an analysis of the implications of these on how to manage the economic shocks in an integrated region, as well as the implications for macroeconomic policy coordination in the region.

Keywords**:** regional integration, macroeconomic shocks, spillovers, vector autogressions, global projection model, Bayesian estimation
JEL Classification**:** C32, C51, E31, E32, E52, F15, F41, F42, F43, F47

1. Introduction

This paper analyses the economic and financial interlinkages between the ASEAN region and the rest of the world, as well as the linkages within ASEAN and between ASEAN member states (AMSs). We are interested in answering a set of interrelated questions. How are ASEAN member countries economically and financially linked to each other and the rest of the world? How should a shock, originating from, say, the United States or Europe affect the ASEAN region and the individual AMSs? How are those shocks transmitted? For example, an event in the U.S. can impact a typical AMS not only directly, but also indirectly through its impact to the ASEAN region as an aggregate. How then does one decompose those direct and indirect impacts? Also, what are the channels through which those shocks are transmitted -- through the trade channel, the financial channel, or the commodity price channel? What are the ripple effects of such a shock to ASEAN's GDP growth, inflation, unemployment, interest rates, and exchange rates? What are the ripple effects to a typical AMS's GDP growth, inflation, unemployment, interest rates, and exchange rate?

We hope that such a detailed and nuanced analysis will give valuable insights on how to manage economic and financial shocks in an integrated world, both at the national and at the regional level, as we go forward to a more integrated ASEAN beyond 2015. A by-product of such a policy analysis are the implications for managing the economic shocks at the regional level, say by coordination of macroeconomic policies among AMSs in the region.

Our findings indicate that ASEAN economies, whether a developed economy like Singapore, or part of ASEAN-5 like the Philippines, or a CLMV country like Vietnam, are increasing integrated with ASEAN and the world, not only through the trade channel, but also through the financial channel, among others. This highlights the importance of understanding and quantifying how ASEAN economies are affected by shocks that originate elsewhere. In this paper, we find that a typical shock to the rest of the world is about 0.5 percentage point on impact, increasing to about 1.3 percentage point after a year. As a result of this, ASEAN GDP growth will rise by about 0.4 percentage point on impact and accumulates to about 0.9 percentage point after a year. In response, a typical AMS economy's GDP may rise as a result of direct impact from the originator of the shock (e.g., the U.S.) as well as through the indirect impact through its effect on ASEAN. In this paper, we detail how each representative AMS, e.g., Singapore, Indonesia, Philippines, or Vietnam, are impacted, directly or indirectly, by these shocks.

Our results also indicate that all three channels -- financial, trade, and commodity price channels -- are important. In this paper, we quantify the magnitude of each of these channels for representative AMSs.

So too, in this paper, we tease out and quantify how ASEAN's and a "typical" AMS' (e.g., the Philippines') macroeconomic variables (GDP, inflation, unemployment rate, interest rate, and exchange rate) are impacted by shocks originating from the U.S., EU, Japan, and China. Our results indicate that the greatest influence on ASEAN GDP are shocks from ASEAN itself, followed by shocks from US, China, Japan, and EU, in that order. Our results also indicate that, for a "typical" AMS, e.g., the Philippines, the domestic aggregate demand shock has the strongest influence on economy's macroeconomic fluctuations. Next to the Philippines, the U.S. has the strongest influence on Philippine GDP fluctuations, followed by China and Japan, and then by the ASEAN and the EU, in that order. Thus, a shock to Philippine aggregate demand results in a 0.5 percent decrease in the log of real Philippine GDP. The U.S. shock's impact, represents about 1/7 of the domestic shock's impact, followed by Japan and China which both have an impact of about 1/10 relative to the Philippines', and then by ASEAN and the EU, which both have a relative impact of about 1/17 of the size of the Philippine impact.

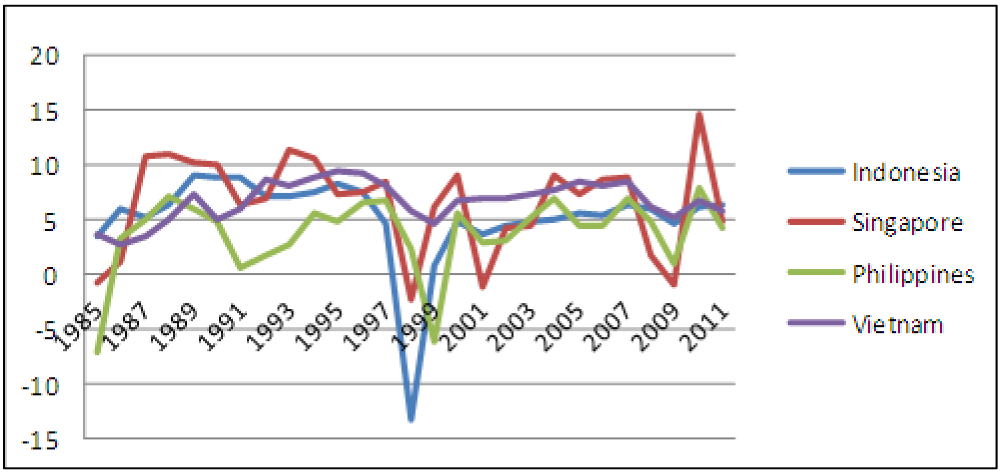
The paper is organized as follows. Section 2 presents the analysis of trade and financial linkages among AMS and between a typical AMS and the ASEAN region. Section 3 presents the specialized-type of VAR analysis, which is the primary tool we employ to decompose the component cross-region shocks into the trade, financial, and commodity price components. Section 4 presents the global projection model (GPM) we employ, and discusses our GPM estimation results. Section 5 presents the policy implications and concluding comments.

2. Business Cycles Synchronization, Trade and Financial Linkages in ASEAN and Between AMSs

2.1. Business Cycle Synchronization

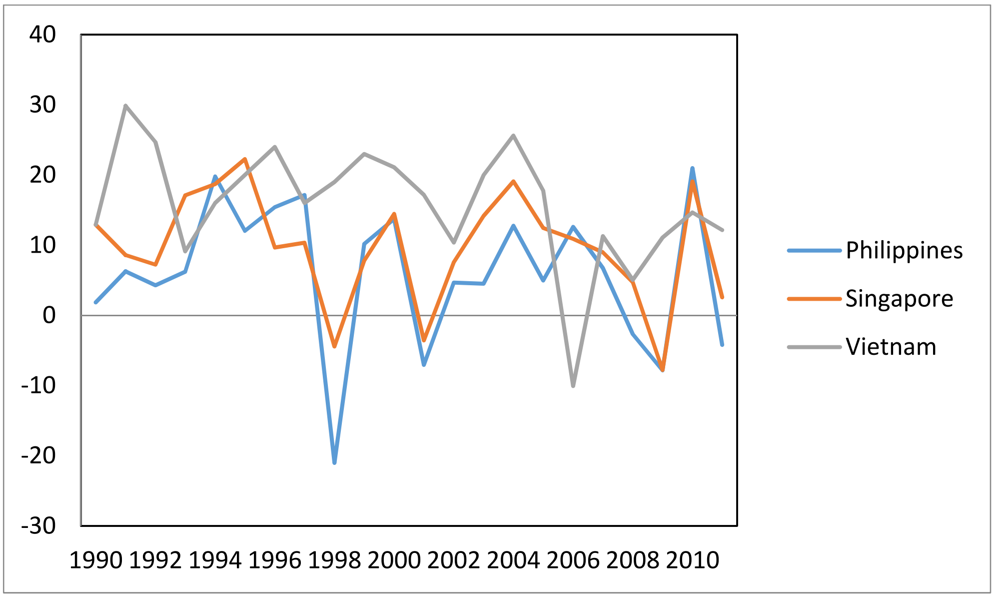
An examination of the data would indicate that business cycles have become increasingly synchronized in ASEAN. Figure 1 presents the output growth co-movement between ASEAN as a whole and representative ASEAN member states, while Figure 2 presents the co-movement in exports between representative ASEAN countries. Table 1 shows that with the exception of the Philippines, a typical ASEAN member state became more synchronized with ASEAN business cycle as a whole. That is, the representative AMSs generally exhibit an increased correlation of their GDP growth with the ASEAN region as an aggregate, in the later dates. In addition, the AMS business cycles, including that of the Philippines, have become more synchronized with each other. Noticeable also is the significant change in Vietnam's indicator of synchronization with ASEAN and other AMS. For example, Vietnam's correlation with ASEAN as a whole increased from 0.09 in Q11998 to Q42004, to 0.63 in Q12005 to Q42011. It likewise showed an increased in correlation coefficient with other AMS. That is, Vietnam's GDP growth correlation coefficient with Singapore increased from 0 to 0.51 (Singapore), and 0.12 to 0.31 with the Philippines.

Figure 1: Co-movements in GDP Growth, 1985-2011 (annual %)



Source: International Monetary Fund, International Financial Statistics (IFS)

Figure 2: Co-Movements in Exports of Goods and Services, 1990-2011 (annual % growth)



Source of basic data: Word Bank, *World Development Indicators Online.*

Table 1: Selected AMSs Business Cycle Synchronization with ASEAN and Each Other[2]

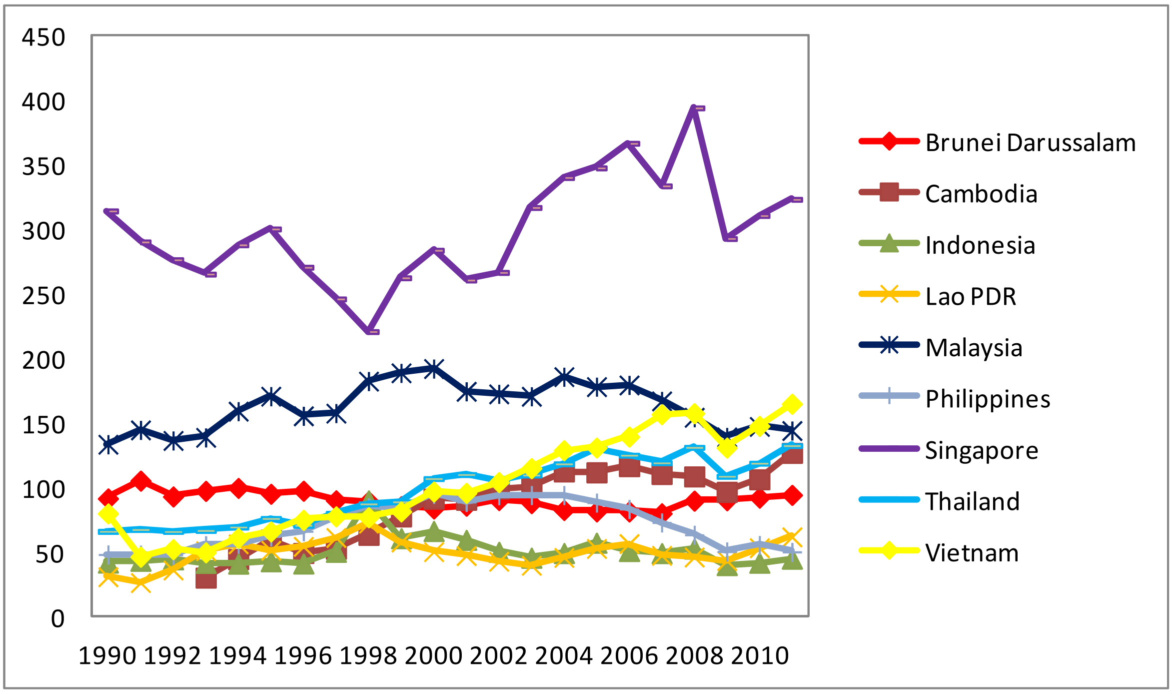
Cross Correlation	1998Q1-2004Q4				2005Q1-2001Q4			
	ASEAN	Singapore	Philippines	Vietnam	ASEAN	Singapore	Philippines	Vietnam
ASEAN	1.00	0.61	0.70	0.09	1.00	0.93	0.64	0.63
Singapore	0.61	1.00	0.31	0.00	0.93	1.00	0.64	0.51
Philippines	0.70	0.61	1.00	0.12	0.64	0.64	1.00	0.31
Vietnam	0.09	0.00	0.12	1.00	0.63	0.51	0.31	1.00

Source: IFS and author's calculations.

2.2. Trade Patterns and Linkages

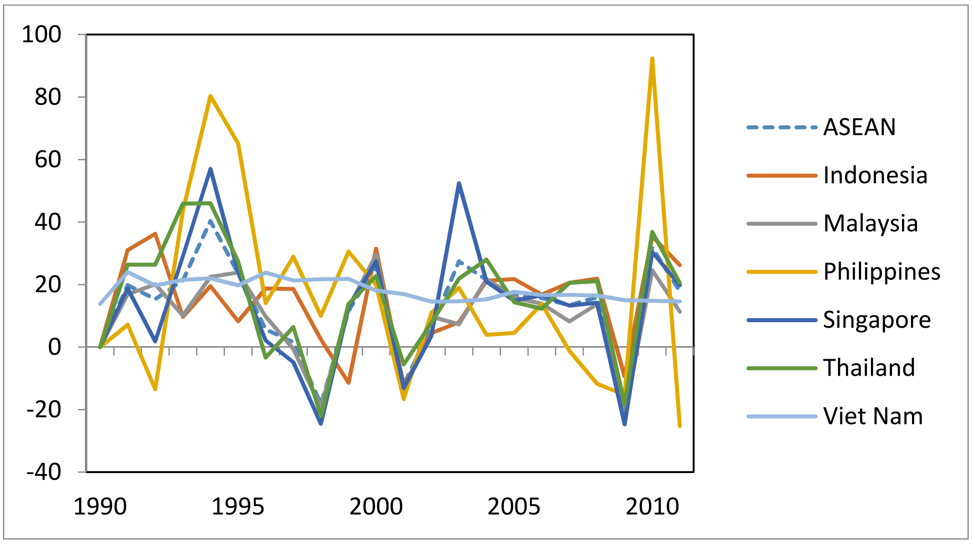
Figure 3 shows a general rise in merchandise trade in ASEAN countries as a percentage of GDP. Some authors have documented that an increase in trade openness is instrumental to economic growth (see Frankel and Romer 1999). Overall, Singapore registers the highest merchandise trade as a percent of GDP in ASEAN, followed historically by Malaysia. However, the rapid rise of Vietnam's figures saw it overtaking Malaysia for second place in recent years.

Figure 3: Merchandise Trade in ASEAN, 1990-2011 (percent of GDP)



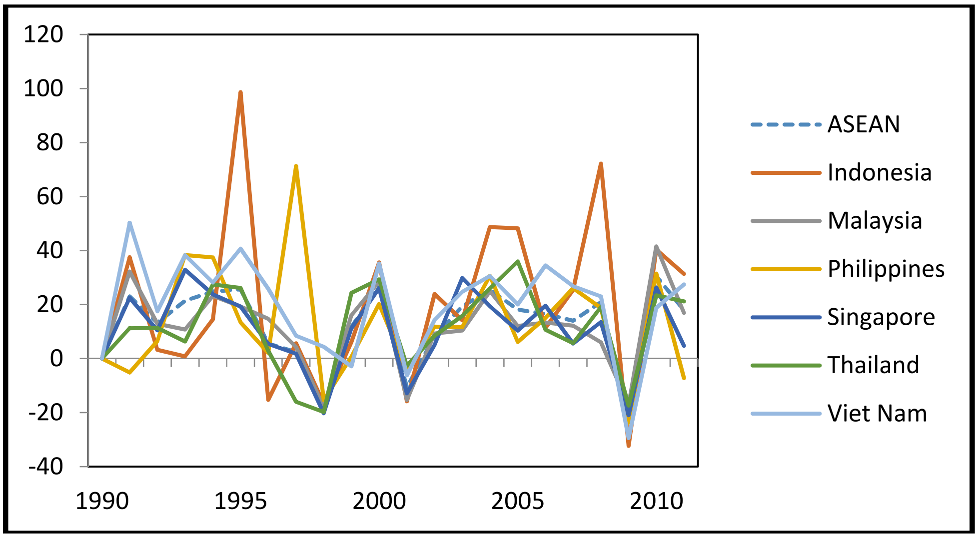
Figures 4a to 4c show the growth patterns of the intra-ASEAN exports, imports, and total trade. They show that although the growth rates of intra-ASEAN exports, imports, and total trade may fluctuate from year to year, for example, decreasing during the crisis years (e.g., the 1997 Asian crisis and 2008 global crisis), overall, intra-ASEAN trade is growing fast, registering an average growth rate of more than 20 percent.

Figure 4a: Intra-ASEAN Export Growth Rate, By Country: 1990-2012 (annual % change)



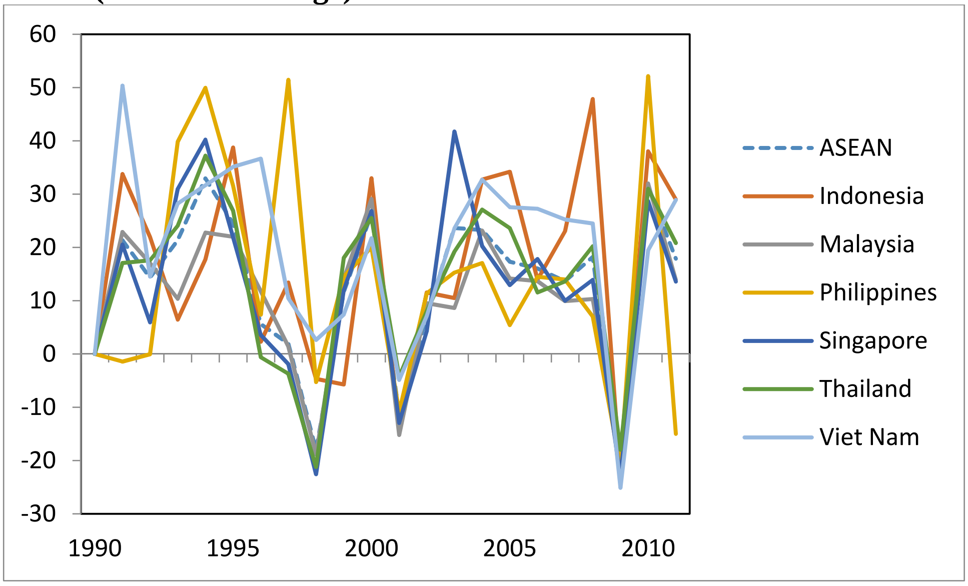
Source: Asia Regional Integration Center, ADB (2013)

Figure 4b: Intra-ASEAN Import Growth Rate, By Country: 1990-2012 (annual % change)



Source: Asia Regional Integration Center, ADB (2013).

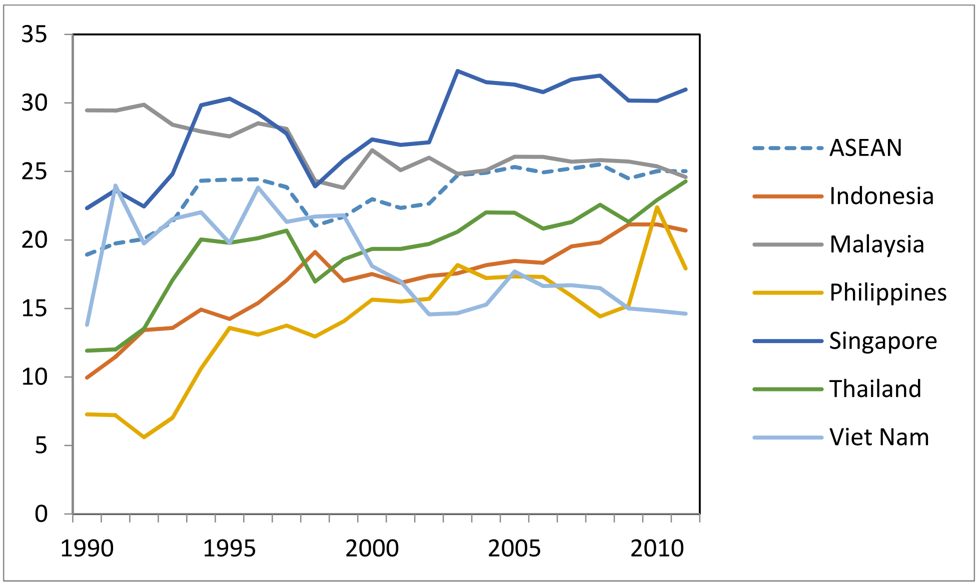
Figure 4c: Intra-ASEAN Total Trade Growth Rate, By Country: 1990-2012 (annual % change)



Source: Asia Regional Integration Center, ADB

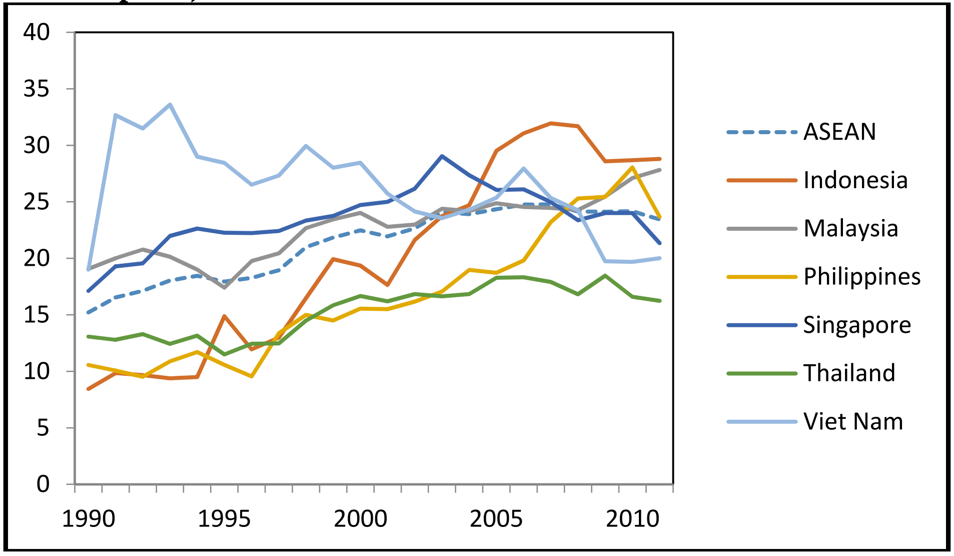
As a result, as Figures 5a and 5b show, relative to total exports and imports, the share of exports to and imports from, the other ASEAN member states, has been increasing over the years.

Figure 5a: ASEAN Exports Share, By Country: 1990-2012 (% share to total exports)



Source: Asia Regional Integration Center, ADB (2013).

Figure 5b: ASEAN Imports Share, By Country: 1990-2012 (% share to total imports)

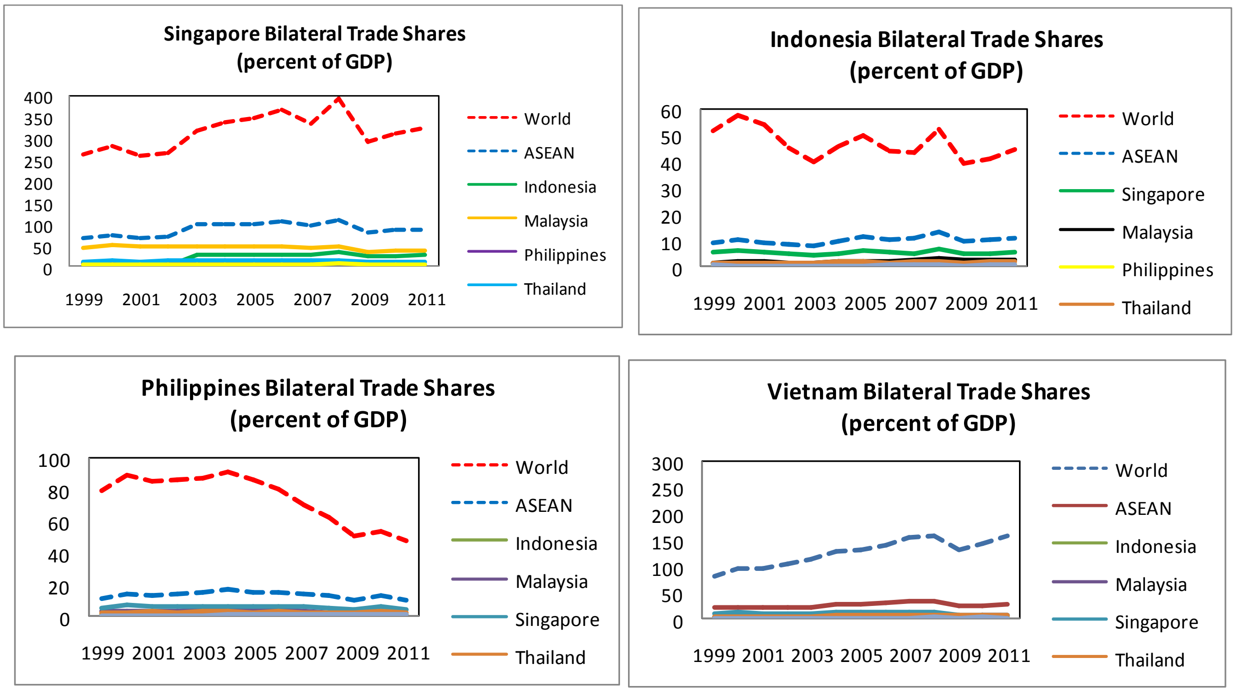


Source: Asia Regional Integration Center, ADB (2013).

Figure 6 presents the same story, albeit from a somewhat different, more nuanced, perspective. It shows the bilateral trade shares of selected AMSs with the world, ASEAN, and each other. Overall, abstracting from the impact of the 2007-2008 global crisis, it depicts an increasing trend of trade intensity for Singapore and Vietnam. On the other hand, Indonesia's trade intensity with the world appears to be constant during the past decade, while the Philippines appears to have a decreasing share of trade as a percent of GDP. What might be interesting to point out, however, is that relative to its trade to the world, the AMSs tended to have an increasing share of bilateral trade with ASEAN countries. This is true even for the Philippines, where although trade with ASEAN as a percent of GDP decreased slightly from 11.4 percent in 1999 to 10.2 percent in 2011, yet because its trade with the world dropped as a percent of GDP, the share of ASEAN trade relative to the world increased from 14.3 percent to 21.1 percent during the same period. The same increasing intensity for ASEAN trade characterizes the Indonesian data, while the Singaporean data shows a marginally increasing importance for ASEAN trade. Vietnam, on the other hand, saw its trade with ASEAN as a percentage of GDP increased substantially 20.3 percent in 1999 to 27.9 percent in 2011, yet because its trade with the world increased even faster, it registered a relatively lower importance for ASEAN trade relative to trading with the world. Nonetheless, in absolute terms, it is clear that trade with ASEAN is also increasing in importance for Vietnam.

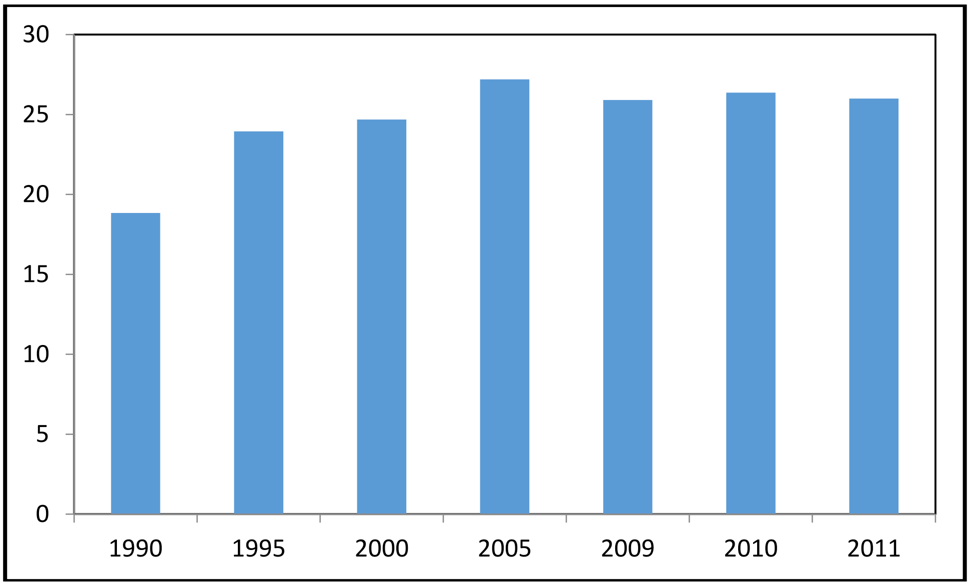
Thus, one may conclude that the individual AMSs' trade linkages with the ASEAN are increasing in importance (see also Figure 7), although in the case of Singapore and Vietnam its trade outside of ASEAN have also increased in importance. Hence, as the cases of Vietnam and Singapore illustrate, it is important to consider both internal integration (within ASEAN and within Asia) and external integration (e.g., integration of an AMS or ASEAN with the rest of the world), in analyzing cross-border spill-over effects.

Figure 6: Bilateral Trade Shares: Selected AMSs



Source: IFS and WDI.

Figure 7: ASEAN Intra-regional Trade Share, 1990-2011 (% share)



Source: Asia Regional Integration Center, ADB (2013).

2.3. FDI Patterns and Linkages

Table 2a and Table 2b present the patterns of ASEAN total FDI inflows and outflows in US$ million, while Figure 8a and Figure 8b present the ASEAN FDI total inflows and outflows as a percent of GDP. Overall, the data show a pattern of increasing importance of the FDI channel for ASEAN, either viewed from the absolute numbers of relative numbers as a percent of GDP. This same information is summarized by Figure 9 which shows an increasing pattern of FDI net inflows into ASEAN. Overall, Singapore gets the lion share of net inflows, which also highlights the importance of FDI channel to the economy.

Table 2a: ASEAN FDI Inflows (In US$ Million)

	1990	1995	2000	2005	2008	2009	2010	2011
Brunei Darussalam	7	582.7606	549.6073	289.4836	330.0627	371.3786	625.6676	1208.299
Cambodia	0	150.7	148.504	381.18	815.18	539.113	782.597	891.7
Indonesia	–	–	–	8336	9318	4877.369	13771	18906
Lao PDR	6	95.1	33.89	27.7	227.7564	318.6181	332.6	450
Malaysia	2611	5815	3787.632	4065.311	7171.978	1452.972	9102.974	11966.01
Myanmar	225.1	317.6	208	235.8	975.56	963.3	450.2	850
Philippines	550	1459	2240	1854	1544	1963	1298	1262
Singapore	5574.749	11942.81	15515.33	18090.3	11797.78	24417.64	48636.68	64003.24
Thailand	2575	2070	3410.119	8066.551	8454.701	4854.395	9733.323	9571.976
Viet Nam	180	1780.4	1298	1954	9578.997	7600	8000	7430

Table 2b: ASEAN FDI Outflows (In US$ Million)

	1990	1995	2000	2005	2008	2009	2010	2011
Brunei Darussalam	0.139	86.347	30	15	16	9	6	10
Cambodia	0	0	6.593	6.278	20.489	18.873	20.58	23.568
Indonesia	–	–	–	3065	5900	2249	2664.248	7771
Lao PDR	0.168	4.178	9.909	-0.087	-74.695	1.343	5.671	7
Malaysia	129	2488	2026.053	3075.501	14964.88	7784.367	13328.5	15257.52
Myanmar	..	..	..	..	..	..	..	..
Philippines	22	98	125	189	259	359	616	9
Singapore	2033.787	7282.874	6650.27	11589.28	6812.193	17703.69	21214.88	25227.46
Thailand	154	887	-19.8196	529.4853	4056.634	4172.07	5414.925	10634.22
Viet Nam	0	0	0	65	300	700	900	950

Source of basic data: UNCTAD.

Figure 8a: Total ASEAN FDI Inflows, 1990-2011 (percent of GDP)

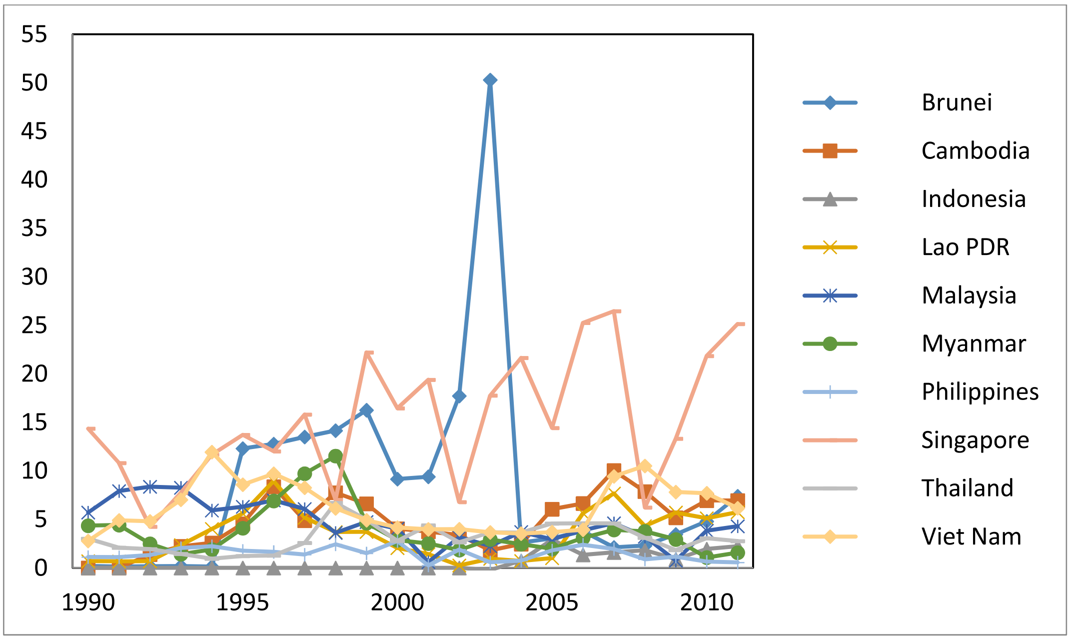
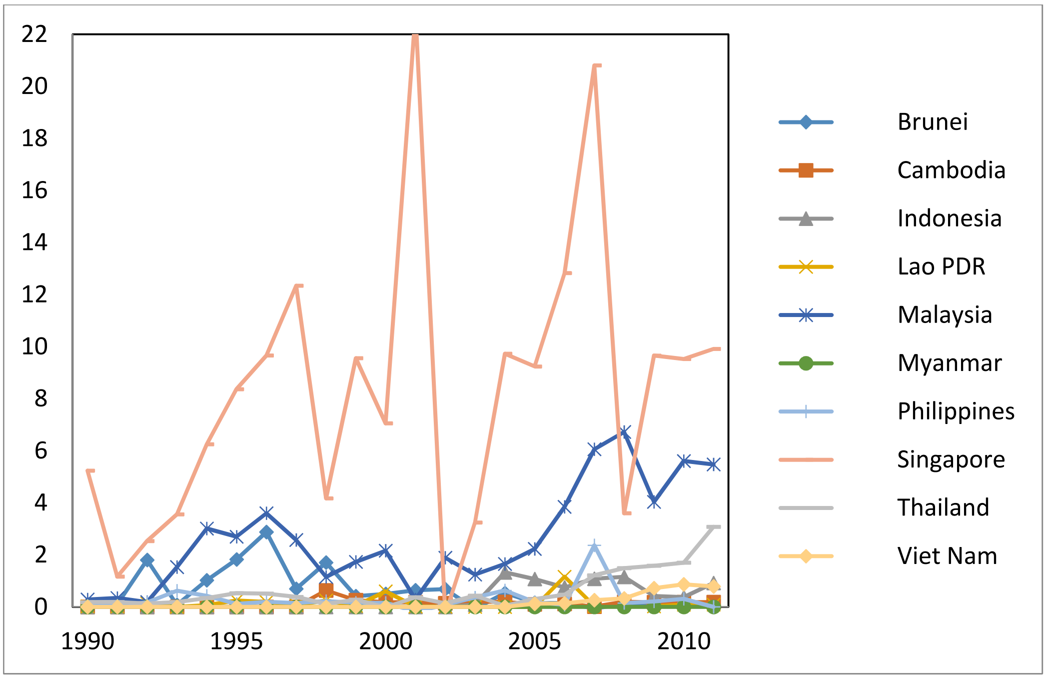
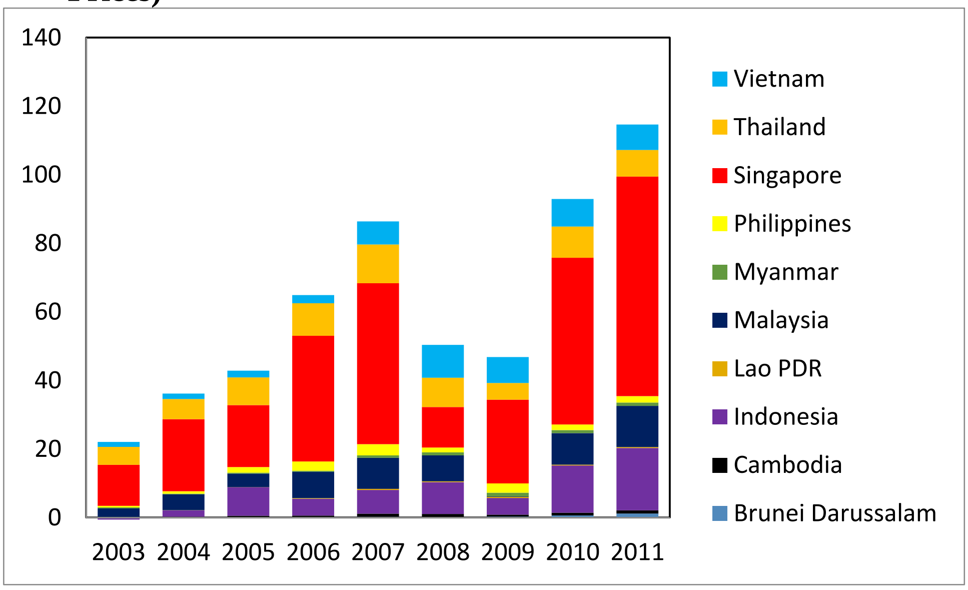


Figure 8b: Total ASEAN FDI Outflows (percent of GDP)



Source of basic data: UNCTAD.

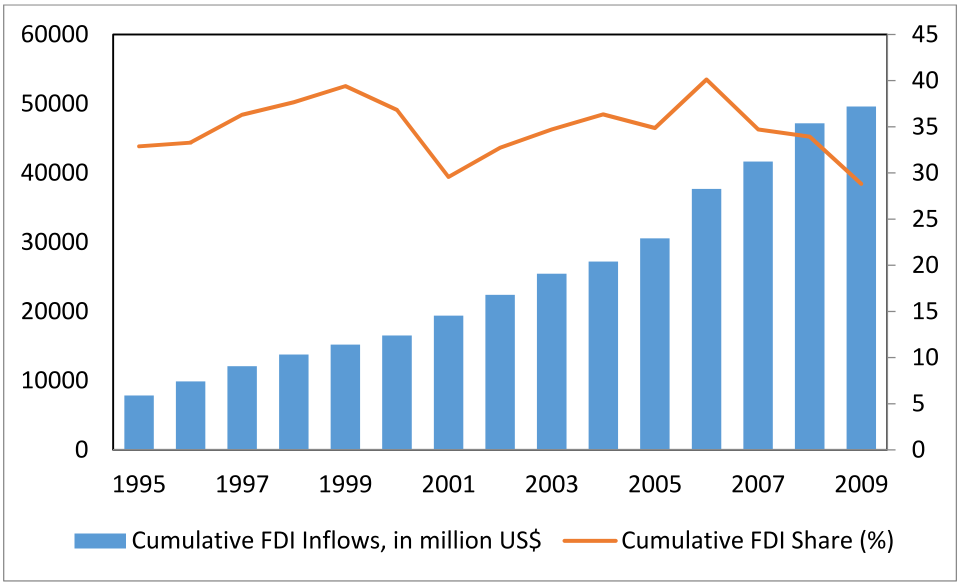
Figure 9: ASEAN FDI Net Inflows, By Country (BoP, Million US$, Current Prices)



Source of basic data: Word Bank, *World Development Indicators Online*.

Figure 10 presents information on intra-ASEAN net FDI flows. It shows that the intra-ASEAN cumulative net FDI inflows has been increasing over the years. However, as mentioned, total ASEAN FDI flows has also been increasing over the years. Hence, the relative share of intra-ASEAN net FDI inflows to total ASEAN net FDI inflows did not show a remarkable increase. This again highlights the importance of considering both internal integration (within ASEAN and Asia) as well as external integration (with the rest of the world).

Figure 10: Intra-ASEAN Net FDI Inflows



Source: Asia Regional Integration Center, ADB (2013).

2.4. Banking Systems Linkages

Tables 3 to 6 present the banking linkages with the rest of the world for four typical ASEAN countries. The tables present the exposure to BIS-reporting banks of the AMSs in US$ million, as represented by lending across border and the foreign bank subsidiaries' locally funded assets. Overall, the figures present that cross-border financial linkages are non-trivial. In the case of the Philippines, the banking system in the US, EU and Japan are the most important to watch out for, since the banks from these countries account for 81.3% of the foreign claims. The Philippine sectors most exposed are the public sector and the private non-bank sector. In the case of Singapore, there is more cross-border banking risk diversification, with the exposure spread out banks in many countries, instead of being concentrated in a few economies. In the case of Indonesia and Vietnam, there is also a degree of concentration in EU and Japanese banks, but less so compared to the Philippines. In Section III, we attempt to quantify the relative importance of the financial channel as a source of spillovers, *vis-a-vis* the other channels.

Table 3: Philippines: Consolidated Claims of BIS-Reporting Banks (Amount outstanding as of December 2012)

	Value (mil $US)	Share in total (%)
By bank nationality (immediate borrower basis)		
All reporting countries	43075	100.0
Japan	5623	13.1
South Korea	866	2.0
Chinese Taipei	1341	3.1
US	9824	22.8
EU	19554	45.4
Rest of the World	5867	13.6
By sector (ultimate risk basis)		
Banks	5922	16.2
Private non-banks	15966	43.75
Public	14608	40.03
By type (ultimate risk basis)		
Cross-border claims	20969	57.41
Local claims	15553	42.59

Source: Bank for International Settlements.

Table 4: Singapore: Consolidated Claims of BIS-Reporting Banks (Amount outstanding as of December 2012)

	Value (mil $US)	Share in total (%)
By bank nationality (immediate borrower basis)		
All reporting countries	400606	100.0
Japan	55528	13.9
South Korea	3655	0.9
Chinese Taipei	7918	2.0
US	59927	15.0
EU	12365	3.0
Rest of the World	261213	65.20
By sector (ultimate risk basis)		
Banks	40909	12.8
Private non-banks	205327	23.0
Public	73444	64.2
By type (ultimate risk basis)		
Cross-border claims	103793	32.3
Local claims	217525	67.7

Source: Bank for International Settlements.

Table 5: Indonesia: Consolidated Claims of BIS-Reporting Banks (Amount outstanding as of December 2012)

	Value (mil $US)	Share in total (%)
By bank nationality (immediate borrower basis)		
All reporting countries	130707	100.0
Japan	24421	18.7
South Korea	3126	2.4
Chinese Taipei	1539	1.2
US	17284	13.2
EU	44833	34.3
Rest of the World	39504	30.2
By sector (ultimate risk basis)		
Banks	12686	12.6
Private non-banks	64481	64.1
Public	23458	23.3
By type (ultimate risk basis)		
Cross-border claims	55762	55.4
Local claims	44948	44.6

Source: Bank for International Settlements.

Table 6: Vietnam: Consolidated Claims of BIS-Reporting Banks (Amount outstanding as of December 2012)

	Value (mil $US)	Share in total (%)
By bank nationality (immediate borrower basis)		
All reporting countries	33212	100.0
Japan	5483	16.5
South Korea	5315	16
Chinese Taipei	3231	9.7
US	2265	6.8
EU	12365	37.2
Rest of the World	4553	13.7
By sector (ultimate risk basis)		
Banks	5295	23.5
Private non-banks	13036	57.8
Public	4206	18.7
By type (ultimate risk basis)		
Cross-border claims	12280	54.4
Local claims	10282	45.6

Source: Bank for International Settlements.

2.5. Overall Assessment of the Linkages

In sum, we conclude that the ASEAN economies, whether a developed economy like Singapore, or part of ASEAN-5 like the Philippines, or a CLMV country, are increasingly integrated with ASEAN and the world through both the trade and financial channels. It is, therefore, important to understand how the shocks from the rest of the world, would affect ASEAN as an aggregate as well as the individual AMSs. At the same time, it is important to understand the channels through which these shocks reverberate to the ASEAN economies. We discuss this in the next section of the paper.

3. Decomposing the Shocks into its Trade, Financial and Commodity Price Components: A VAR Analysis

The previous section illustrated that it is important to consider both internal integration (within ASEAN and within Asia) and external integration (e.g., integration of country or ASEAN with the rest of the world). At the same time, since integration and linkages occur not only because of trade, but also through financial and commodity price channels, it is important to delve into the nuances of the trade, financial and commodity price effects.

In this paper, we estimated a three-variable vector autoregression (VAR) model with the following Cholesky-type ordering: rest of the world GDP growth rate (as measured by the difference of the log quarterly real output), ASEAN5 GDP growth rate, and the AMS GDP growth rate, where the VARs are estimated for four AMSs, namely, Singapore, Indonesia, Philippines, and Vietnam. The sample period is from 1998 to 2011. Data on quarterly real GDP were taken from the International Financial Statistics (IFS) database. Following Bayoumi and Swiston (2007, 2008), the rest of the world (ROW) is defined as 13 country aggregate of the U.S., Austraila, Canada, Denmark, New Zealand, Norway, Sweden, Switzerland, United Kingdom, Korea, Mexico, South Aftrica, and Taiwan. ASEAN5 on the other hand, is the aggregate of the following six ASEAN countries with dataset, minus the AMS under consideration: Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam.[3] For both ROW and ASEAN5, the aggregate growth rate is defined as the PPP GDP weighted growth rate of each countries.

Figures 11 to 14 present our estimation results.

A typical shock to the rest of the world is about 0.5 percentage point on impact, increasing to about 1.3 percentage point after a year. In response, ASEAN GDP growth rises by about 0.4 percentage point on impact and rises by about 0.9 percentage point after two years.

In response to the resulting ASEAN GDP growth, Singapore's GDP rises by about 0.6 percentage point on impact and increases to about 1 percentage point after a year. However, the direct impact of the rest of the world to Singapore is about 1 percentage point on impact, increasing to about 2.2 percentage points after a year. This is so because as the variance decomposition reveals, about 30% of Singapore's output is explained by the variations in the GDP of the rest of the world, while less than 10% of Singapore's output is explained by variations in ASEAN GDP.

In contrast, for Indonesia, much of the variation in GDP is explained by domestic shocks, so the rest of the world shocks do not have as much impact to Indonesia either directly, or through ASEAN. The same appears to be true for the Philippines. With respect to Vietnam, on the other hand, the initial response to both rest of the world shock, both directly and indirectly through ASEAN is about 0.1 percentage point on impact, accumulating to about 0.4 percentage points after two years.

In conclusion, of the four AMS in consideration, Singapore appears the most sensitive to impacts from the rest of the world, either directly or indirectly through its impact on the ASEAN.

Figure 11a: Impulse Response Functions ROW, ASEAN, Singapore

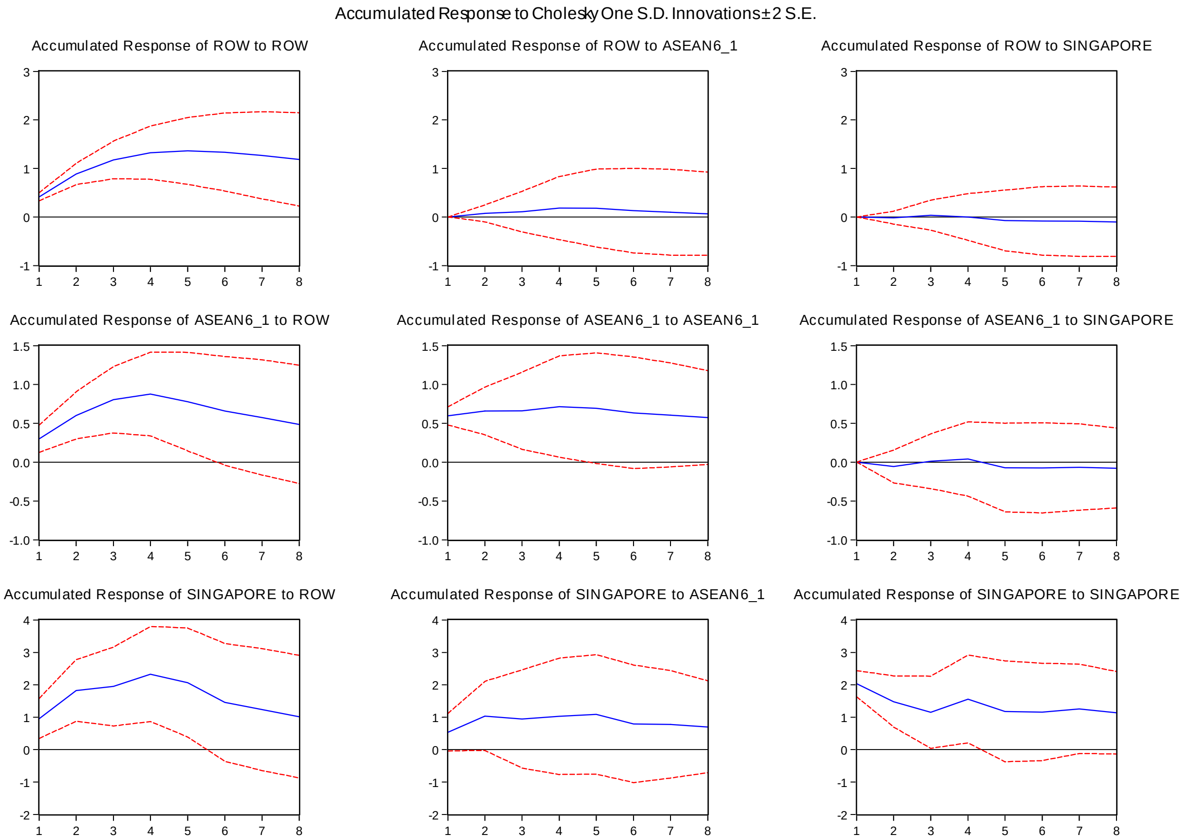


Figure 11b: Variance Decompositions ROW, ASEAN, Singapore

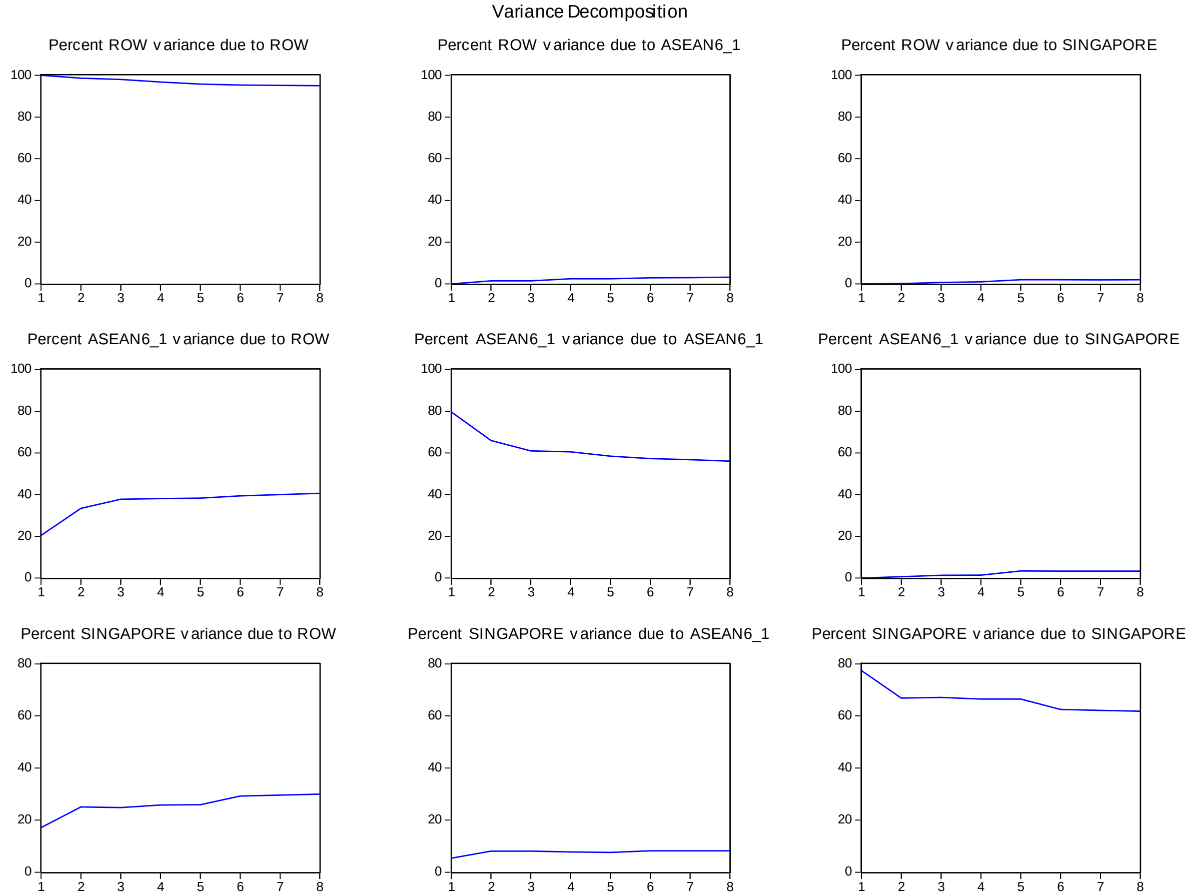


Figure 12a: Impulse Response Functions ROW, ASEAN, Indonesia

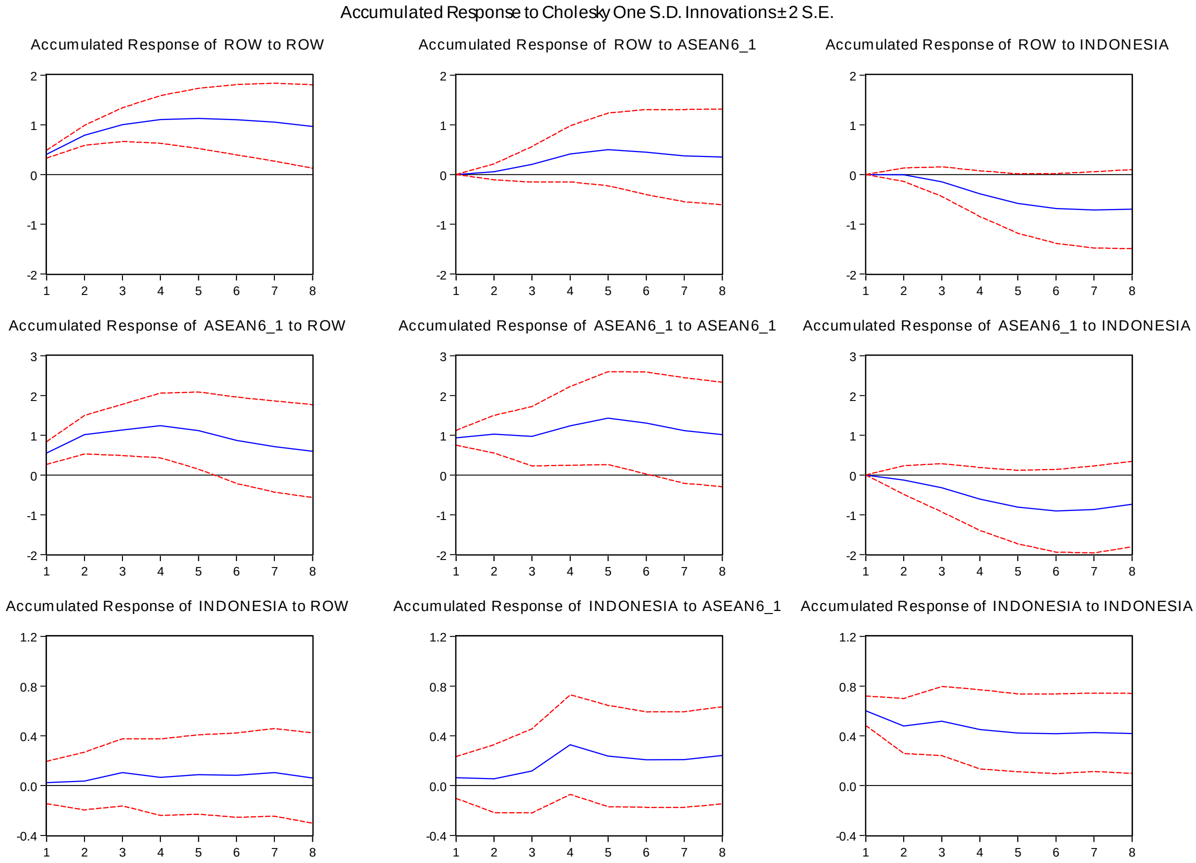


Figure 12b: Variance Decompositions ROW, ASEAN, Indonesia

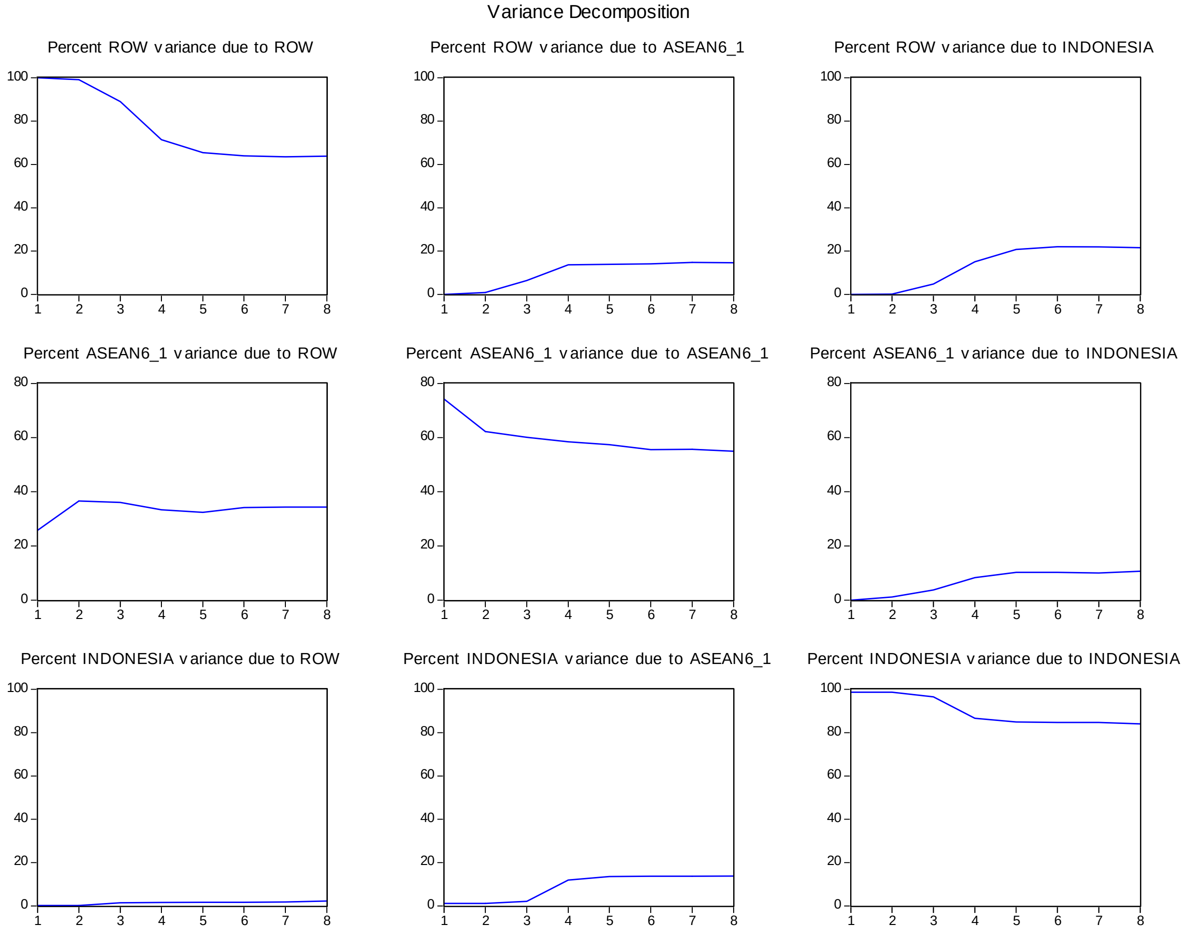


Figure 13a: Impulse Response Functions ROW, ASEAN, Philippines

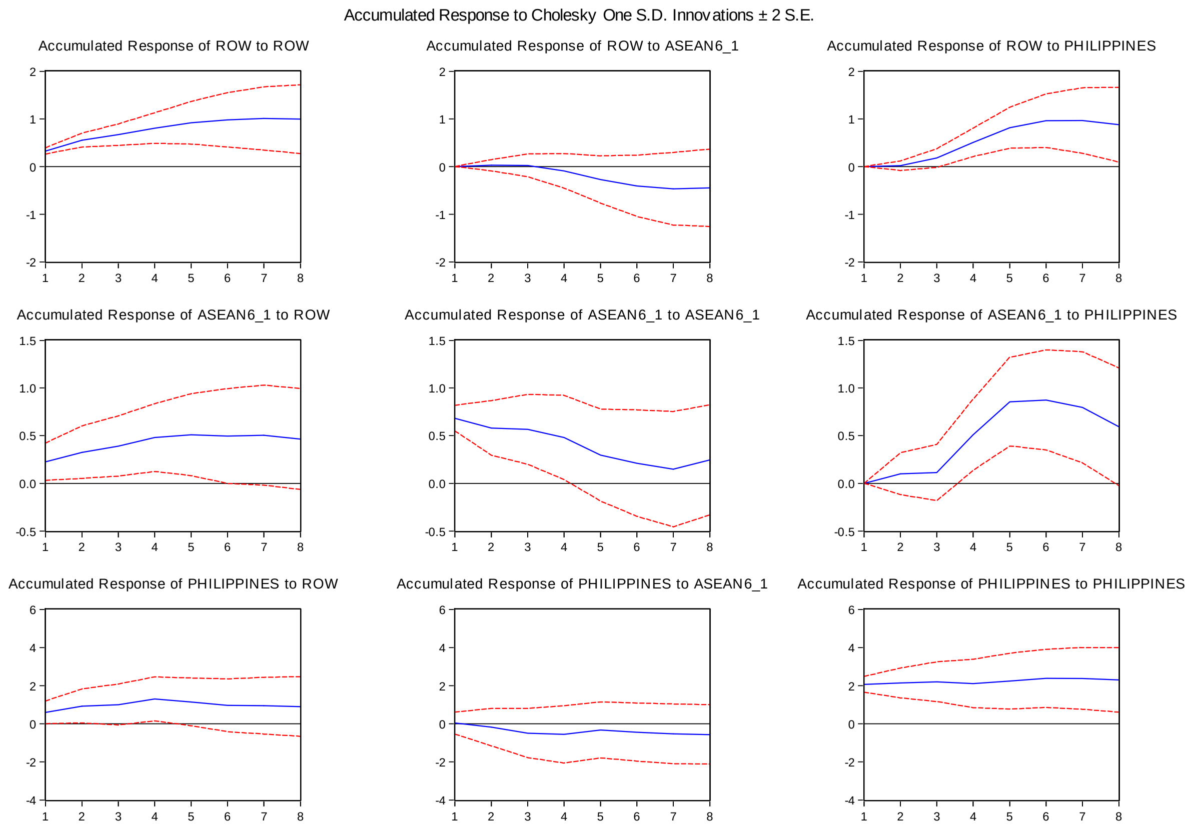


Figure 13b: Variance Decompositions ROW, ASEAN, Philippines

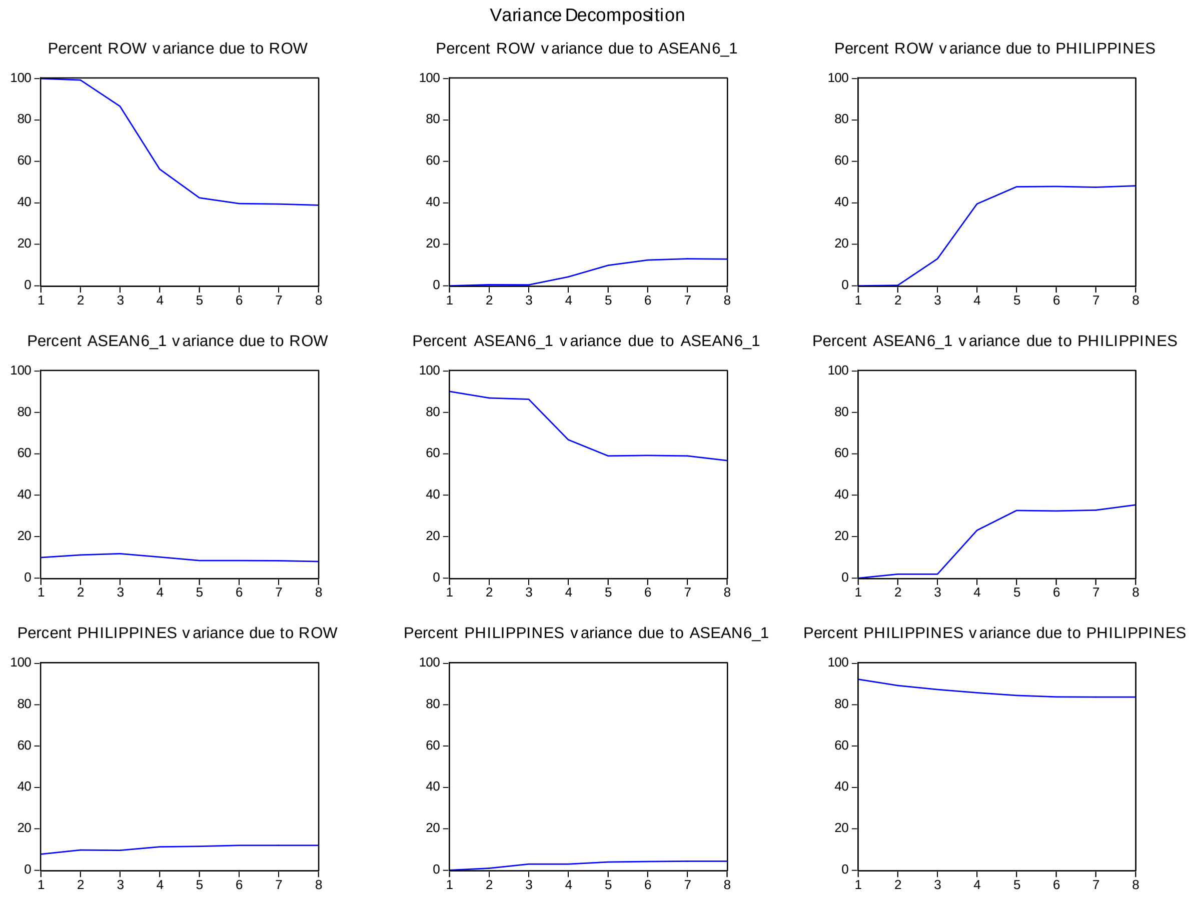


Figure 14a: Impulse Response Functions ROW, ASEAN, Vietnam

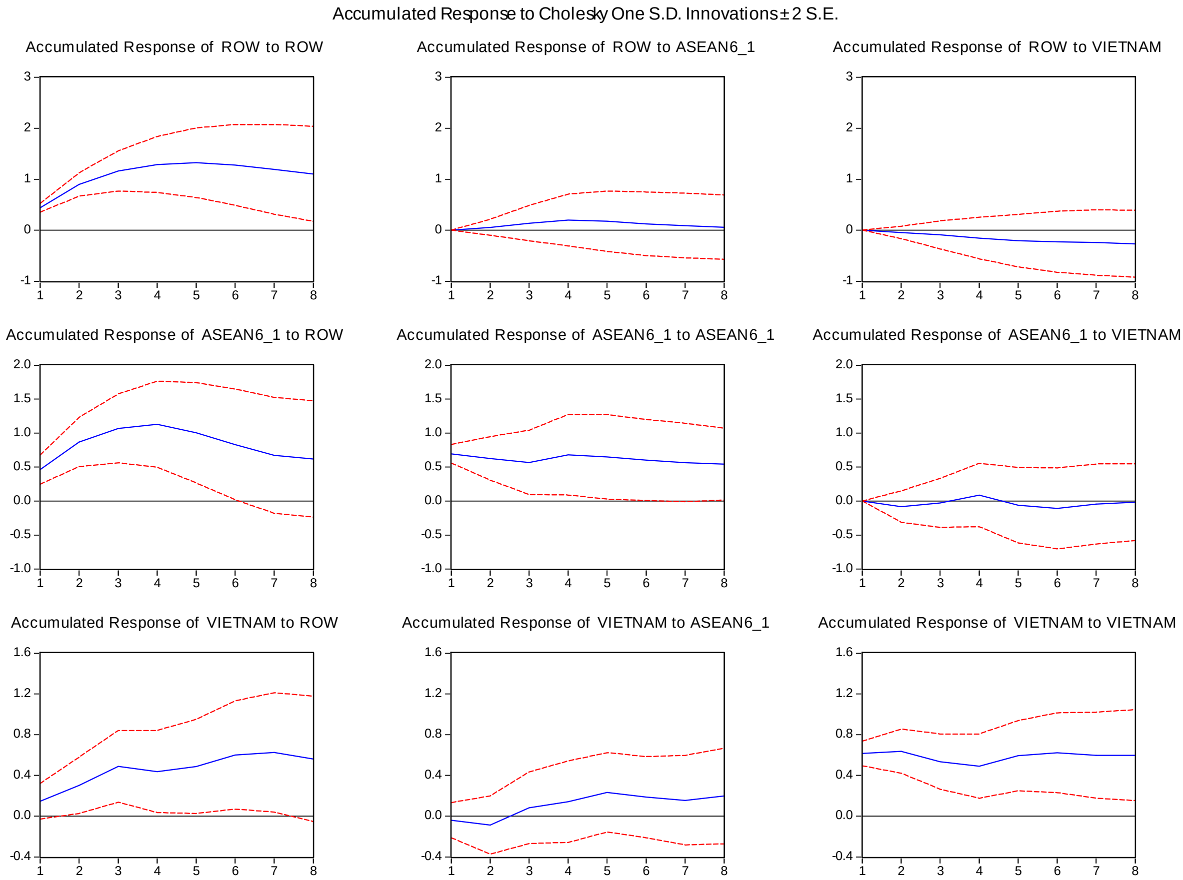
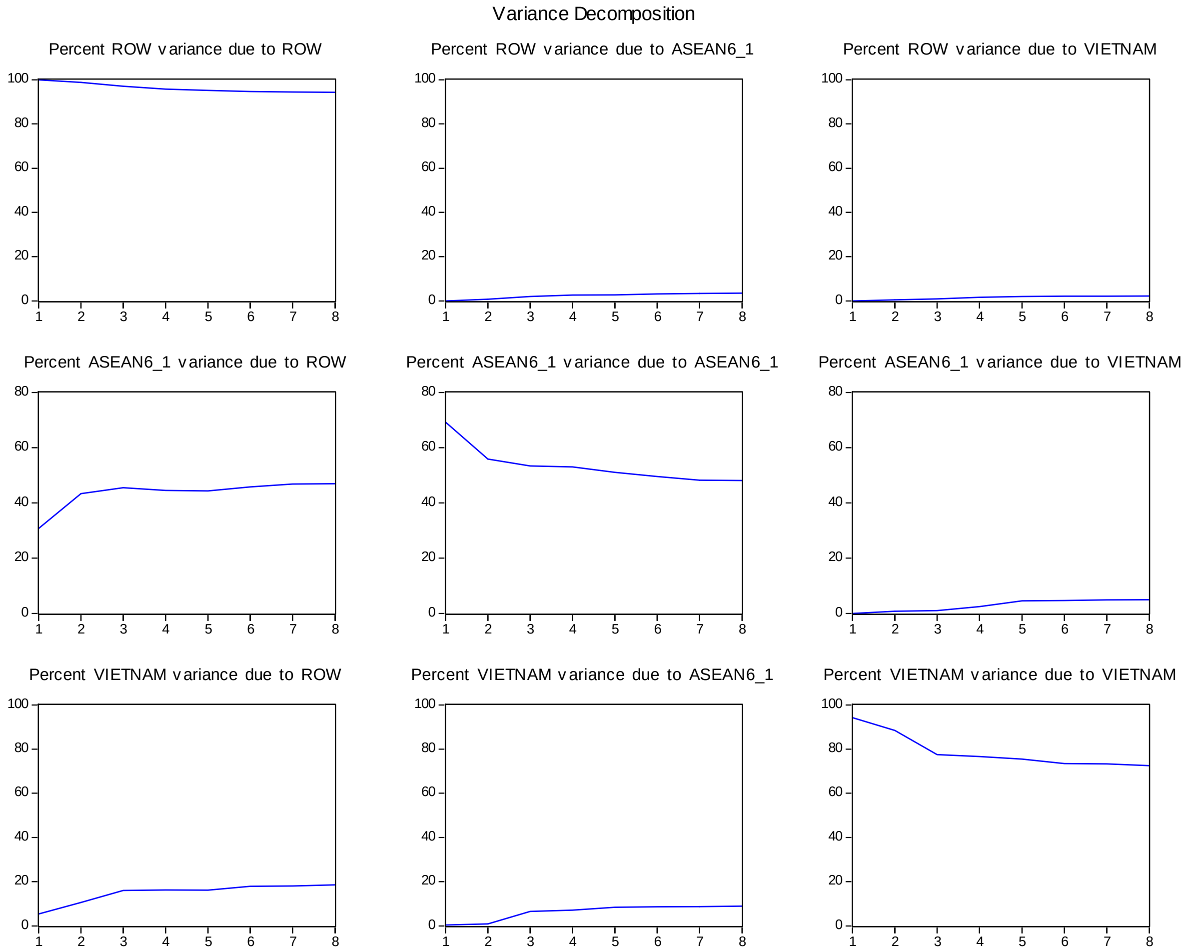


Figure 14b: Variance Decompositions ROW, ASEAN, Vietnam



In addition to the impulse response and variance decomposition analyses above, we also attempt to decompose here the cross-region spillovers into three potential channels, namely the trade channel, financial channel, and commodity prices channel. Following Bayoumi and Swiston (2007, 2008), the contribution of a specific channel can be estimated by calculating the difference of the impulse responses generated by the base VAR and that of the base VAR augmented by including each channel as exogenous variables and separate runs. To wit, the contribution of the particular channel j in period i, $c_{i,j}$, is calculated herein as

$$c_{i,j} = r_i - r_{i,j},$$

where r_i is the impulse response of the original (base) VAR and $r_{i,j}$ is the impulse response of the original VAR augmented by channel j.

For the trade channel, we used the contribution of exports to real GDP. For the financial channel, we used the short-term interest rates (i.e., yields on short-term and medium-term government securities), long-term interest rates (i.e., yields on long-term government securities), and the equity prices of the countries. The interest rates were in levels, and the equity prices were deflated by the country's GDP deflator then expreseed in quarterly percent changes.

Figures 15a to 15c show the decomposition of spillovers for three typical AMSs. It shows that for Singapore, the exports and the financial channels are the most significant channels of the growth spillovers. For Indonesia, the commodity price channel is the most important, followed by the financial channel, and then the exports channel. For the Philippines, the commodity price channel appears to play a prominent role.

Figure 15: Decomposition of Spillovers

Figure15a: Singapore

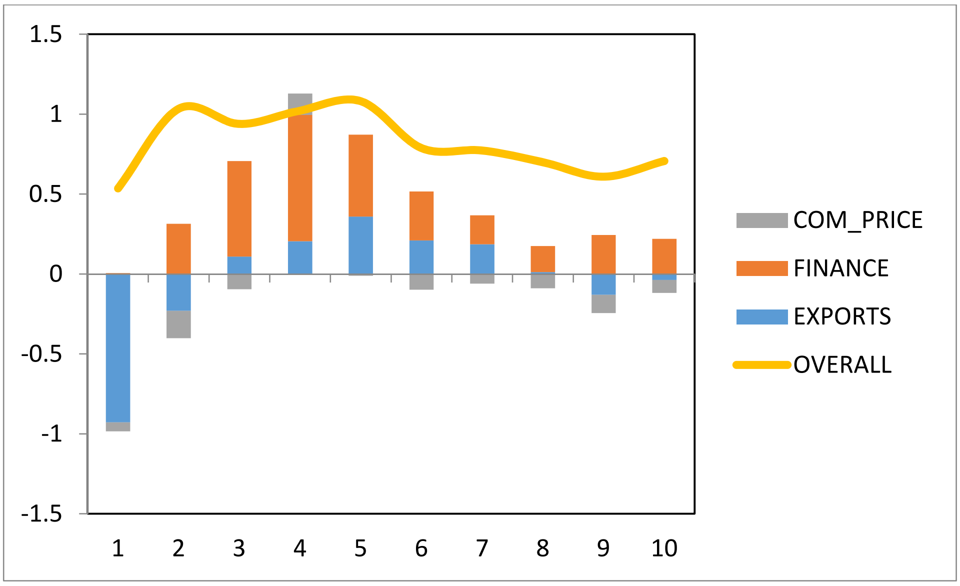


Figure 15b: Indonesia

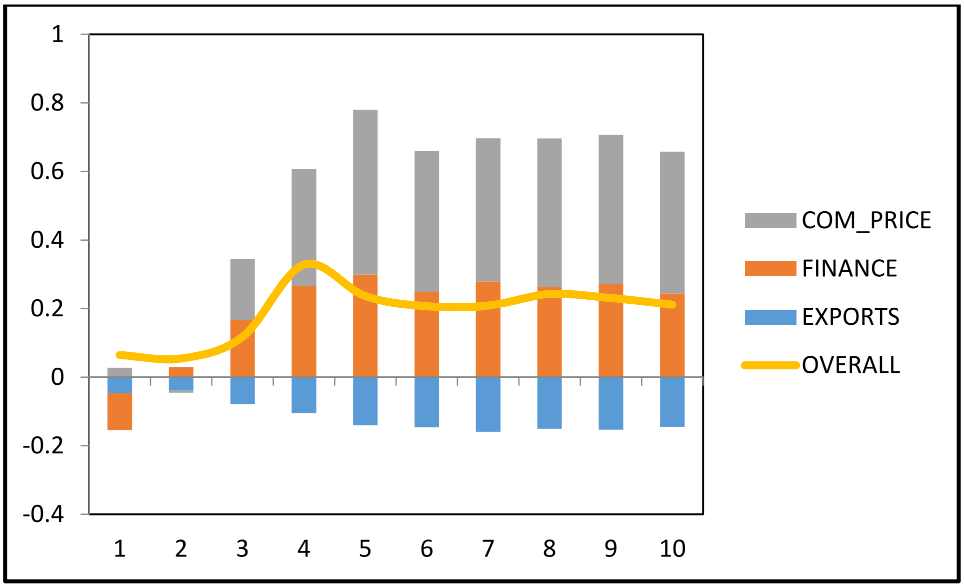
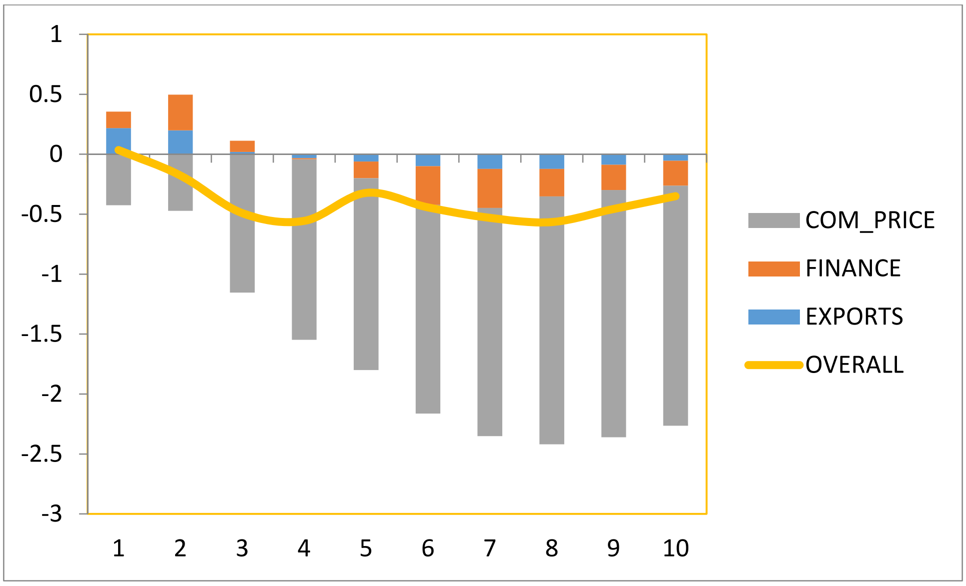


Figure 15c: Philippines



4. Ripple Effects to GDP Growth, Inflation, Interest Rates, Exchange Rates, and Unemployment: Results from A Global Projection Model

In this paper, we employed a three-stage global projection model (GPM) estimation process (see, e.g., Carabenciov, *et al*. 2008a, b, c; Canales-Kriljenko, *et al.* 2009, Andrle, *et al*. 2009; and Carabenciov, *et al*. 2013 for a description of the GPM). In the first stage, in order to trace the ripple effects of a shock from, say the U.S. or EU to China and Japan, we estimated a global projection model for the four economies ("GPM4"). This we use to analyze the spillovers of macroeconomic shocks to these four regions' output, inflation, unemployment rate, interest rate, and exchange rate. For example, a shock to the U.S.' output, inflation, etc. can impact not only the U.S. macroeconomic variables but also to Europe, China, and Japan, and the impact can come directly from the U.S. to these economies, and indirectly via the effect to the other economies. The shocks we considered were shocks to each of the four economies' output, inflation, interest rates, unemployment, and exchange rates, as well as the shock to the U.S.' bank lending tightening condition. We trace the impulse responses on those shocks of the each of these economies' macroeconomic variables (i.e., output, inflation, interest rates, unemployment, and exchange rates).

In the second stage, we estimated a second GPM model with five economies (U.S., EU, China, Japan, ASEAN), "GPM5", by adding ASEAN to the initial four economies. It is assumed that the four large economies (U.S., EU, China, Japan) can affect each other and ASEAN, but ASEAN is small enough to be able to impact the coefficient estimates of the four large economies.

Finally, in the third stage, we estimated a "GPM6" model, by adding a "typical" AMS (i.e., the Philippines) to the five economies mentioned above. Thus, in the GPM6 model, we include the following six economies in the model: U.S., EU, China, Japan, ASEAN, and the Philippines. As in the second stage, we assume that the U.S., EU, China, Japan, and ASEAN can affect the Philippines, but the Philippines is small enough that it cannot affect the coefficient estimates of the five larger economies.

4.1. The Model

To enable the reader to have an intuition for the model and our results, we discuss briefly below the main features of the GPM model.[4]

We estimated a version of the GPM that follows closely Andrle, *et al*. (2009) and incorporates a U.S. bank lending tightening, but no oil price. Capital letters represent the variables themselves while lowercase letters represent their deviation from equilibrium values.[5]

The dynamics of the potential output is characterized by:

(1) $\overline{Y}_{i,t} = \overline{Y}_{i,t-1} + g^{\overline{Y}}_{i,t}/4 + \varepsilon^{\overline{Y}}_{i,t}$

(2) $g^{\overline{Y}}_{i,t} = \tau_i g^{\overline{Y}_{ss}}_{i} + (1-\tau_i) g^{\overline{Y}}_{i,t-1} + \varepsilon^{g\overline{Y}}_{i,t}$

where $\overline{Y}_i$ is the potential GDP of economy *i*, $g^{\overline{Y}}_i$ is the growth rate of potential GDP of economy *i*, $g^{\overline{Y}_{ss}}_i$ is the state-state growth rate, and the $\varepsilon_{i,t}$'s are the disturbance terms. The *i* subscript refers to the economy *i*, while the *t* refers to the time subscript.

The NAIRU rate of unemployment is characterized by

(3) $\overline{U}_{i,t} = \overline{U}_{i,t-1} + g^{\overline{U}}_{i,t}/4 + \varepsilon^{\overline{U}}_{i,t}$

(4) $g^{\overline{U}}_{i,t} = \left(1-\alpha_{i,3}\right) g^{\overline{U}}_{i,t-1} + \varepsilon^{g\overline{U}}_{i,t}$

where the variables are analogously defined. $g^{\overline{U}}_{i,t}$ is the growth rate of unemployment rate and is a function of its own lagged value and the disturbance term $\varepsilon^{g\overline{U}}_{i,t}$. The dynamics of the equilibrium real rate of interest, $\overline{RR}_{i,t}$, is described by,

(5) $\overline{RR}_{i,t} = \rho_i \overline{RR}_{i,SS} + (1-\rho_i)\overline{RR}_{i,t} + \varepsilon^{\overline{RR}}_{i,t}$

where $\bar{R}^{ss}_i$ is the steady-state real interest rate and $\varepsilon^{\overline{R}}_{i,t}$ is a stochastic shock, while the log of real exchange rate, $LZ_{i,t}$, evolves according to,

(6) $LZ_{i,t} = 100 * \log\,(S_{i,t}P_{us,t}/P_{i,t})$

(7) $\Delta LZ_{i,t} = 100\Delta\log\left(S_{i,t}\right) - (\pi_{i,t} - \pi_{us,t})/4$

(8) $\overline{LZ}_{i,t} = \overline{LZ}_{i,t-1} + \varepsilon_{i,t}^{\overline{LZ}}$

where $S_{i,t}$ is the amount of the local currency units per USD.

In the equation for the output gap, all variables represent deviations from equilibrium values,

(9)

$$y_{i,t} = \beta_{i,1}y_{i,t-1} + \beta_{i,2}y_{i,t+1} - \beta_{i,3}r_{i,t-1} + \beta_{i,4}\sum_j \omega_{i,j,4}z_{i,j,t-1} + \beta_{i,5}\sum_j \omega_{i,j,5}y_{j,t-1} + \varepsilon_{i,t}^{y},$$

where there $\beta_{i,3}$ and $\omega_{i,j,4}$ terms capture the real interest rate and real exchange rates effects, respectively, while the foreign activity parameters, $\omega_{i,j,5}$, capture the trade links among the economies.

The inflation equation is

(10) $\pi_{i,t} = \lambda_{i,1}\pi 4_{i,t+4} + (1-\lambda_{i,1})\pi 4_{i,t-1} + \lambda_{i,2}y_{i,t-1} + \lambda_{i,3}\sum_j \omega_{i,j,3}\Delta Z_{i,j,t} + \varepsilon_{i,t}^{\pi}$,

where $\Delta Z_{i,j,t}$ is the change in the bilateral real rate of exchange of currency *i* relative to currency *j*. The Taylor-type rule the short-term nominal interest rate is

(11) $I_{i,t} = (1-\gamma_{i,1})\left[\overline{R}_{i,t} + \pi 4_{i,t+3} + \gamma_{i,2}(\pi 4_{i,t+3} - \pi_i^{tar}) + \gamma_{i,4}y_{i,t}\right] + \gamma_{i,1}I_{i,t-1} + \varepsilon_{i,t}^{I},$

where π_i^{tar} is the inflation target. The uncovered interest parity equation is

(12) $4(Z_{i,t+1}^{e} - Z_{i,t}) = (R_{i,t} - R_{us,t}) - (\overline{R}_{i,t} - \overline{R}_{us,t}) + \varepsilon_{i,t}^{Z-Ze}.$

The unemployment gap is given by,

(13) $u_{i,t} = \alpha_{i,1}u_{i,t-1} + \alpha_{i,2}y_{i,t} + \varepsilon_{i,t}^{u},$

while the U.S. bank lending tightening equation is given by

(14) $BLT_{US,t} = \overline{BLT}_{US,t} - \kappa_{US}y_{US,t+4} + \varepsilon_{US,t}^{BLT}$

(15) $\overline{BLT}_{US} = \overline{BLT}_{US,t-1} + \varepsilon_{US,t}^{\overline{BLT}}$

where $\overline{BLT}$ is the equilibrium level of $BLT_{US,t}$.

4.2. Estimation

We employed Bayesian techniques in estimating the above GPM model. As mentioned, we adopted a three-stage estimation process. At the first stage, we estimated a GPM4 with four regions (U.S., E.U., China, and Japan) and estimate their parameters. Then, at the second stage, we estimated a GPM5 (U.S., E.U, China, Japan, ASEAN) where we calibrated the parameters for the four large economies (U.S., E.U, China, Japan) from the previous GPM4 estimation, and estimated the parameters for ASEAN only. This is based on the assumption ASEAN is affected by the four large economies, but that ASEAN is small enough to affect the parameters of the four large economies. Finally, at the third stage, we estimated a GPM6 by adding the Philippines to the first five economies. Again, at this estimation stage, we calibrated the parameters for U.S., E.U, China, Japan, and ASEAN using the estimation results of the second stage, and estimated the parameters for the Philippines only. Hence, we assumed the U.S., E.U., China, Japan, and ASEAN can affect the Philippines, but the Philippines is small enough the affect the parameter estimates of the five larger economies. For all three stages of the estimation, we used Dynare ver. 4.3 and a sample of 250,000 were drawn for the Metropolis Hastings algorithm, dropping the first 30% of the draws.

All the data (real GDP, unemployment rate, CPI inflation, policy interest rate, and the exchange rate) were taken from the IFS and country-specific sources such as statistics departments and central banks. The prior distributions for all three GPM estimations are presented in Table A, B, and C in the Appendix.

4.3. Results

Tables A1 to C2 present the posterior estimates for the parameters of model equations, while Figures A1 to C19 present the selected impulse response functions.

Figures A1 to A4 present the impulse responses for the output gap shocks to the U.S., EU, Japan, and China, respectively. All these figures are divided into parts (a) and (b). Thus, Figure A1(a) presents the impulse responses to a shock on the U.S. output gap, of the U.S macroeconomic variables (real GDP, growth rate, unemployment rate, inflation rate, interest rates, exchange rate, and the BLT variable), while Figure A2 (b) presents the impulse responses to a shock on the U.S.

output gap, of all the other economies' output. Consistent with what is predicted by economic theory, a shock to U.S. aggregate demand results in a 0.4 percent increase of the log of US real GDP on impact, and the positive impact persists for more than two years. There are also resulting increases in the U.S. GDP growth rate, inflation, short term interest rate, an appreciation of the U.S. dollar and an easing in U.S. bank lending conditions. Likewise, the unemployment rate decrease in the U.S. The higher output in the U.S. results in increases in output in all other economies, with the peak increase occurring after about five or six quarters. The increase is highest for China and the EU, with the size of the impact representing about 1/4 of the size of the impact on U.S. GDP, while the impact to ASEAN and Japan are about 1/7 of the impact on U.S. GDP.

Figures A2 to A4, respectively, show the same information on the impulse responses to a shock in aggregate demand in the EU, Japan, and China.

Figures B1 to B8, on the other hand, present selected impulse responses of ASEAN macroeconomic variables (GDP, inflation, unemployment, etc.) to the different shocks to the other large economies' macroeconomic variables (U.S. GDP and inflation, EU GDP and inflation, etc.). Overall, one can glean that the most important influence to ASEAN's macroeconomic fluctuations other than shocks from within ASEAN itself, come from the U.S., then China, then Japan, then the EU, in that order. Thus, for example, an aggregate demand shock to ASEAN GDP increases on impact by about 0.4 percent. On the other hand, the response of ASEAN GDP to a U.S. aggregate demand shock peaks to about 0.06 percent after about five or six quarters, which amount represents about 1/7 of the impact of the ASEAN shock to ASEAN GDP. Next to the U.S., China has the biggest influence on the ASEAN GDP with about 1/9 of the impact relative to ASEAN's. China has a slightly bigger influence on ASEAN GDP compared to Japan, which has about 1/10 of the impact of ASEAN on ASEAN GDP. EU, on the other hand, has the smallest impact with about 1/11 of the ASEAN's impact. Thus, overall, the greatest influence on ASEAN GDP are shocks from ASEAN itself, followed by shocks from US, China, Japan, and EU, in that order. This result is very much consistent with the three-variable VAR analysis in the previous section, which show that the internal shocks from ASEAN itself has a bigger impact than shocks coming from the rest of the world.

Looking at the impact of other economies on a "typical" AMS like the Philippines, consistent with economic theory, Philippine GDP and inflation increase with an increase in the aggregate demand in the U.S., EU, Japan, China, or ASEAN. Comparing Figures C18 with Figures C1 to C5, one can glean that, on impact, a shock to Philippine aggregate demand results in a 0.5 percent decrease in the log of real Philippine GDP. The U.S. shock's impact, which peaks after about five or six quarters, represents about 1/7 of domestic shock's impact, followed by Japan and China which both have an impact of about 1/10 relative to the Philippines', and then by ASEAN and the E.U., which both have a relative impact of about 1/17 of the size of the Philippine impact. All the impacts from the other economies peak after about five or six quarters. Thus, in summary, next to the Philippines' own aggregate demand shock, the U.S. has the strongest influence on Philippine GDP fluctuations, followed by China and Japan, and then by the ASEAN and the E.U. This is very much consistent with the three-variable VAR analysis in the previous section which show that domestic shocks have the greatest influence on Philippine GDP, followed by shocks from the rest of world aggregate, followed by shock from ASEAN.

Overall, therefore, one can see that the results of the GPM are very consistent with the VAR analysis. What's more, the GPM provides a more nuanced and detailed analysis, as well as a more comprehensive analysis of other macroeconomic variables (e.g., inflation, unemployment, interest rates, exchange rate), in contrast to the VAR that capture on real GDP variables.

Finally, Figures C1 to C19 present impulse responses of Philippine macroeconomic variables to selected shocks, both domestic shocks as well as shock from other economies. Consistent with economic theory, a shock in the domestic aggregate demand results in a 0.5 percent increase in Philippine real GDP on impact, and the positive impact persists for more than two years. This results in a decrease in unemployment (which lasts for about three years before it returns to the steady state), a demand-pull increase in inflation, and an appreciation of the currency. The increases in inflation and the output gap induce the monetary authorities to increase the policy rate, via the Taylor-type monetary reaction function (equation 11).

5. Summary of Findings and Policy Implications

Section 2 narrated how, ASEAN economies, whether a developed economy like Singapore, or part of ASEAN-5 like the Philippines, or a CLMV country, are increasingly integrated with ASEAN and the world through both the trade and financial channels. For example, as we found in Section 3, a typical shock to the rest of the world (ROW) is about 0.5 percentage point on impact, increasing to about 1.3 percentage point after a year. In response, ASEAN GDP growth rises by about 0.4 percentage point on impact, and rises to about 0.9 percentage point after a year. In turn, an AMS like Singapore, for example, will see GDP growth rise by about 0.6 percentage point on impact indirectly because of the impact of ROW on ASEAN. However, ROW also impacts an AMS like Singapore directly (about 1 percentage point on impact). Section 3 also decomposed the various channels (exports channel, commodity price channel, and financial channel) through which the spillovers are transmitted, and quantified the relative importance of these channels.

As discussed in Section IV, the ripple effects extend not only to the GDP but also to other macroeconomic variables such as inflation, unemployment, interest rate, and exchange rate. We found that the greatest influence on ASEAN macroeconomic variables come from ASEAN's internal shocks, followed by shocks from the U.S., China, Japan, and EU in that order. This result is consistent with the result of the VAR analysis in Section 3. So too, for a "representative" AMS, e.g., the Philippines, we found that the greatest influence on domestic macroeconomic variables are the domestic shocks, followed by shocks from the U.S., then shocks from Japan and China, and then shocks from ASEAN and EU, in that order. This result is again consistent with the results of the VAR analysis. The Appendix (Figures A1 to C20) details the impulse responses of the various ASEAN and typical AMS macroeconomic variables (GDP, inflation, unemployment, interest rate, exchange rate) to the different shocks, both shocks coming from within, as well as shock coming from U.S., EU, Japan and China.

The linkages and spillovers mentioned above, as well the close trade and FDI linkages and high business cycle synchronization of the ASEAN +3 economies, highlight the possible scope for closer macroeconomic policy coordination. This is because some of the threats to macroeconomic stability are common to the AMS and

ASEAN +3 economies, and there is scope to either minimize negative spillovers across countries or maximize the gains from a coordinated action. As the Asian crisis, for example, has demonstrated, financial shocks can ripple across national borders. So too, as is well-known in optimal currency area (OCA) literature, the coordination of monetary and exchange rate policies would help intensify the trade and production linkages. Also, monetary and exchange rate coordination may help minimize some exchange rate risks and some beggar-thy-neighbor policies and other non-cooperative type of strategies.[6] So too, the contagion effects of speculative attacks tend to be more prevalent in areas that are more closely interconnected, and a realignment of exchange rates may help the countries to be more resistant to shocks (see Aminian, 2005).

To date, there are several efforts toward macroeconomic and financial cooperation. In April 2011, the ASEAN + 3 Macroeconomic Research Office (AMRO) was established as a surveillance body tasked to monitor the regional economies. In May 2012, the Chiang Mai Initiative Multilateralization (CMIM) fund, a regional reserve pooling fund, was expanded from USD 120 billion to USD 240 billion. Bilateral swap arrangements were also established among major Asian economies, including India, Japan, China, and the Republic of Korea. In the later part of 2012, the ASEAN stock exchanges rolled out the ASEAN Trading link. Also, various policy for a exist to serve as venue for policy dialogues and cooperation. These include the South East Asian Central Banks (SEACEN) Meetings, the Executives' Meeting of East Asia Pacific Central Banks (EMEAP), the Asia-Pacific Economic Cooperation (APEC) Finance Ministerial Meetings, the Asia-Europe Meetings (ASEM) and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) meetings, among others (see ADB, 2013).

These efforts notwithstanding, there is more scope to closer coordination of macroeconomic and exchange rate policies. Yet, there are several obstacles to achieving more commitment for policy coordination among ASEAN +3 economies. In analyzing these hindrance, we can perhaps glean some lessons from microeconomic theory. The lessons from *prisoner's dilemma* and the *tragedy of the commons* are that short-sighted and selfish motives may motivate individuals and countries, notwithstanding the Pareto gains from cooperation. Also, the theory of public goods will remind us that the benefits from a collective response notwithstanding, free-rider issues may prevent the provision of the regional public good, such as a coordinated of macroeconomic and exchange rate response to common shocks. Although non-cooperative game theory may offer a way by which a cooperative equilibrium can be achieved in repeated games (e.g., via *tit-for-tat* strategies), such a beneficial outcome is not guaranteed, specifically in time horizons that are not sufficiently long (Escaith, 2004). Inevitably perhaps, one would have to resort to cooperative game theory instead, in order to solve the macroeconomic coordination dilemma. A strong political will and binding commitment may be required from the states in order to sustain a cooperation as close an approximation as possible to the Pareto-optimal outcome. In other words, a binding commitment by the parties, or an enforceable coordinating action by a credible outside institution, may be a necessary condition to Pareto optimality. [7]

The obstacles mentioned above notwithstanding, the case for a closer monetary and exchange rate coordination remains. However, a full Asian monetary union may not be optimal in the very near future, as certain preconditions towards it will still have to be met. For one, a monetary union entails the loss of monetary sovereignty and the ability to react to country-specific shocks. Second, there are still significant differences in ASEAN + 3 economies, in levels of financial and economic development, size, and industrial structures, and well as heterogeneity in exchange rate regimes, monetary goals and preferences. Also, in practice, achieving a full monetary union may require political commitments, or at least concord, from the participating economies, which may be difficult to achieve at the moment given the state of Sino-Japanese relations. Instead, what may be the optimal way to proceed is to foster a closer monetary and exchange rate coordination, and a full monetary union may be optimal only in the long run. When there is already real convergence in the economies as to make the shocks symmetric, political and institutional commitments for a full monetary union are strong, and there are in place compensating mechanisms such more labor mobility and/or availability of fiscal transfers, then the case for a monetary union would be more pressing (see Aminian, 2005).

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Table A1: Results from GPM4 Estimation – Parameters

	Prior distribution	Prior mean	Prior s.d.	Posterior mode	s.d.
alpha1_EU	beta	0.750	0.0500	0.7149	0.0449
alpha1_JA	beta	0.750	0.0500	0.7503	0.0516
alpha1_US	beta	0.750	0.0500	0.7458	0.0458
alpha2_EU	gamm	0.300	0.0500	0.1847	0.0206
alpha2_JA	gamm	0.100	0.0500	0.0344	0.0151
alpha2_US	gamm	0.300	0.0500	0.2573	0.0290
alpha3_EU	beta	0.500	0.2000	0.5253	0.2430
alpha3_JA	beta	0.500	0.2000	0.3227	0.1934
alpha3_US	beta	0.500	0.2000	0.2536	0.1603
beta_fact_EU	gamm	0.052	0.0100	0.0504	0.0098
beta_fact_JA	gamm	0.045	0.0100	0.0407	0.0093
beta_fact_US	gamm	0.040	0.0100	0.0377	0.0096
beta_reergap_EU	gamm	0.104	0.0200	0.1098	0.0185
beta_reergap_JA	gamm	0.090	0.0100	0.0919	0.0101
beta_reergap_US	gamm	0.060	0.0100	0.0497	0.0085
beta1_EU	gamm	0.750	0.0500	0.7857	0.0405
beta1_JA	gamm	0.750	0.0500	0.6915	0.0457
beta1_US	gamm	0.750	0.0500	0.7451	0.0406
beta2_EU	beta	0.100	0.0500	0.1371	0.0511
beta2_JA	beta	0.100	0.0500	0.0657	0.0392
beta2_US	beta	0.100	0.0500	0.0574	0.0335
beta3_EU	gamm	0.200	0.0500	0.1486	0.0357
beta3_JA	gamm	0.200	0.0500	0.1556	0.0400
beta3_US	gamm	0.200	0.0500	0.1069	0.0264
pietar_EU_ss	gamm	1.900	0.0500	1.9046	0.0496
pietar_JA_ss	gamm	1.000	0.1000	0.9522	0.0966
pietar_US_ss	gamm	2.500	0.0500	2.5066	0.0500
gamma1_EU	beta	0.500	0.1000	0.8673	0.0199
gamma1_JA	beta	0.500	0.1000	0.8273	0.0574
gamma1_US	beta	0.500	0.1000	0.8673	0.0197
gamma2_EU	gamm	1.500	0.1000	1.4844	0.0986
gamma2_JA	gamm	1.500	0.1000	1.4138	0.0956
gamma2_US	gamm	1.500	0.0500	1.4956	0.0497
gamma4_EU	gamm	0.200	0.0500	0.1973	0.0505
gamma4_JA	gamm	0.200	0.0500	0.1586	0.0412
gamma4_US	gamm	0.200	0.0500	0.1970	0.0505
growth_EU_ss	norm	2.000	0.0200	1.9969	0.0199
growth_JA_ss	norm	1.700	0.0200	1.6985	0.0200
growth_US_ss	norm	2.200	0.0400	2.2266	0.0386
lambda1_EU	beta	0.500	0.1000	0.4838	0.0603
lambda1_JA	beta	0.500	0.1000	0.6025	0.0960
lambda1_US	beta	0.500	0.1000	0.6778	0.0626
lambda2_EU	gamm	0.250	0.0500	0.2509	0.0443

	Prior distribution	Prior mean	Prior s.d.	Posterior mode	s.d.
lambda2_JA	gamm	0.250	0.0500	0.1688	0.0368
lambda2_US	gamm	0.200	0.0500	0.2420	0.0482
lambda3_EU	gamm	0.208	0.0500	0.1145	0.0279
lambda3_JA	gamm	0.180	0.0500	0.1290	0.0308
lambda3_US	gamm	0.120	0.0500	0.1439	0.0597
phi_EU	beta	0.500	0.2000	0.7414	0.0393
phi_JA	beta	0.500	0.2000	0.7489	0.0681
rho_EU	beta	0.500	0.1000	0.4892	0.1095
rho _JA	beta	0.500	0.1000	0.4981	0.1071
rho_US	beta	0.500	0.1000	0.4998	0.1066
rr_bar_EU_ss	norm	2.000	0.3000	1.3797	0.1860
rr_bar_JA_ss	norm	2.000	0.3000	1.0358	0.2390
rr_bar_US_ss	norm	2.000	0.3000	1.8794	0.2727
tau_EU	beta	0.100	0.0300	0.0873	0.0286
tau_JA	beta	0.100	0.0300	0.0865	0.0287
tau_US	beta	0.100	0.0300	0.0969	0.0304
theta_US	gamm	1.000	0.5000	1.7040	0.5963
kappa_US	gamm	20.000	0.5000	19.7672	0.4936
alpha1_CH	beta	0.500	0.0200	0.5015	0.0200
alpha2_CH	gamm	0.100	0.0500	0.0431	0.0145
alpha3_CH	beta	0.500	0.2000	0.4655	0.2222
beta1_CH	gamm	0.750	0.0500	0.6910	0.0380
beta2_CH	beta	0.100	0.0500	0.0511	0.0303
beta3_CH	gamm	0.200	0.0500	0.1752	0.0406
gamma1_CH	beta	0.500	0.0200	0.5245	0.0205
gamma2_CH	gamm	1.500	0.1000	1.3390	0.0906
gamma4_CH	gamm	0.200	0.0500	0.1655	0.0425
growth_CH_ss	norm	10.700	0.2000	10.5327	0.2208
pietar_CH_ss	gamm	2.300	0.5000	2.8997	0.4773
lambda1_CH	beta	0.500	0.1000	0.8141	0.0431
lambda2_CH	gamm	0.250	0.0500	0.1919	0.0397
lambda3_CH	gamm	0.200	0.0500	0.1603	0.0400
rho_CH	beta	0.500	0.1000	0.3295	0.0776
rr_bar_CH_ss	norm	1.400	0.1000	1.4302	0.1001
tau_CH	beta	0.100	0.0500	0.0310	0.0260
beta_reergap_CH	gamm	0.100	0.0500	0.0505	0.0230
phi_CH	beta	0.500	0.2000	0.8080	0.0579

Table A2: Results from GPM4 Estimation – Standard Deviation of Structural Shocks

	Prior distribution	Prior mean	Prior s.d.	Posterior mode	s.d.
RES_PIE_CH	invg	0.500	Inf	2.5044	0.3340
RES_Y_CH	invg	0.300	Inf	0.6967	0.1008
RES_RS_CH	invg	0.250	Inf	0.1142	0.0459
RES_LGDP_BAR_CH	invg	0.020	Inf	0.0092	0.0038
RES_G_CH	invg	0.100	Inf	0.1243	0.0784
RES_RR_BAR_CH	invg	0.200	Inf	2.1570	0.3329
RES_UNR_BAR_CH	invg	0.100	Inf	0.0350	0.0091
RES_UNR_G_CH	invg	0.100	Inf	0.0364	0.0091
RES_UNR_GAP_CH	invg	0.200	Inf	0.0500	0.0088
RES_LZ_BAR_CH	invg	1.000	Inf	1.2986	0.2081
RES_RR_DIFF_CH	invg	1.000	Inf	0.4308	0.1550
RES_BLT_BAR_US	invg	0.200	Inf	0.0921	0.0376
RES_BLT_US	invg	0.400	Inf	0.7696	0.2812
RES_G_EU	invg	0.100	0.0500	0.0766	0.0247
RES_G_JA	invg	0.100	0.0500	0.0847	0.0360
RES_G_US	invg	0.100	Inf	0.0418	0.0156
RES_LGDP_BAR_EU	invg	0.200	0.0500	0.1797	0.0360
RES_LGDP_BAR_JA	invg	0.200	0.0500	0.2306	0.1044
RES_LGDP_BAR_US	invg	0.050	0.0500	0.0288	0.0109
RES_LZ_BAR_EU	invg	1.000	Inf	5.5022	0.8278
RES_LZ_BAR_JA	invg	4.000	Inf	5.7895	1.3081
RES_PIE_EU	invg	0.500	Inf	1.2743	0.2022
RES_PIE_JA	invg	1.000	Inf	1.0527	0.1428
RES_PIE_US	invg	0.700	Inf	2.3917	0.3126
RES_RR_BAR_EU	invg	0.200	0.0400	0.1856	0.0338
RES_RR_BAR_JA	invg	0.100	0.0400	0.0787	0.0225
RES_RR_BAR_US	invg	0.200	Inf	0.0929	0.0386
RES_RR_DIFF_EU	invg	1.000	Inf	0.4591	0.1862
RES_RR_DIFF_JA	invg	0.500	Inf	0.2304	0.0941
RES_RS_EU	invg	0.250	Inf	0.1874	0.0300
RES_RS_JA	invg	0.250	Inf	0.3984	0.0828
RES_RS_US	invg	0.700	Inf	0.4223	0.0619
RES_UNR_BAR_EU	invg	0.100	Inf	0.0365	0.0100
RES_UNR_BAR_JA	invg	0.100	Inf	0.0533	0.0325
RES_UNR_BAR_US	invg	0.100	Inf	0.0450	0.0173
RES_UNR_G_EU	invg	0.100	Inf	0.0369	0.0101
RES_UNR_G_JA	invg	0.100	Inf	0.0484	0.0181
RES_UNR_G_US	invg	0.100	Inf	0.0703	0.0259
RES_UNR_GAP_EU	invg	0.200	Inf	0.0556	0.0105
RES_UNR_GAP_JA	invg	0.100	Inf	0.0772	0.0258
RES_UNR_GAP_US	invg	0.200	Inf	0.0817	0.0195
RES_Y_EU	invg	0.300	0.0500	0.2538	0.0312
RES_Y_JA	invg	0.500	0.1000	0.6918	0.1290
RES_Y_US	invg	0.250	Inf	0.3910	0.0539

Table B1: Results from GPM5 Asean Estimation – Parameters

	Prior distribution	Prior mean	Prior s.d.	Posterior mode	s.d.
alpha1_AS	beta	0.750	0.1000	0.8221	0.0356
alpha2_AS	gamm	0.100	0.0500	0.0687	0.0160
alpha3_AS	beta	0.500	0.2000	0.4512	0.0548
beta1_AS	gamm	0.650	0.1000	0.6353	0.0247
beta2_AS	beta	0.150	0.1000	0.0943	0.0320
beta3_AS	gamm	0.150	0.1000	0.0690	0.0126
gamma1_AS	beta	0.750	0.1000	0.9430	0.0155
gamma2_AS	gamm	1.100	0.1000	1.0857	0.0346
gamma4_AS	gamm	0.500	0.2000	0.4719	0.0576
lambda1_AS	beta	0.500	0.1000	0.6299	0.0296
lambda2_AS	gamm	0.400	0.1000	0.3774	0.0198
lambda3_AS	gamm	0.050	0.0100	0.0480	0.0032
rho_AS	beta	0.500	0.2000	0.0110	0.0689
phi_AS	beta	0.600	0.1000	0.6625	0.0258
tau_AS	beta	0.050	0.0200	0.0427	0.0049
rr_bar_AS_ss	norm	1.500	0.1000	1.4835	0.0494
growth_AS_ss	norm	5.000	0.2000	5.0157	0.0651
beta_reergap_AS	gamm	0.050	0.0200	0.0472	0.0074

Table B2: Results from GPM5Asean Estimation – Standard Deviation of Structural Shocks

	Prior distribution	Prior mean	Prior s.d.	Posterior mode	s.d.
RES_PIE_AS	invg	3.000	Inf	3.6982	0.4221
RES_Y_AS	invg	0.500	1.0000	0.2406	0.1084
RES_RS_AS	invg	0.600	1.0000	0.2213	0.0347
RES_LGDP_BAR_AS	invg	0.200	Inf	18.5265	0.9173
RES_G_AS	invg	0.100	Inf	0.0460	0.0381
RES_RR_BAR_AS	invg	0.200	Inf	0.1877	0.5291
RES_UNR_GAP_AS	invg	0.600	1.0000	0.2488	0.0478
RES_UNR_BAR_AS	invg	0.100	Inf	0.0461	0.0493
RES_UNR_G_AS	invg	0.100	Inf	0.0472	0.0237
RES_LZ_BAR_AS	invg	5.000	Inf	4.8714	0.8198
RES_RR_DIFF_AS	invg	1.000	Inf	0.4591	0.3230

Table C1: Results from GPM6 Philippines Estimation - Parameters

	Prior distribution	Prior mean	Prior s.d.	Posterior mode	s.d.
alpha1_PH	beta	0.750	0.0500	0.7810	0.0434
alpha2_PH	gamm	0.100	0.0500	0.0882	0.0503
alpha3_PH	beta	0.500	0.2000	0.4673	0.3086
beta_fact_PH	gamm	0.150	0.1000	0.1171	0.1024
beta1_PH	gamm	0.650	0.1000	0.5710	0.0806
beta2_PH	beta	0.150	0.0500	0.1234	0.0446
beta3_PH	gamm	0.150	0.0200	0.1310	0.0181
gamma1_PH	beta	0.900	0.0500	0.9101	0.0207
gamma2_PH	gamm	1.100	0.5000	0.8872	0.3600
gamma4_PH	gamm	0.500	0.2000	0.4034	0.1745
growth_PH_ss	norm	5.000	0.2000	5.0000	0.2000
lambda1_PH	beta	0.500	0.0500	0.5616	0.0477
lambda2_PH	gamm	0.400	0.1000	0.3522	0.0876
lambda3_PH	gamm	0.050	0.0300	0.0390	0.0292
lambda1_RS_PH	beta	0.500	0.1000	0.4469	0.0868
phi_PH	beta	0.600	0.0500	0.6303	0.0364
pietar_PH_ss	gamm	4.714	0.3000	4.6951	0.2994
rho_PH	beta	0.500	0.2000	0.2675	0.1123
rr_bar_PH_ss	norm	1.500	0.5000	1.5000	0.5000
tau_PH	beta	0.050	0.0200	0.0436	0.0188
beta_reergap_PH	gamm	0.050	0.0100	0.0480	0.0098
chi_PH	beta	0.050	0.0100	0.0481	0.0098
growth_PH_ss	norm	5.000	0.2000	5.0401	0.1632
pietar_PH_ss	gamm	4.714	0.3000	4.6951	0.2994
rr_bar_PH_ss	norm	1.500	0.5000	1.4629	0.4574
beta_reergap_PH	gamm	0.050	0.0100	0.0503	0.0097

Table C2: Results from GPM6 Philippines Estimation – Standard Deviation of Structural Shocks

	Prior distribution	Prior mean	Prior s.d.	Posterior mode	s.d.
RES_PIETAR_PH	invg	0.250	Inf	0.1028	0.0338
RES_PIE_PH	invg	3.000	Inf	3.2548	0.4240
RES_Y_PH	invg	0.500	1.0000	0.4392	0.0933
RES_RS_PH	invg	0.600	1.0000	0.2533	0.0486
RES_LGDP_BAR_PH	invg	0.200	Inf	0.0900	0.0353
RES_G_PH	invg	0.100	Inf	0.0442	0.0168
RES_RR_BAR_PH	invg	2.500	Inf	1.8752	0.4157
RES_UNR_GAP_PH	invg	1.000	1.0000	0.9615	0.1265
RES_UNR_BAR_PH	invg	0.100	Inf	0.0464	0.0192
RES_UNR_G_PH	invg	0.100	Inf	0.0477	0.0210
RES_LZ_BAR_PH	invg	5.000	Inf	5.7296	1.3704
RES_RR_DIFF_PH	invg	1.000	Inf	0.4587	0.1857
RES_DOT_LZ_BAR_PH	invg	0.100	Inf	0.0461	0.0188

Figure A1(a): Shock to RES_Y_US

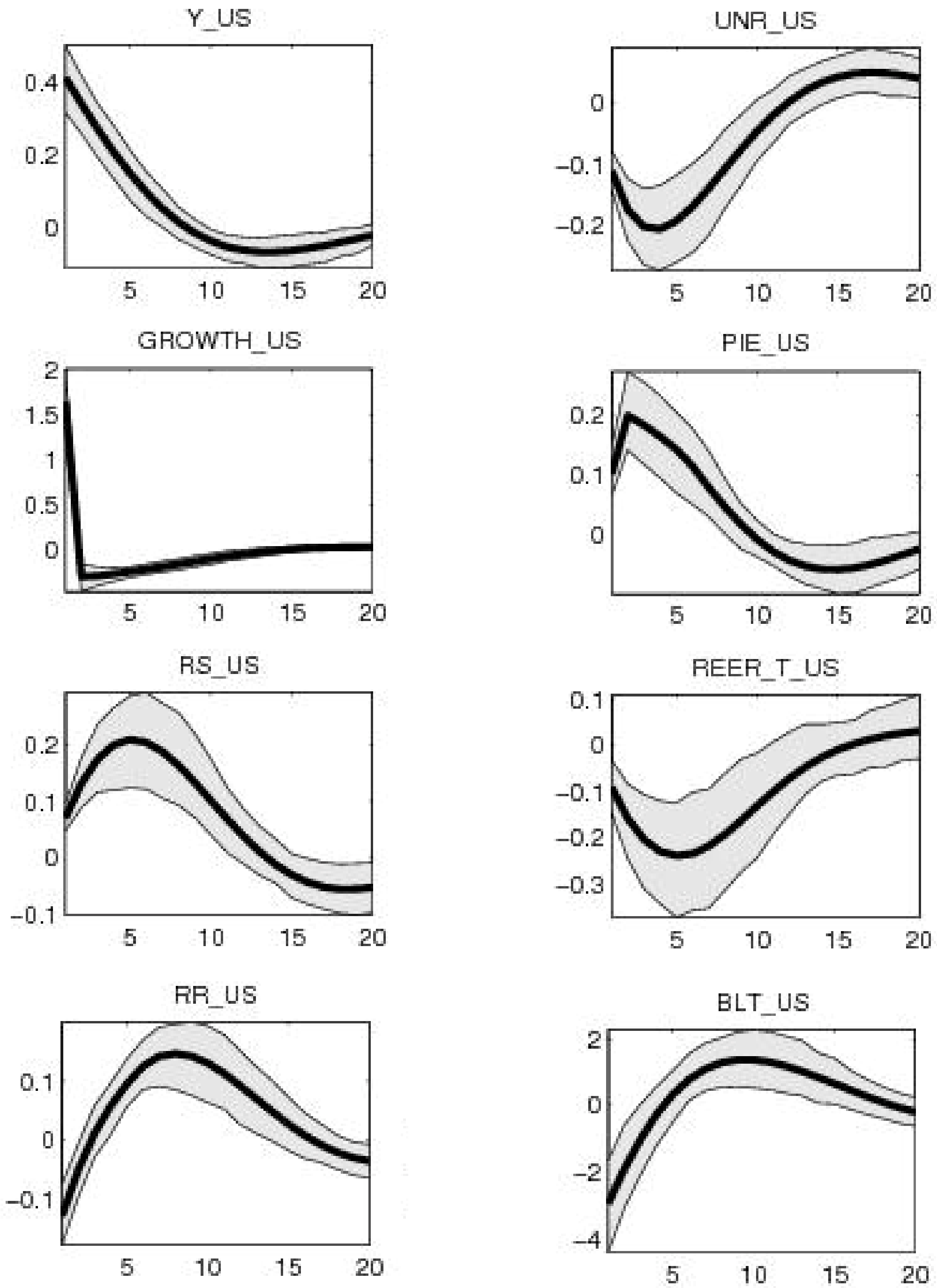


Figure A1(b): Shock to RES_Y_US

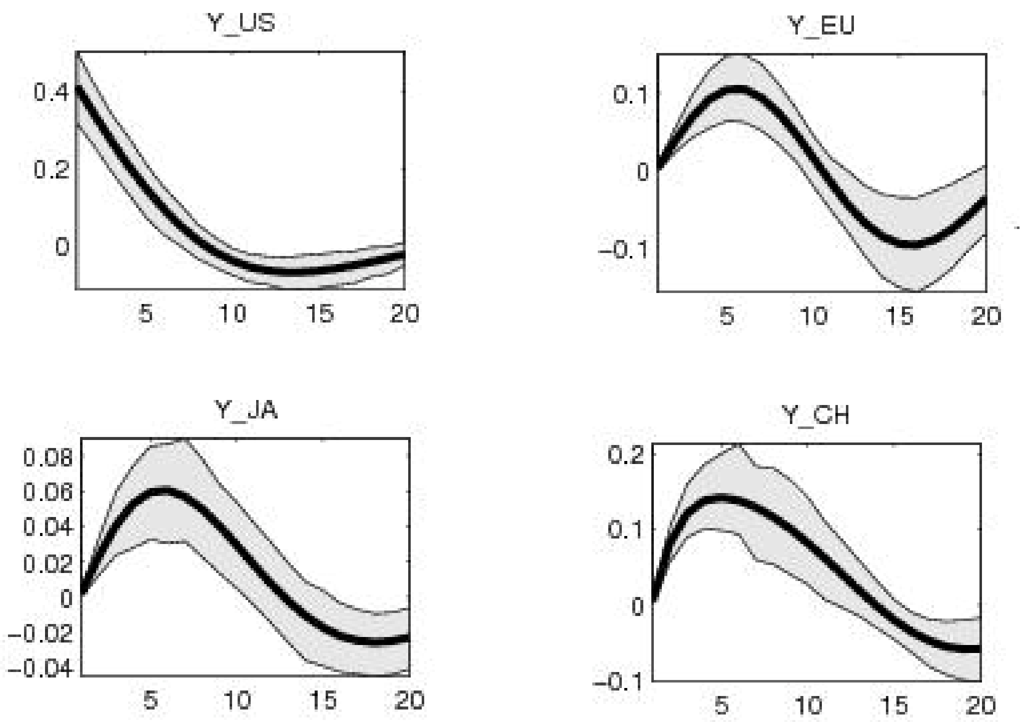


Figure A2(a): Shock to RES_Y_EU

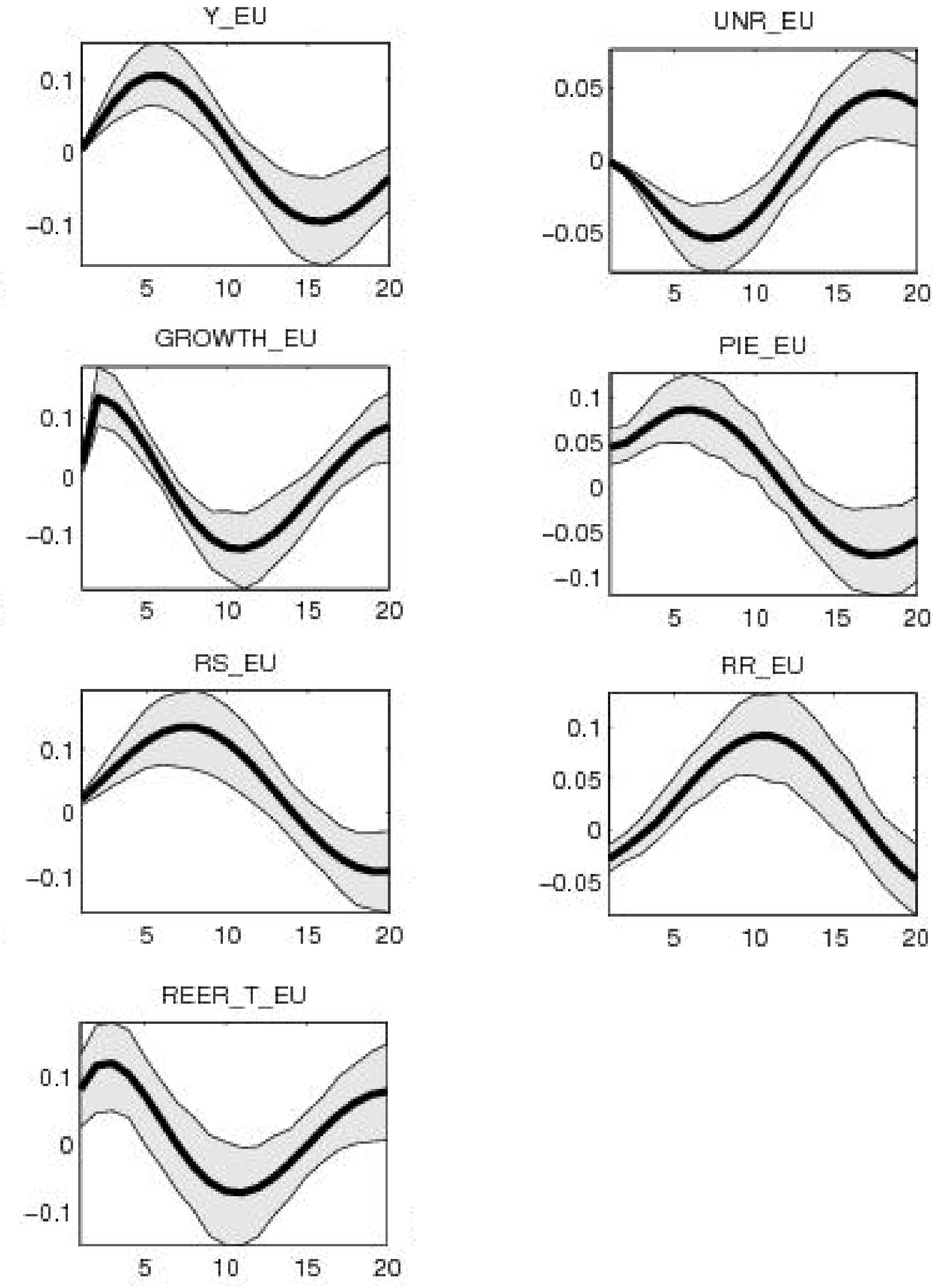


Figure A2(b): Shock to RES_Y_EU

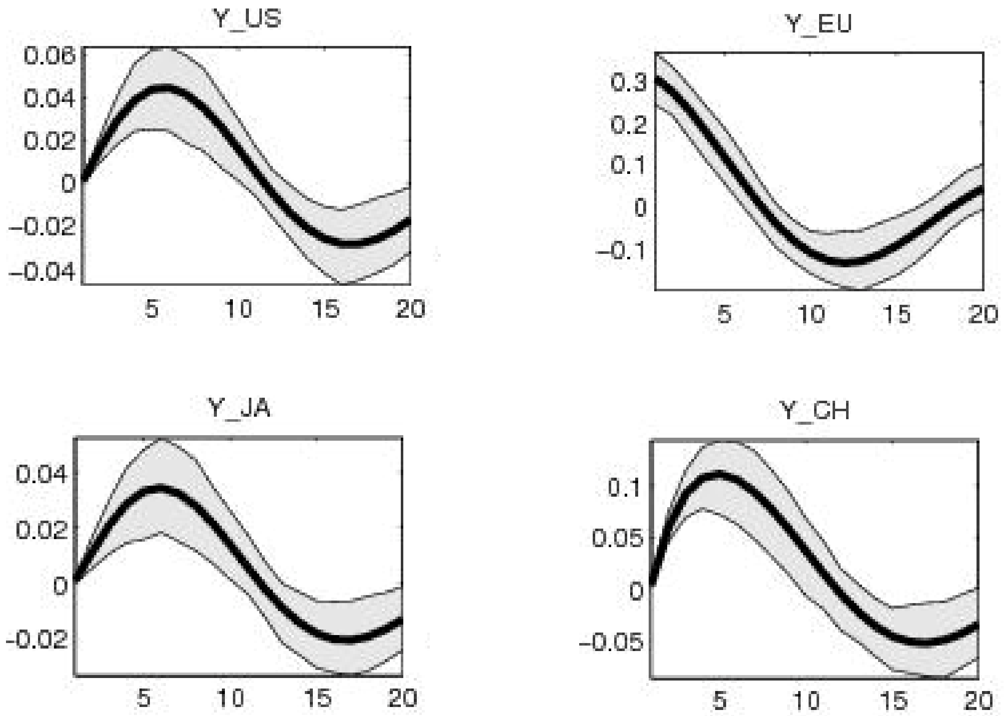


Figure A3(a): Shock to RES_Y_JA

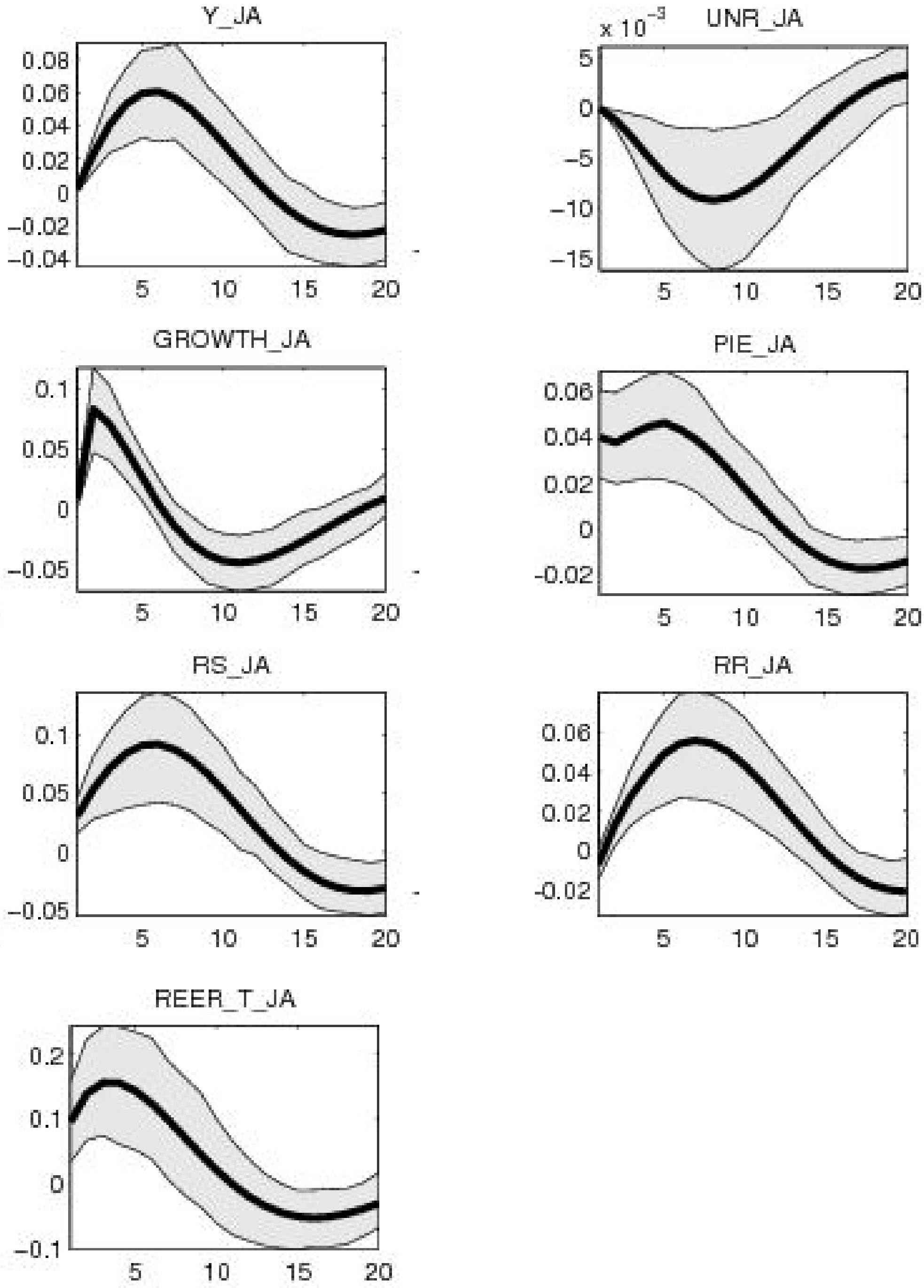


Figure A3(b): Shock to RES_Y_JA

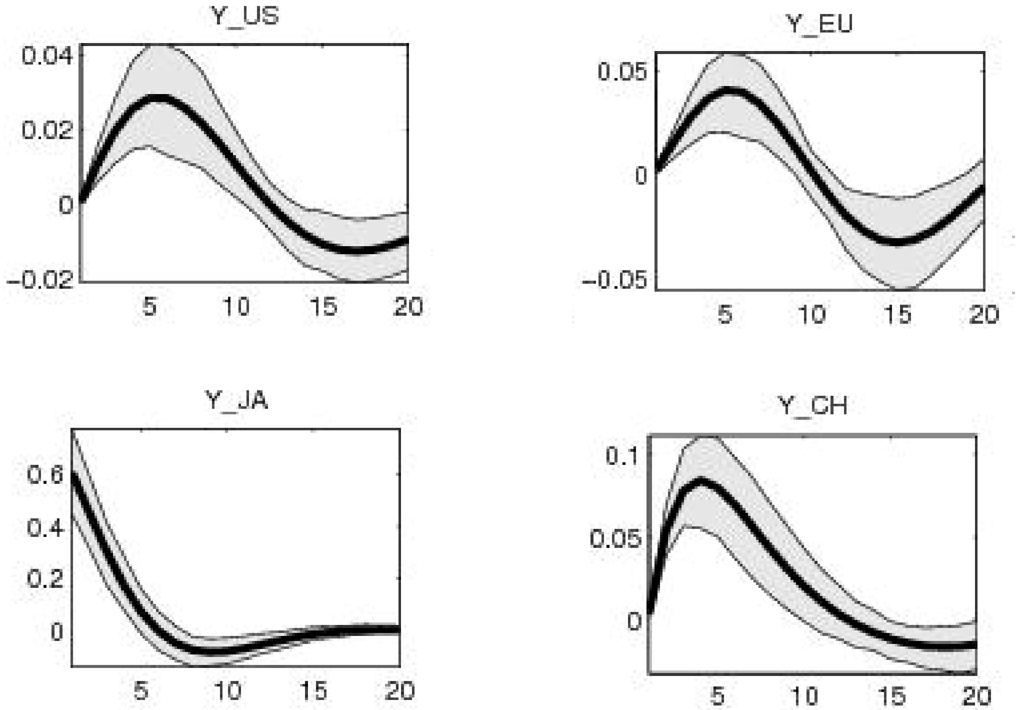


Figure A4(a): Shock to RES_Y_CH

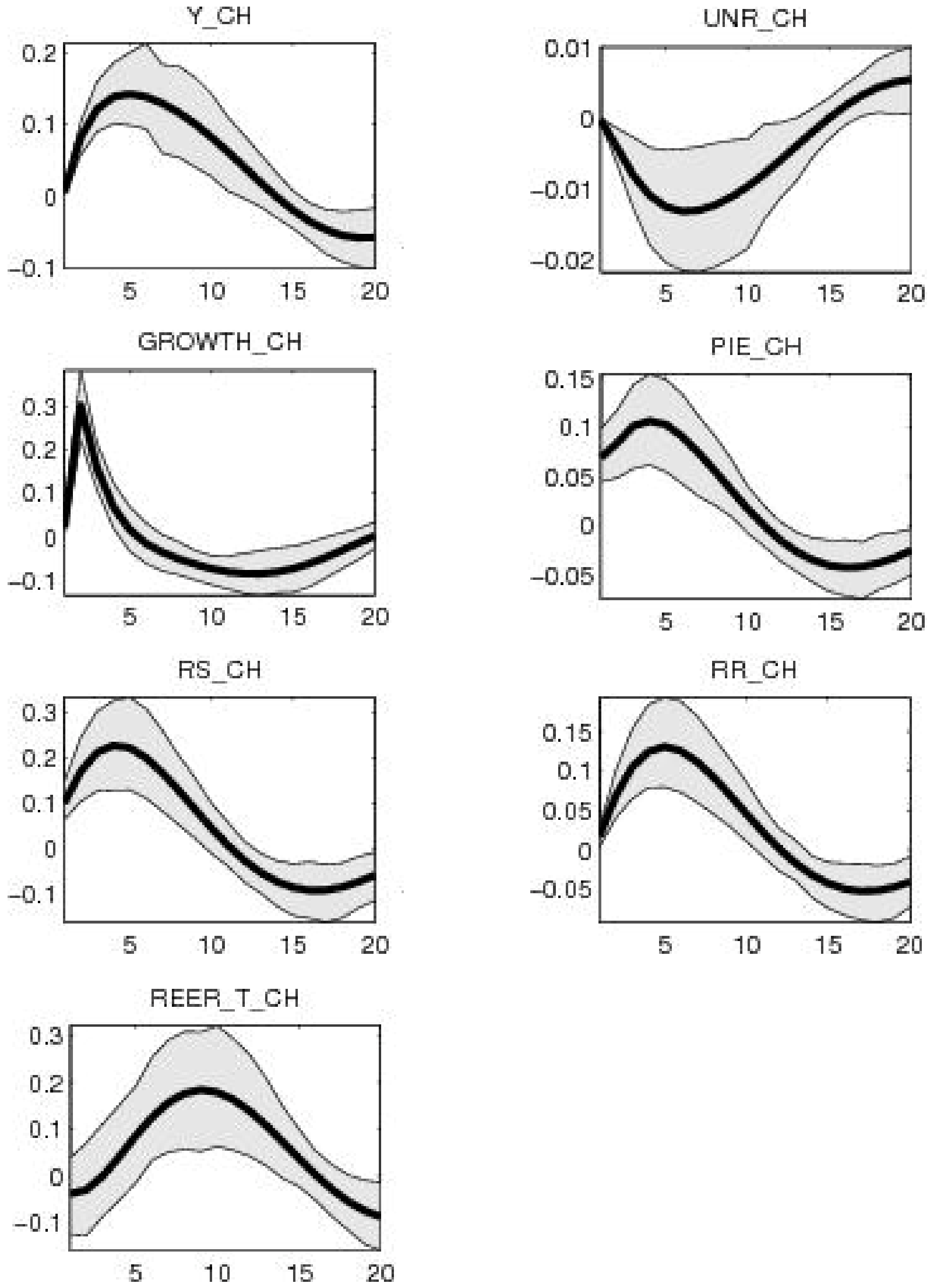


Figure A4(b): Shock to RES_Y_CH

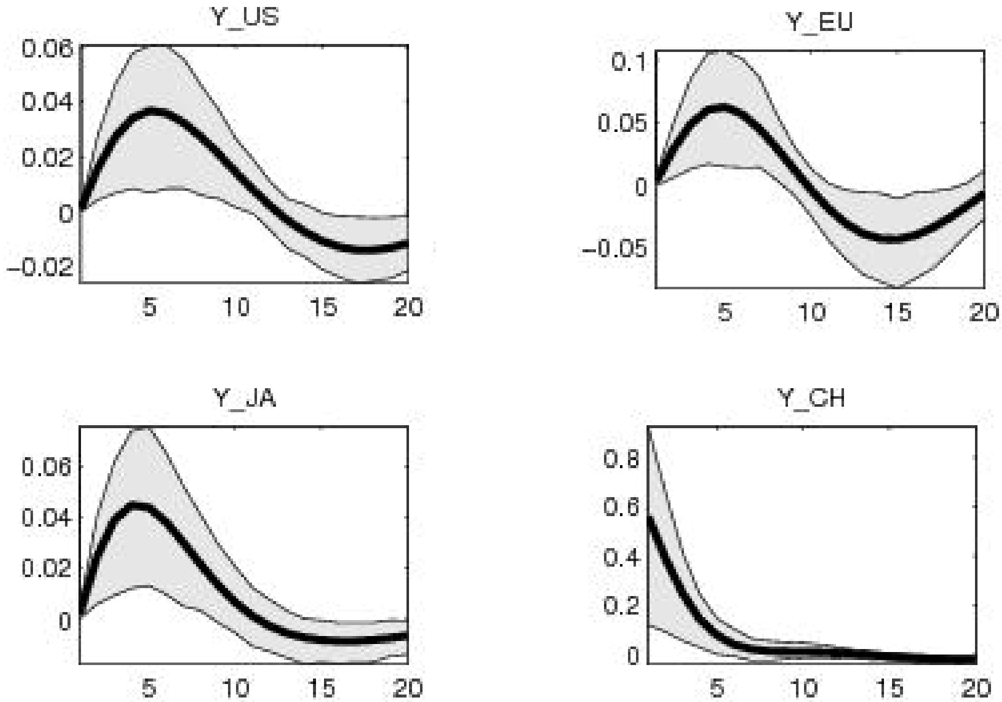


Figure B1: Shock to RES_Y_US

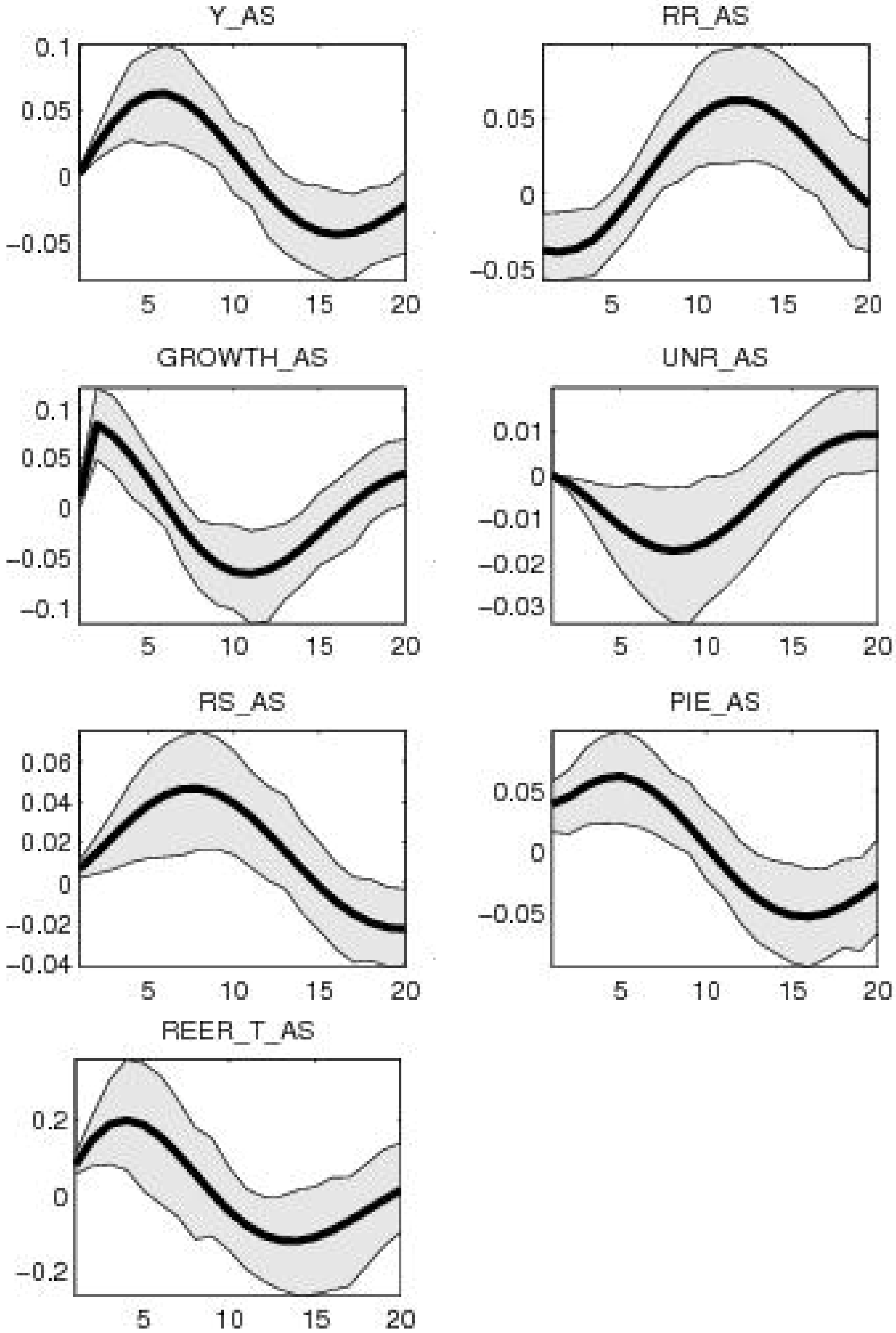


Figure B2: Shock to RES_Y_EU

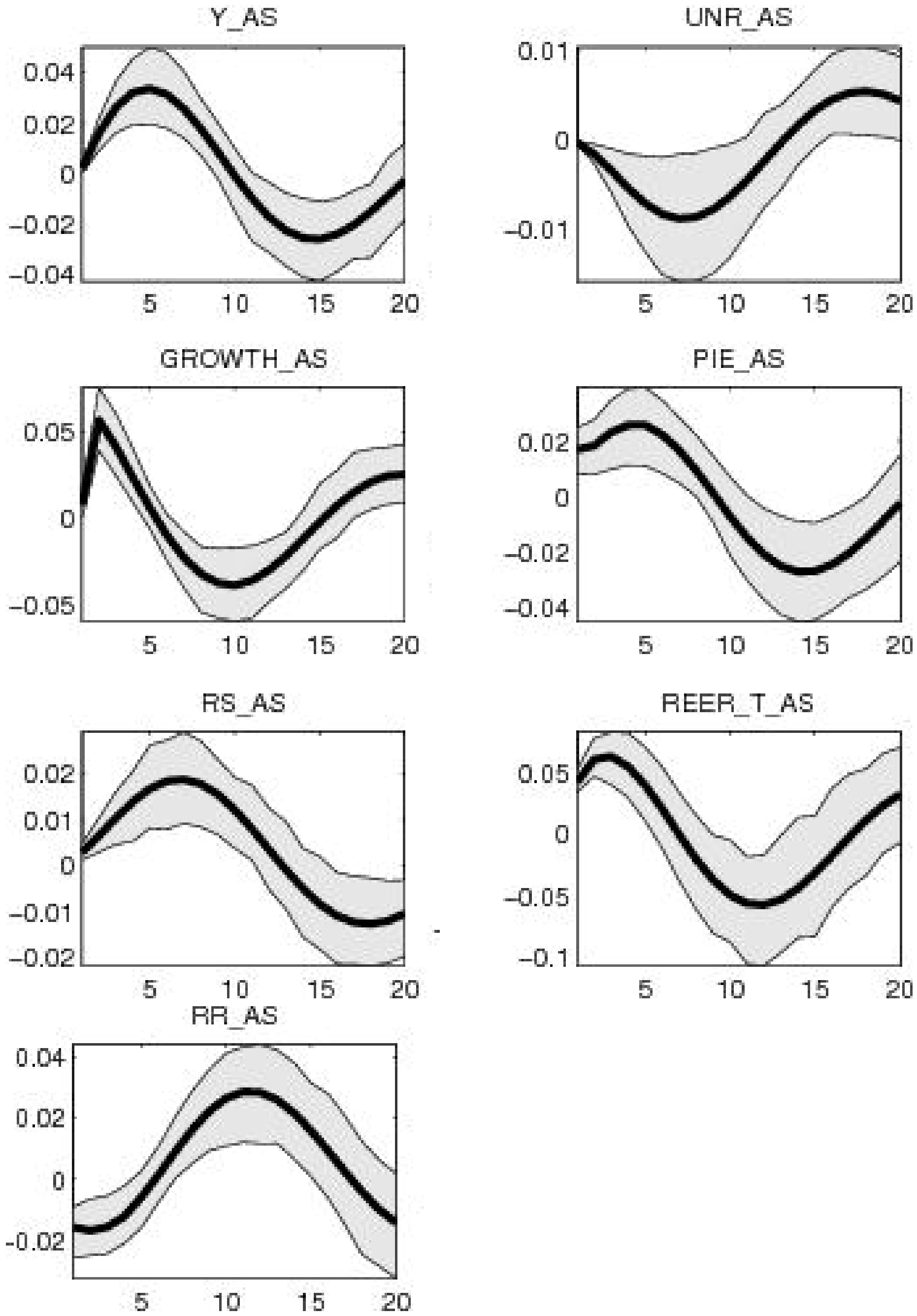


Figure B3: Shock to RES_PIE_US

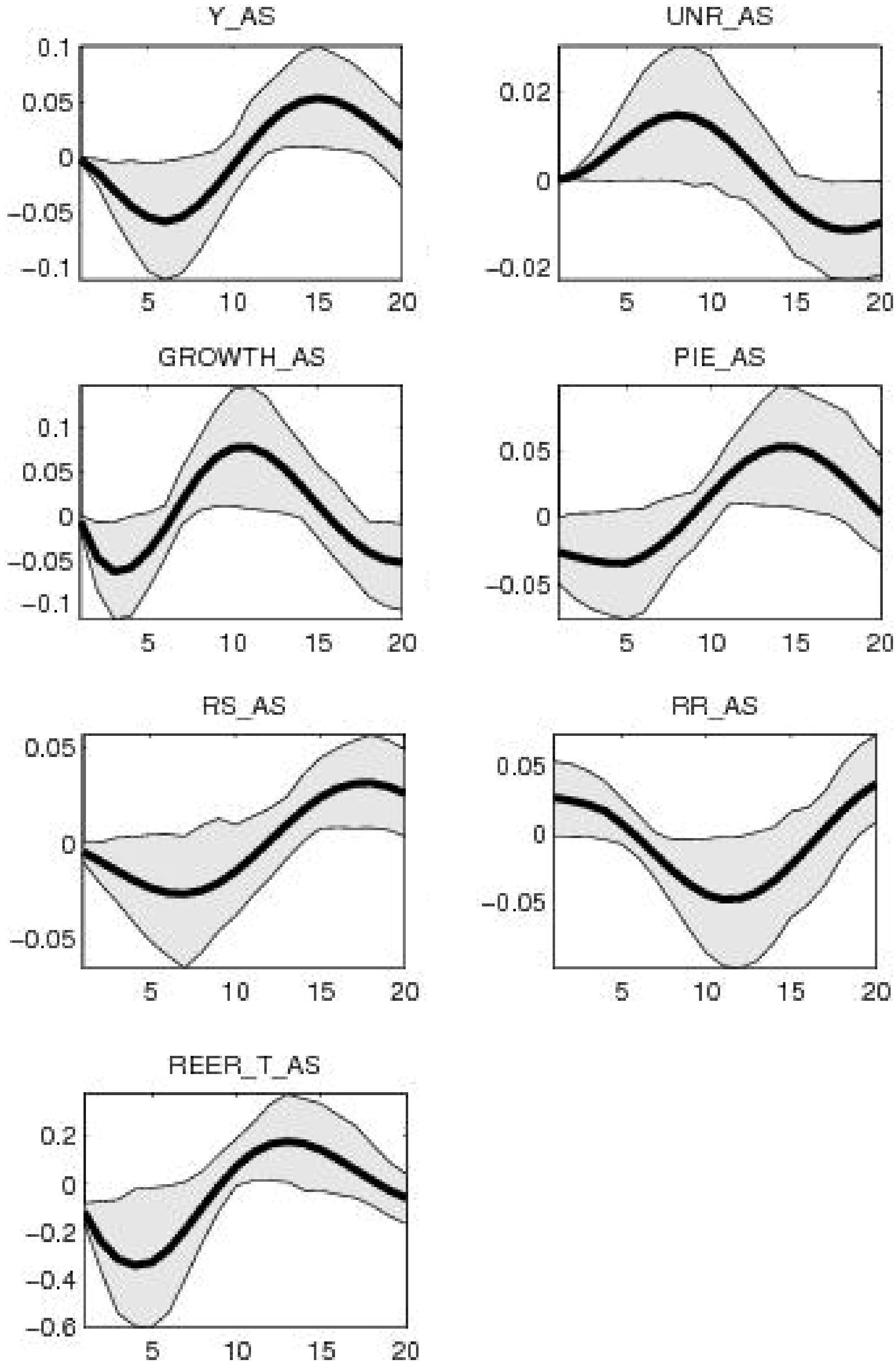


Figure B4: Shock to RES_PIE_EU

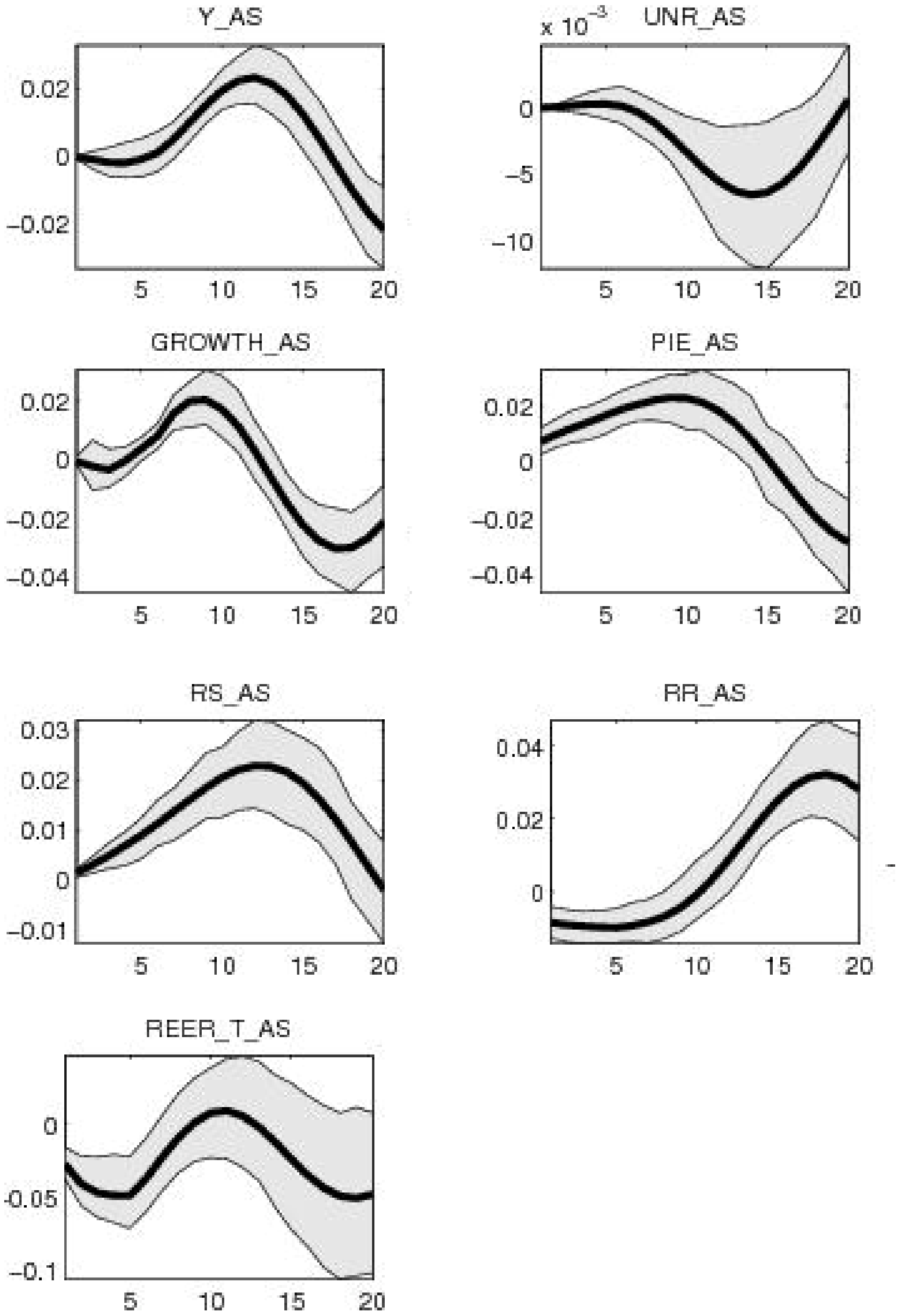


Figure B5: Shock to RES_PIE_JA

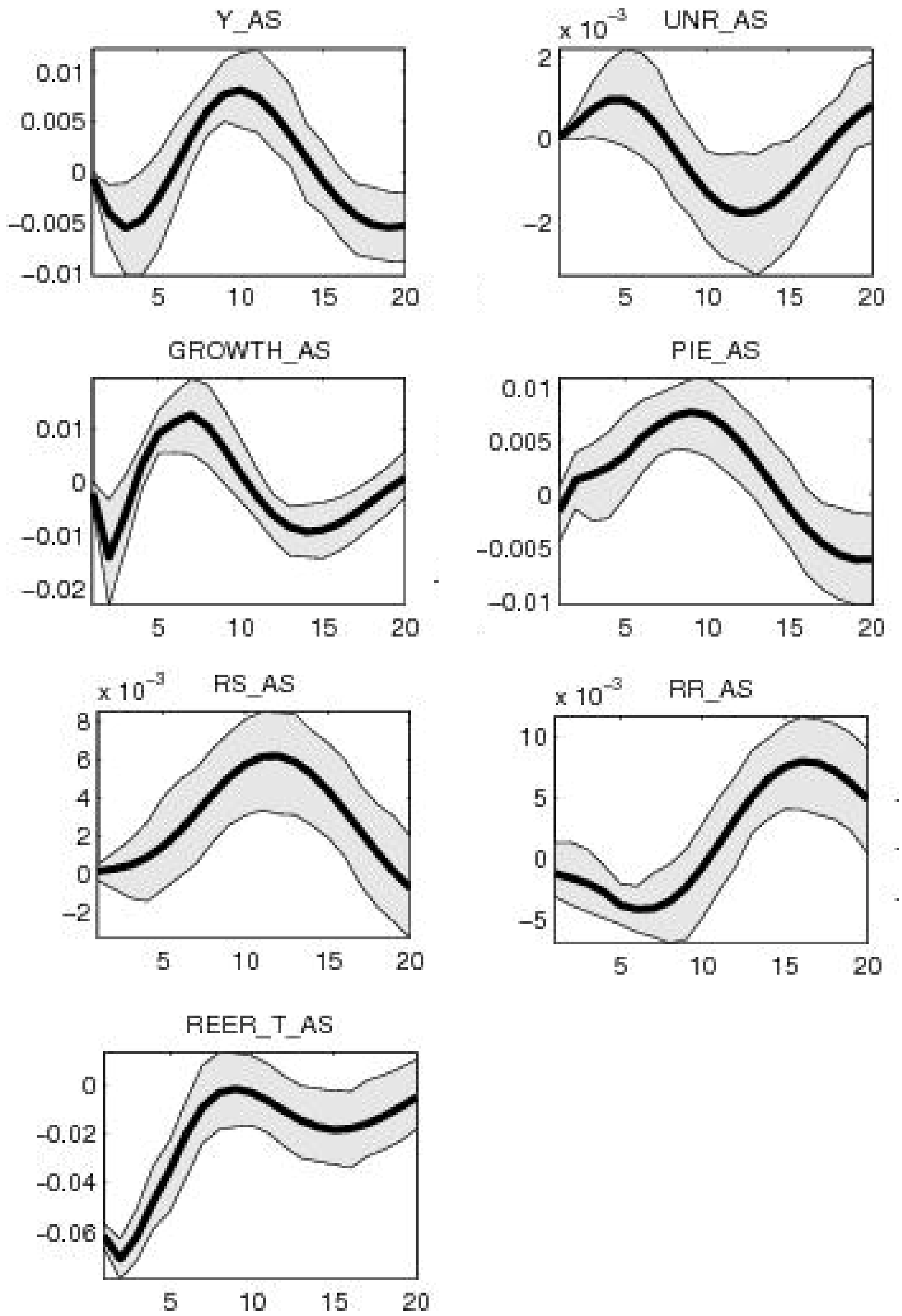


Figure B6: Shock to RES_RS_US

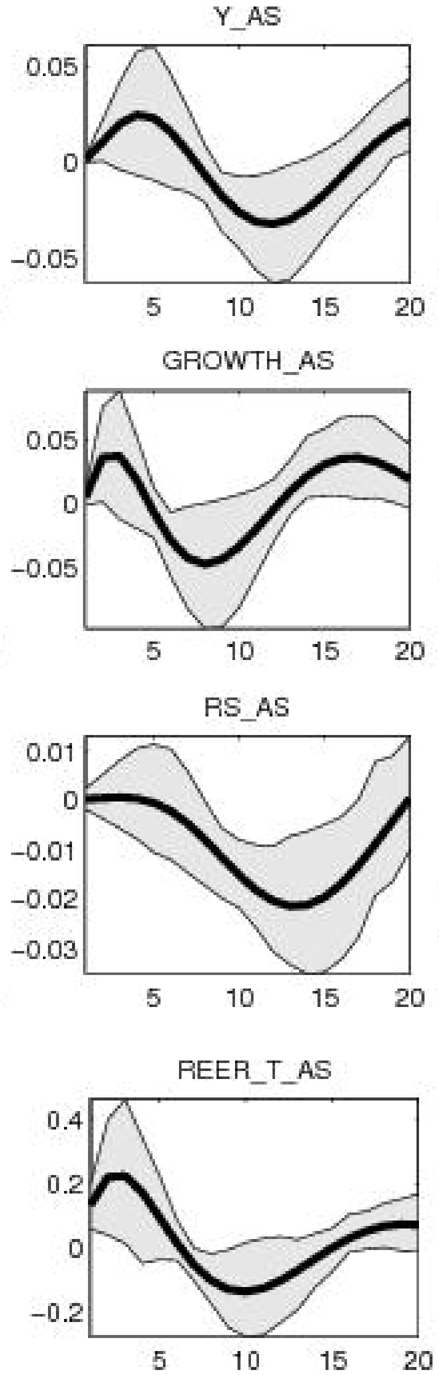


Figure B7: Shock to RES_RS_EU

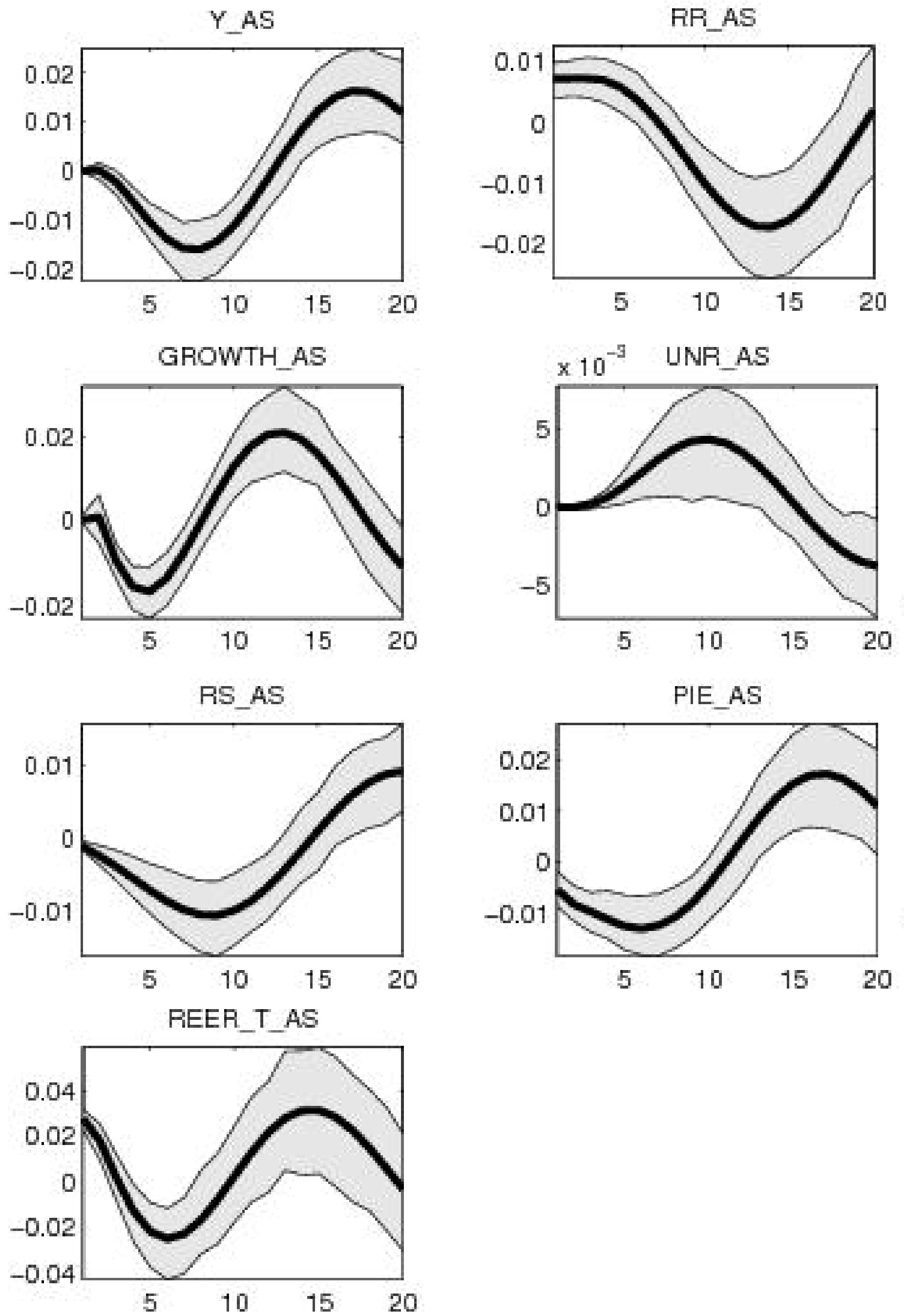


Figure B8: Shock to RES_BLT_US

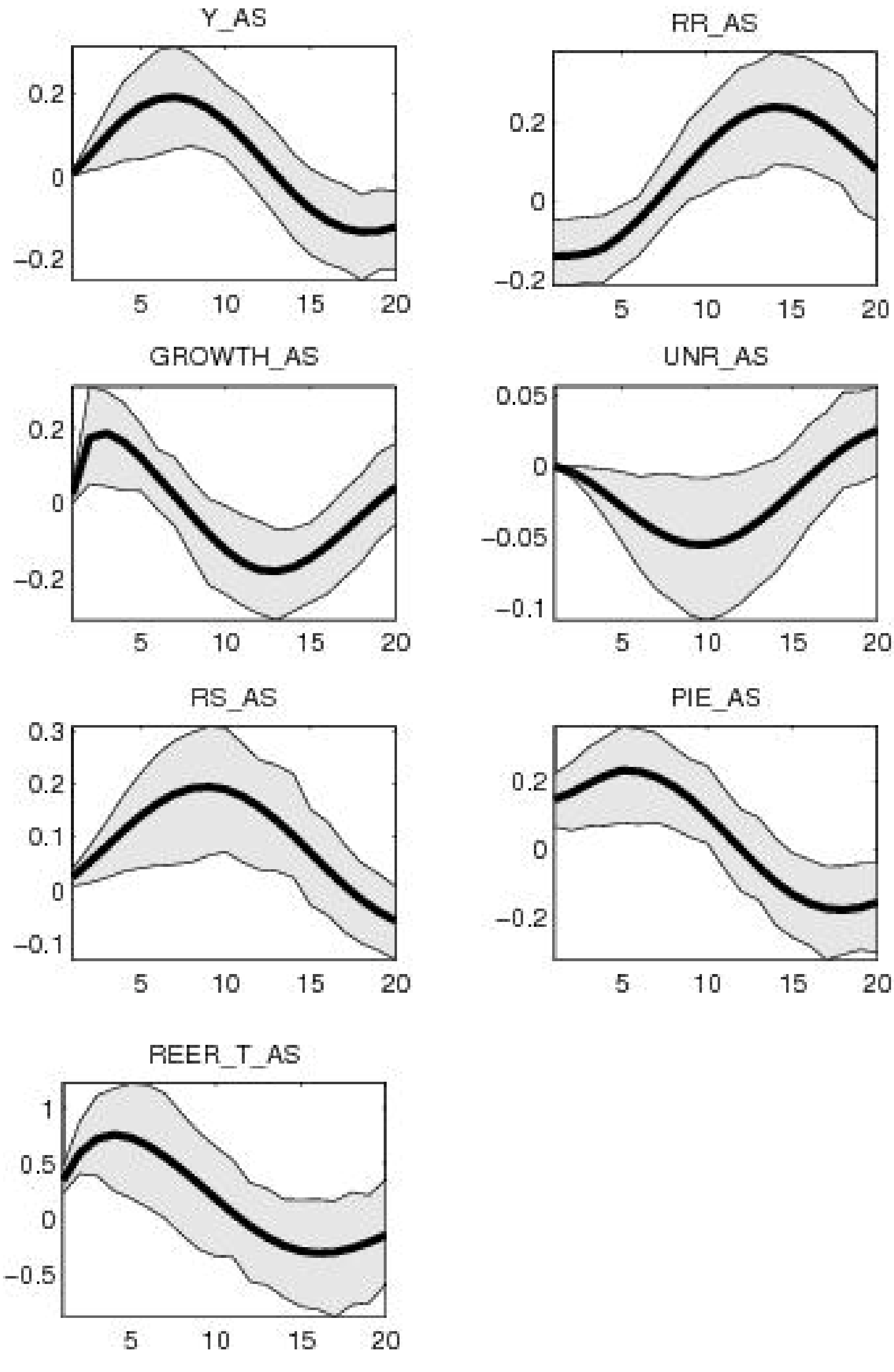


Figure C1: Shock to RES_Y_US

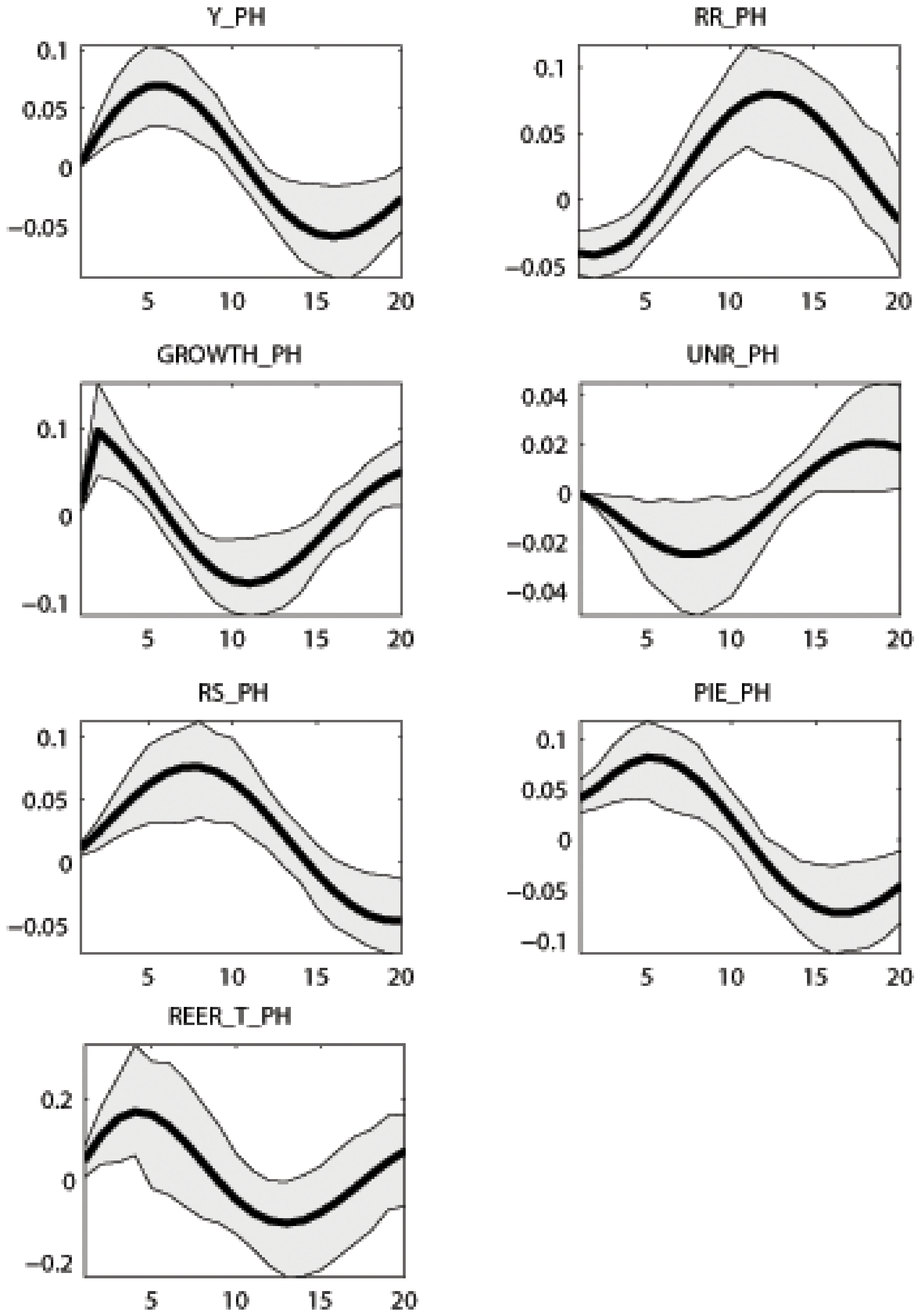


Figure C2: Shock to RES_Y_EU

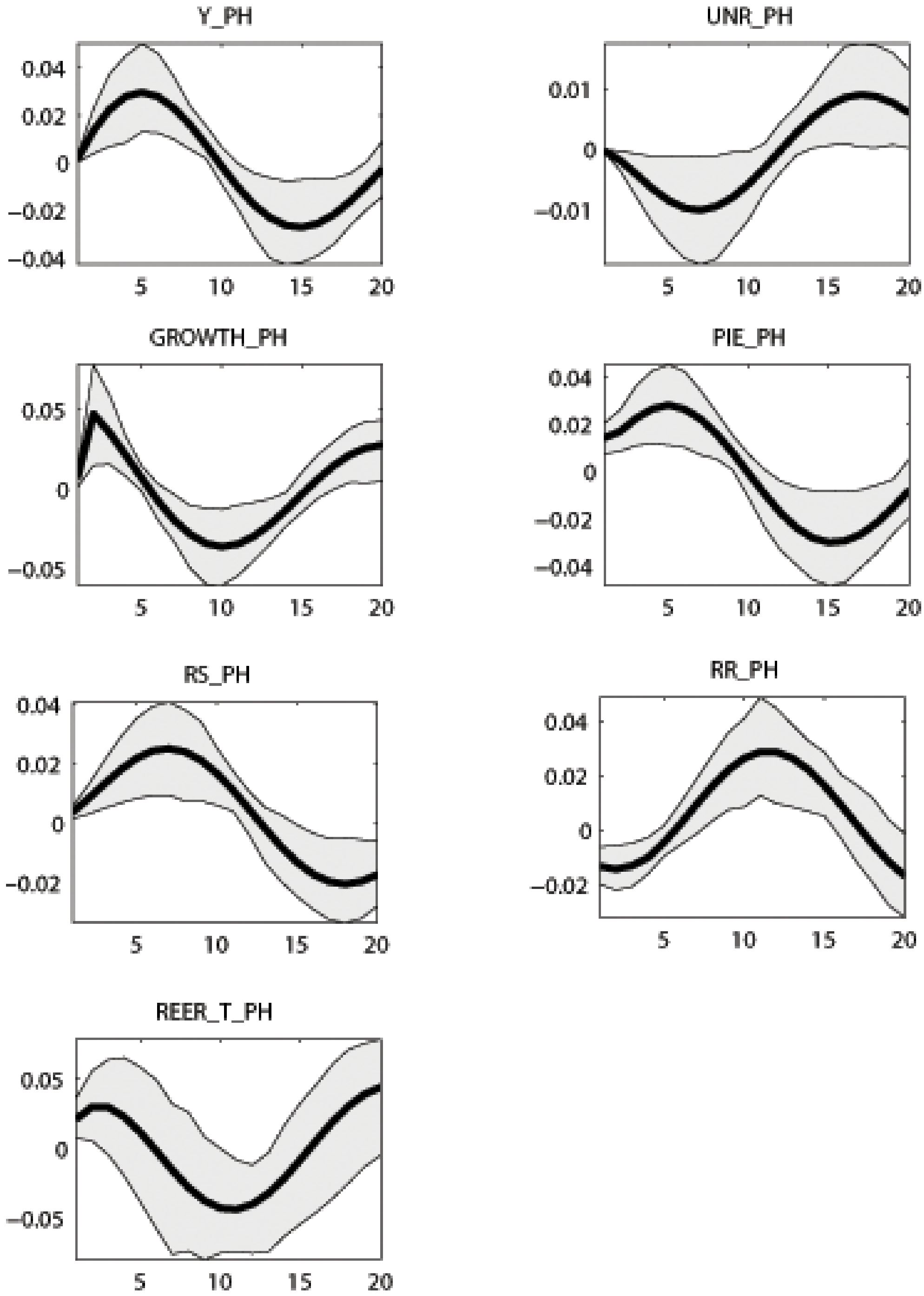


Figure C3: Shock to RES_Y_JA

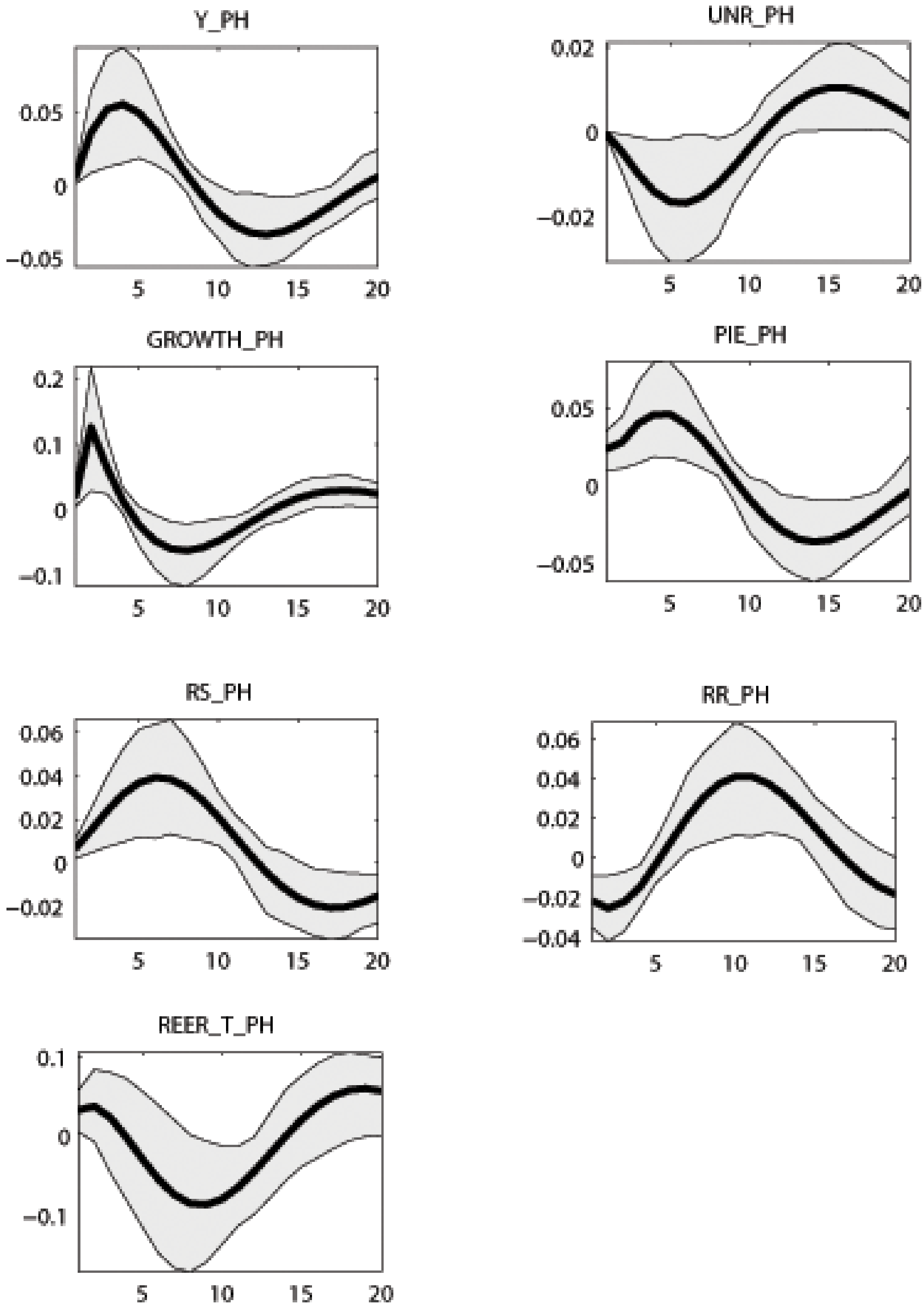


Figure C4: Shock to RES_Y_CH

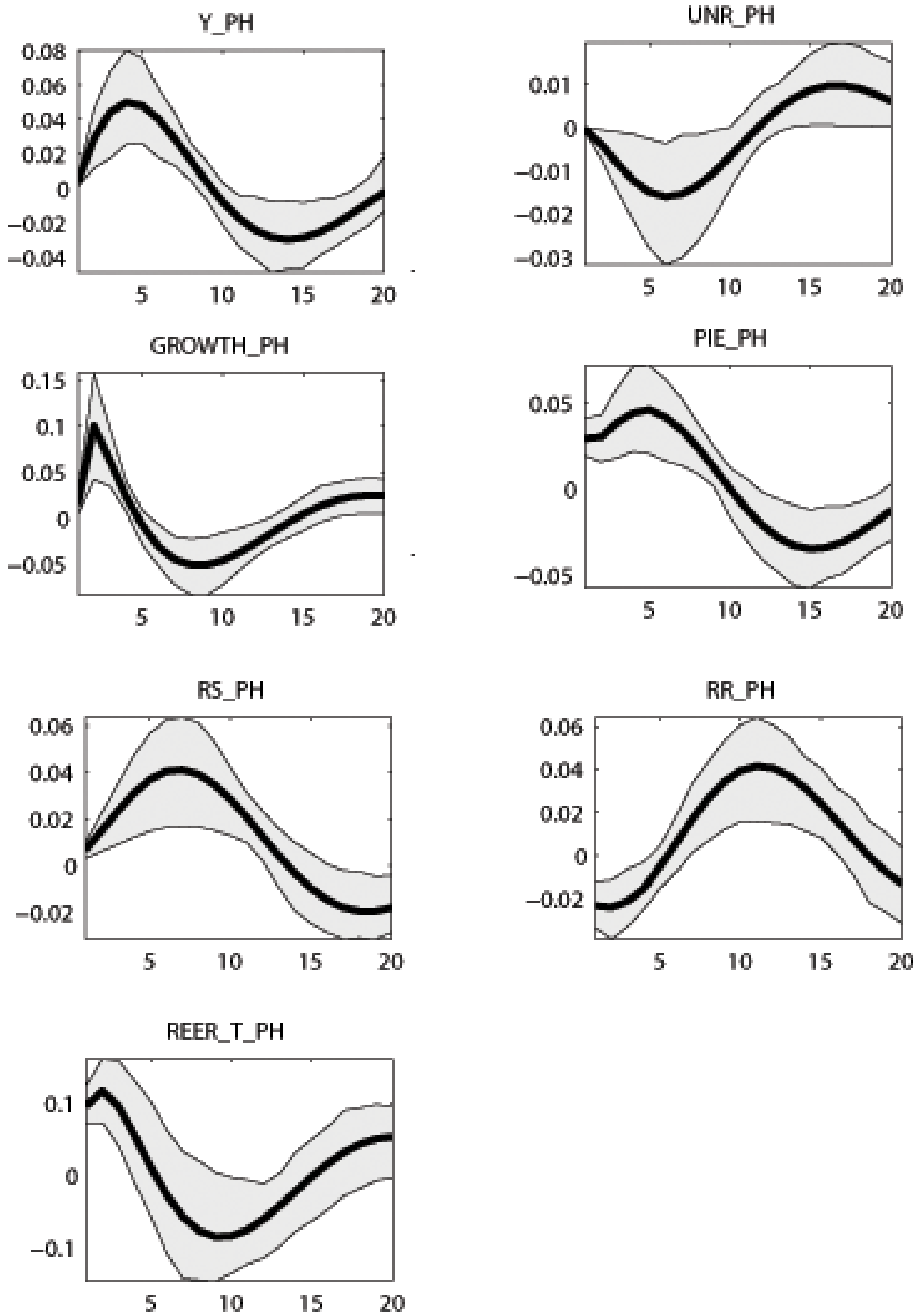


Figure C5: Shock to RES_Y_AS

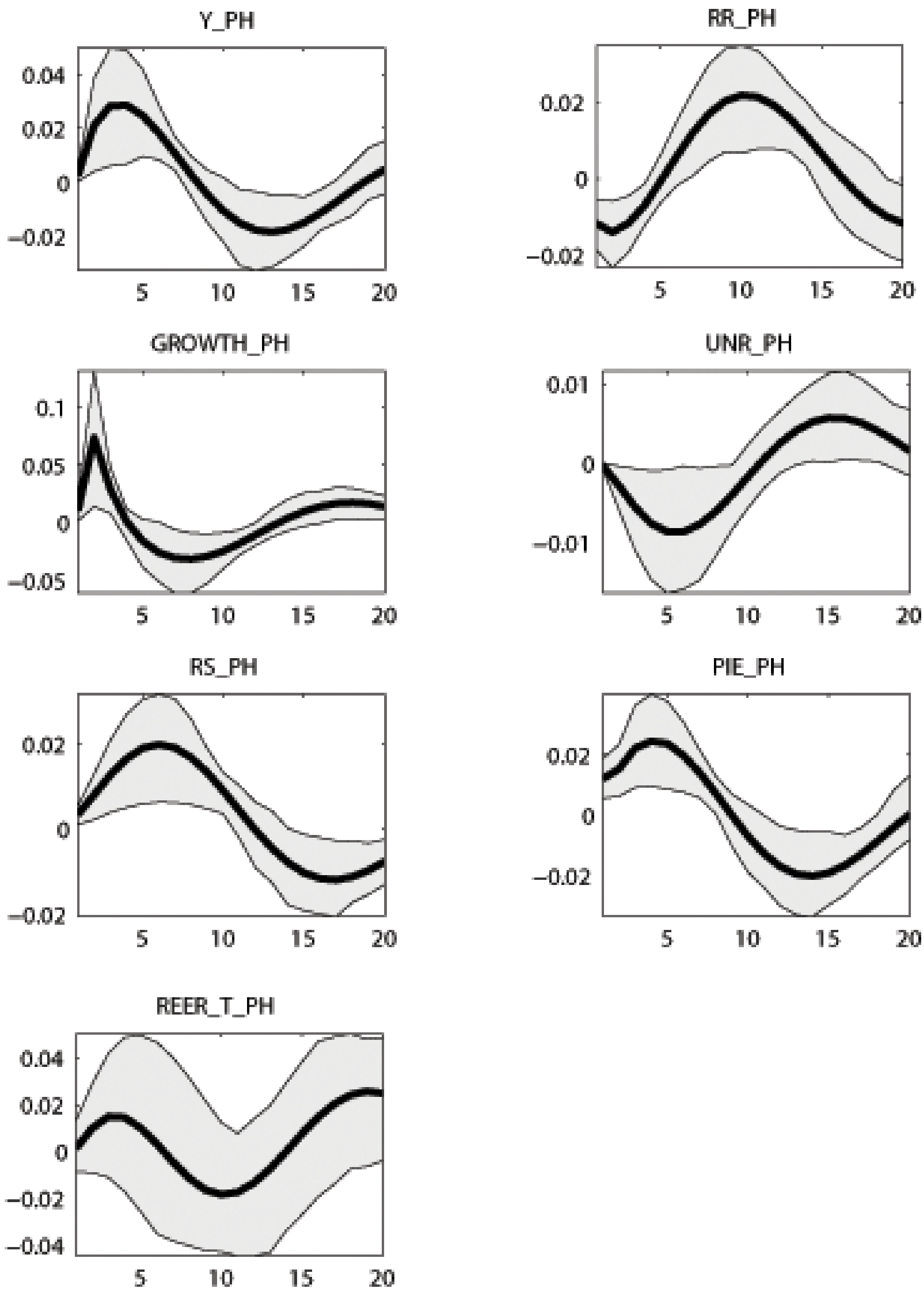


Figure C6: Shock to RES_Y_PH

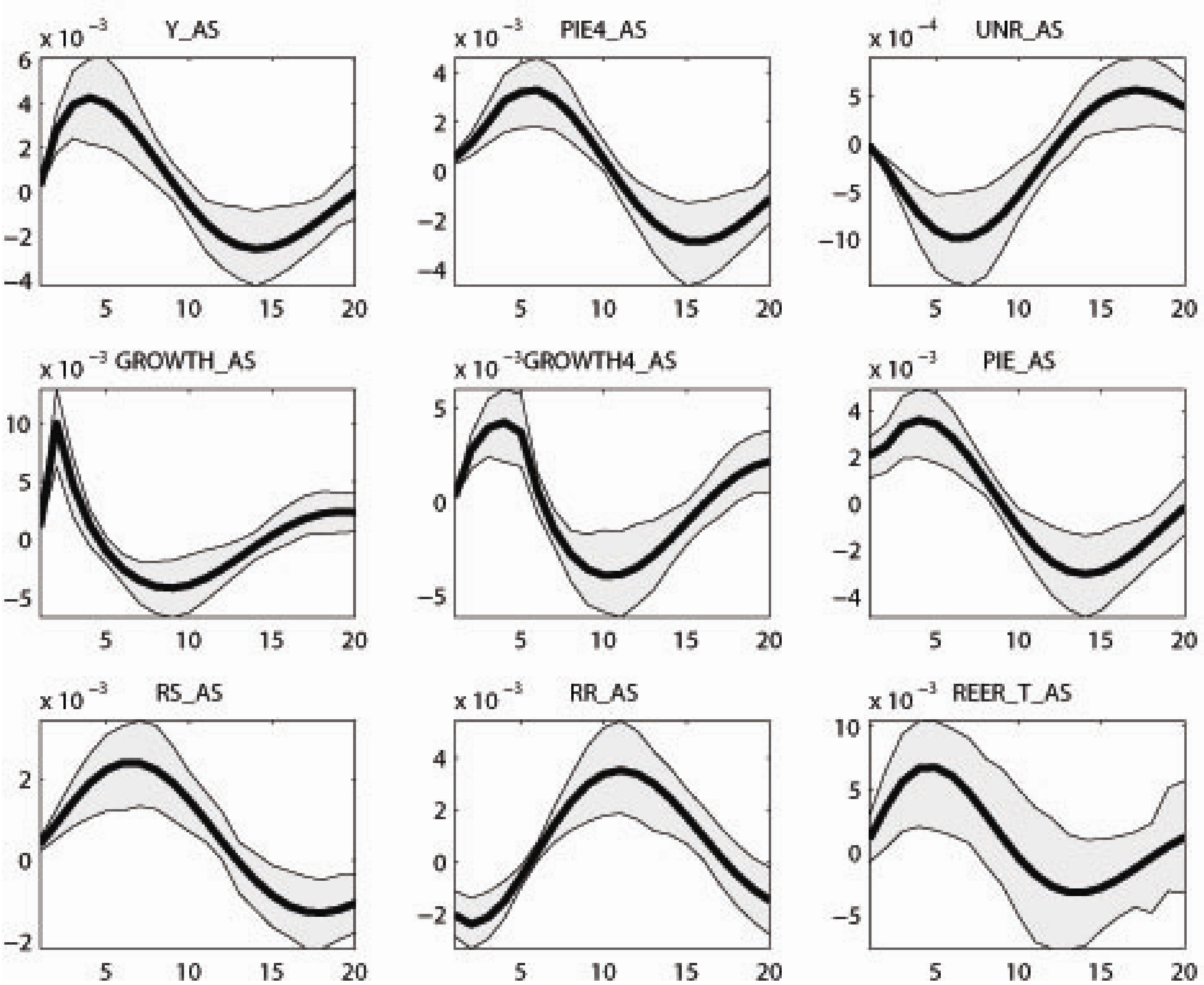


Figure C7: Shock to RES_PIE_US

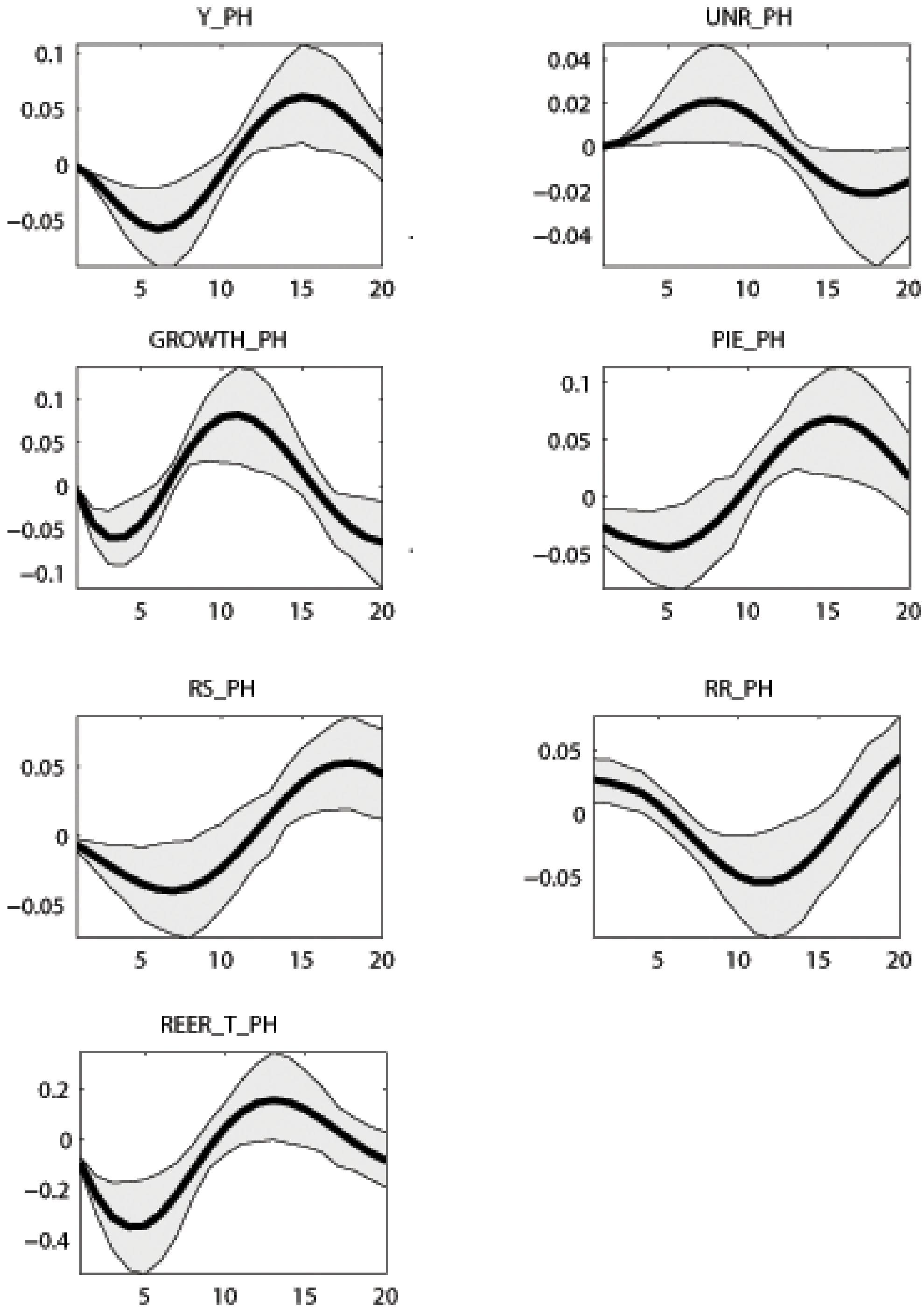


Figure C8: Shock to RES_PIE_EU

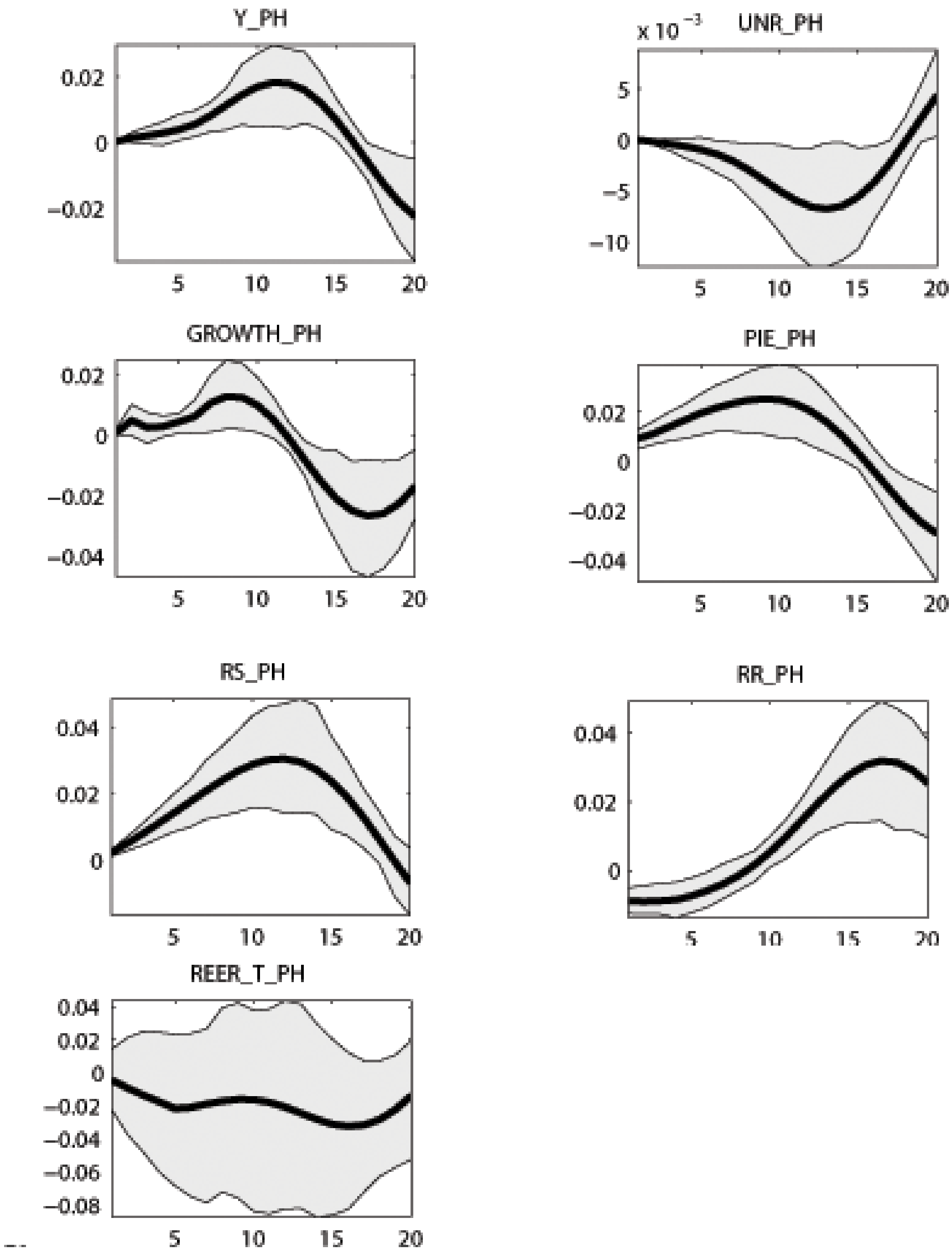


Figure C9: Shock to RES_PIE_JA

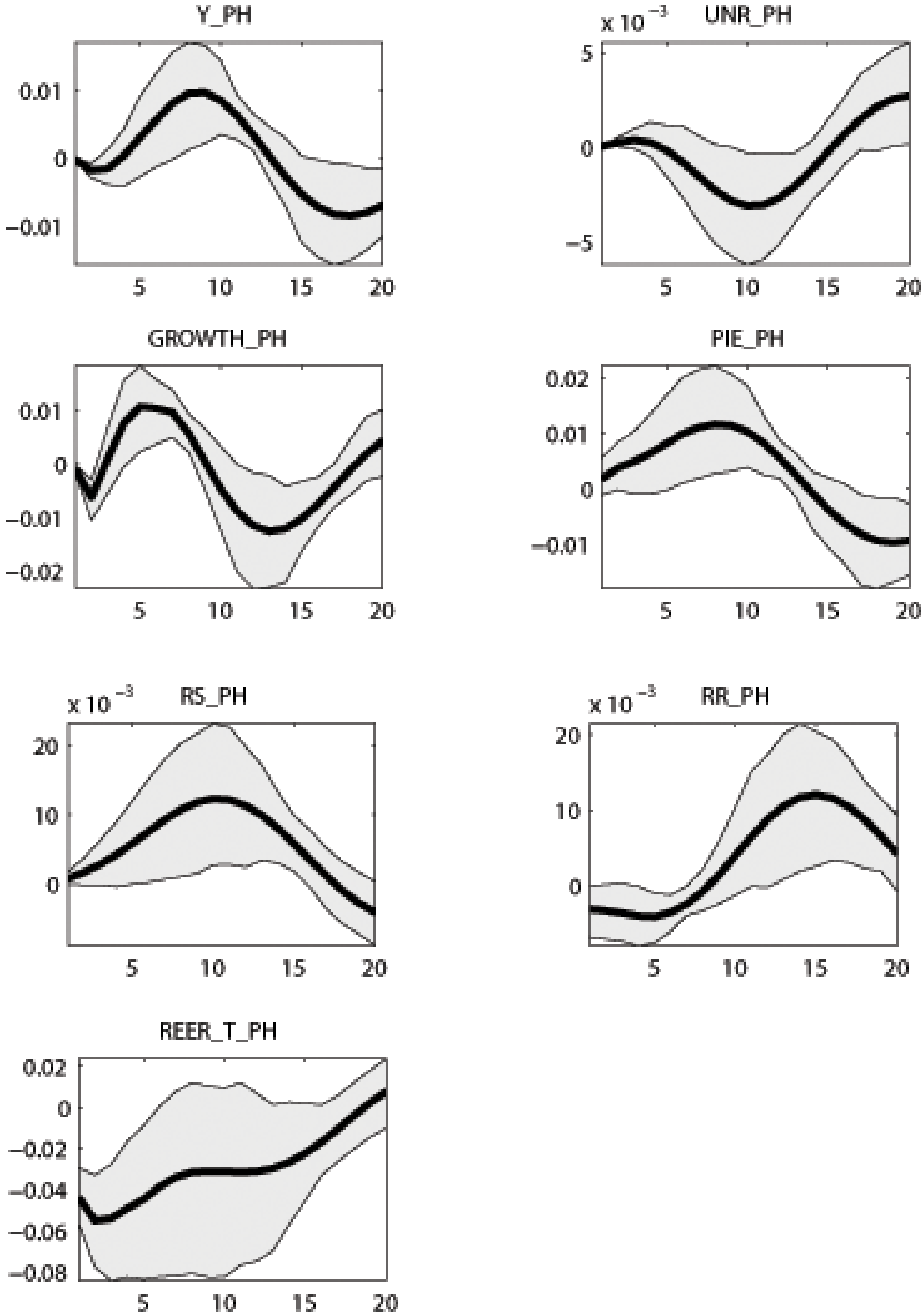


Figure C10: Shock to RES_PIE_CH

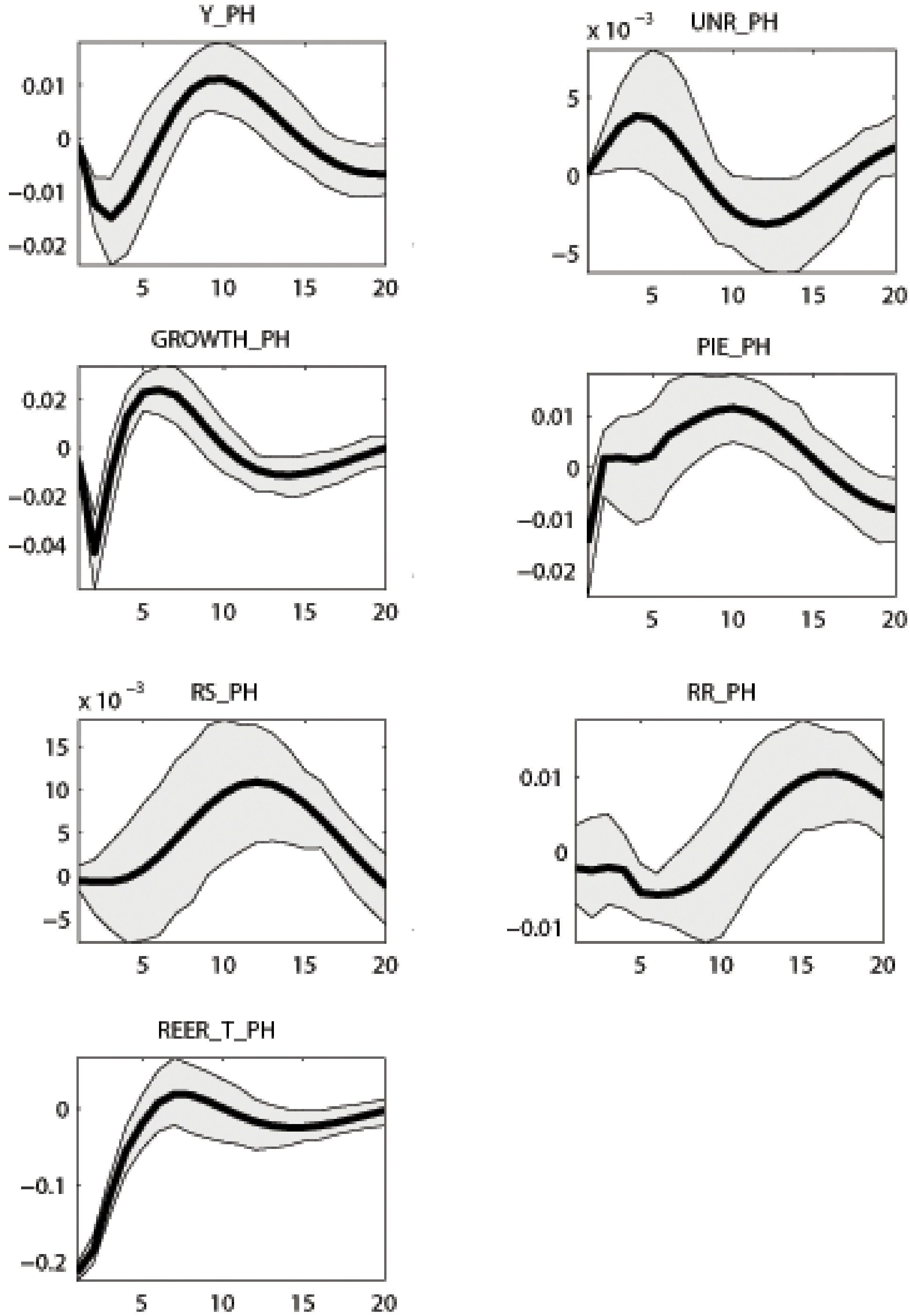


Figure C11: Shock to RES_PIE_AS

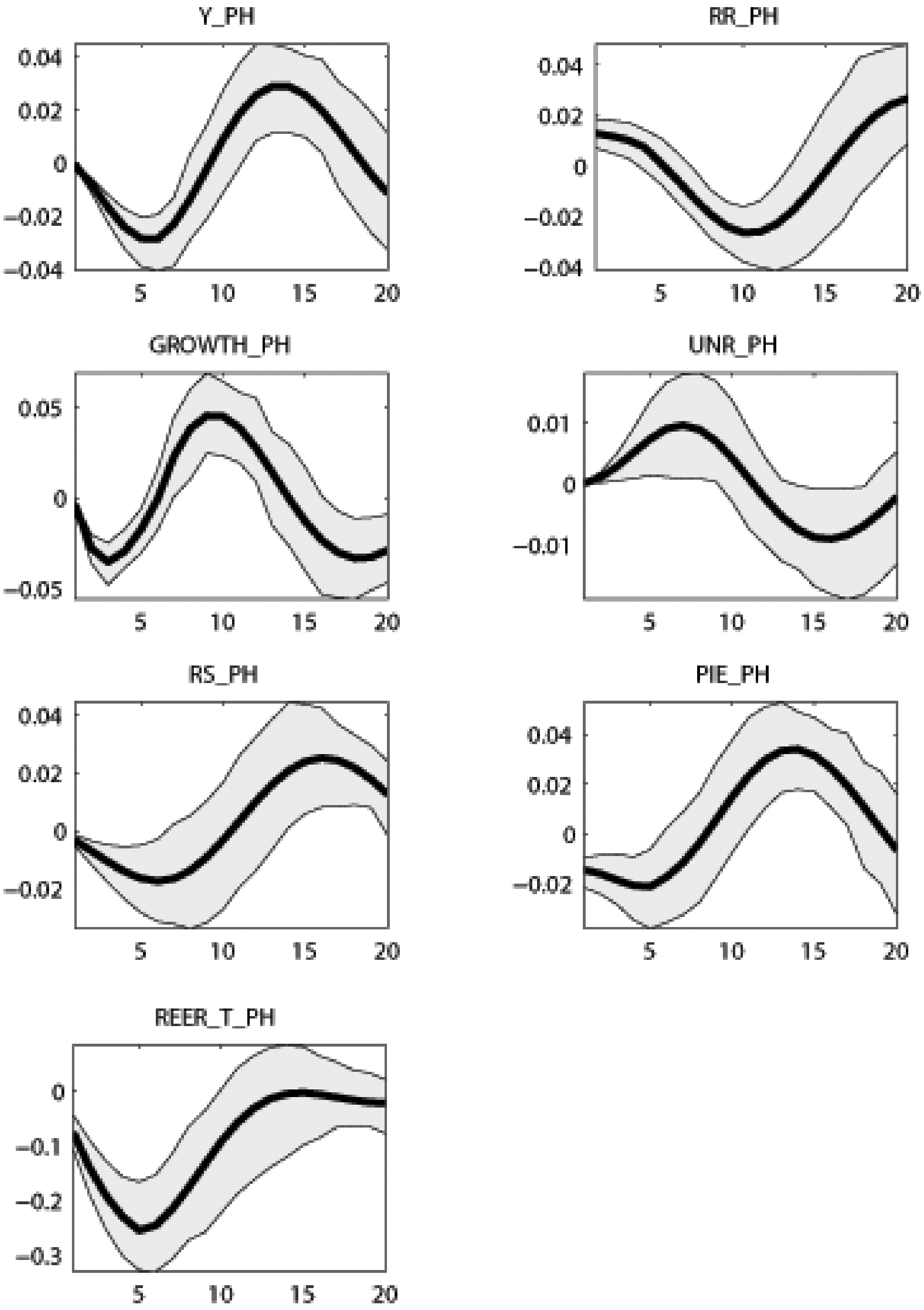


Figure C12: Shock to RES_PIE_PH

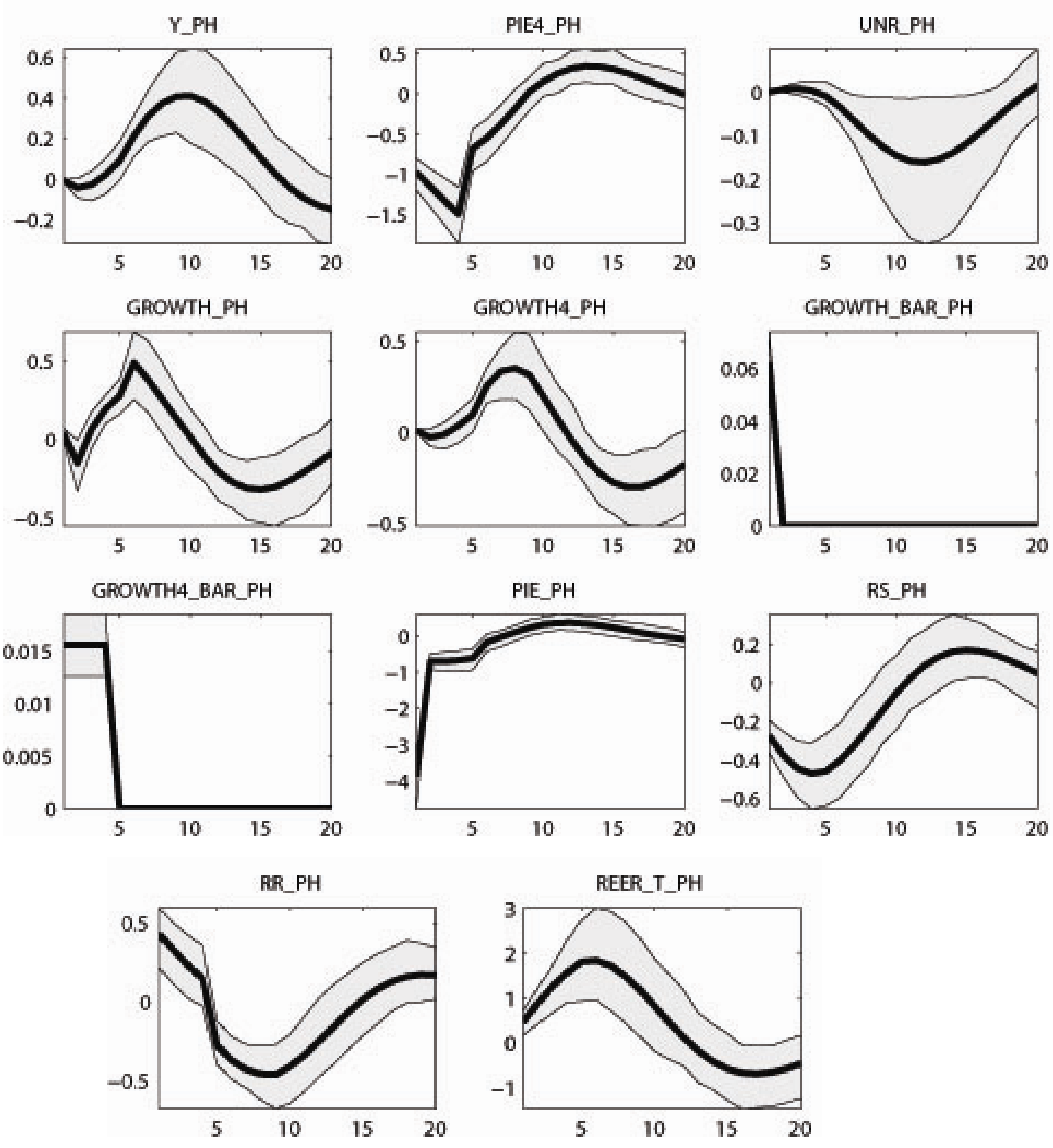


Figure C13: Shock to RES_RS_US

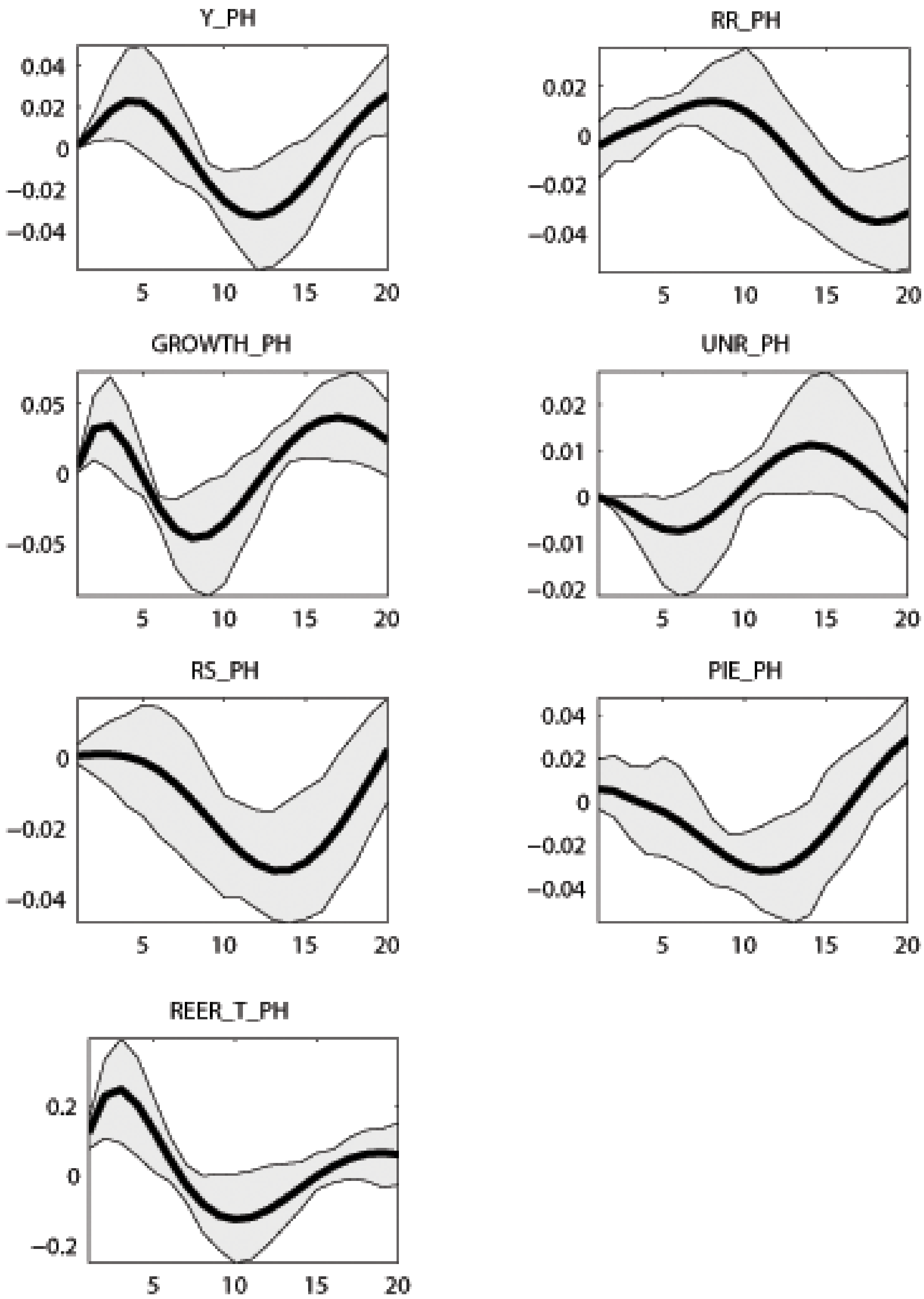


Figure C14: Shock to RES_RS_EU

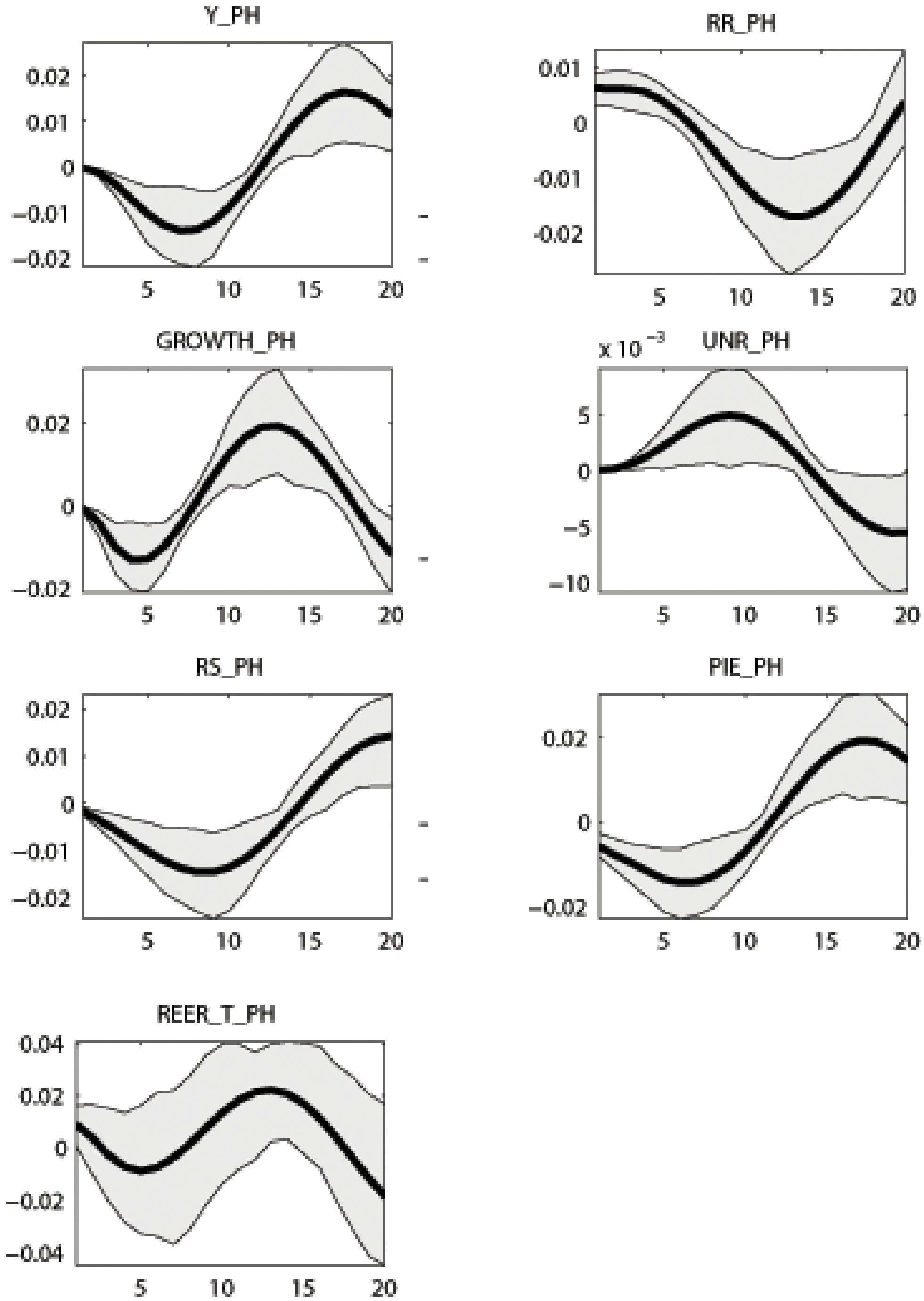


Figure C15: Shock to RES_RS_JA

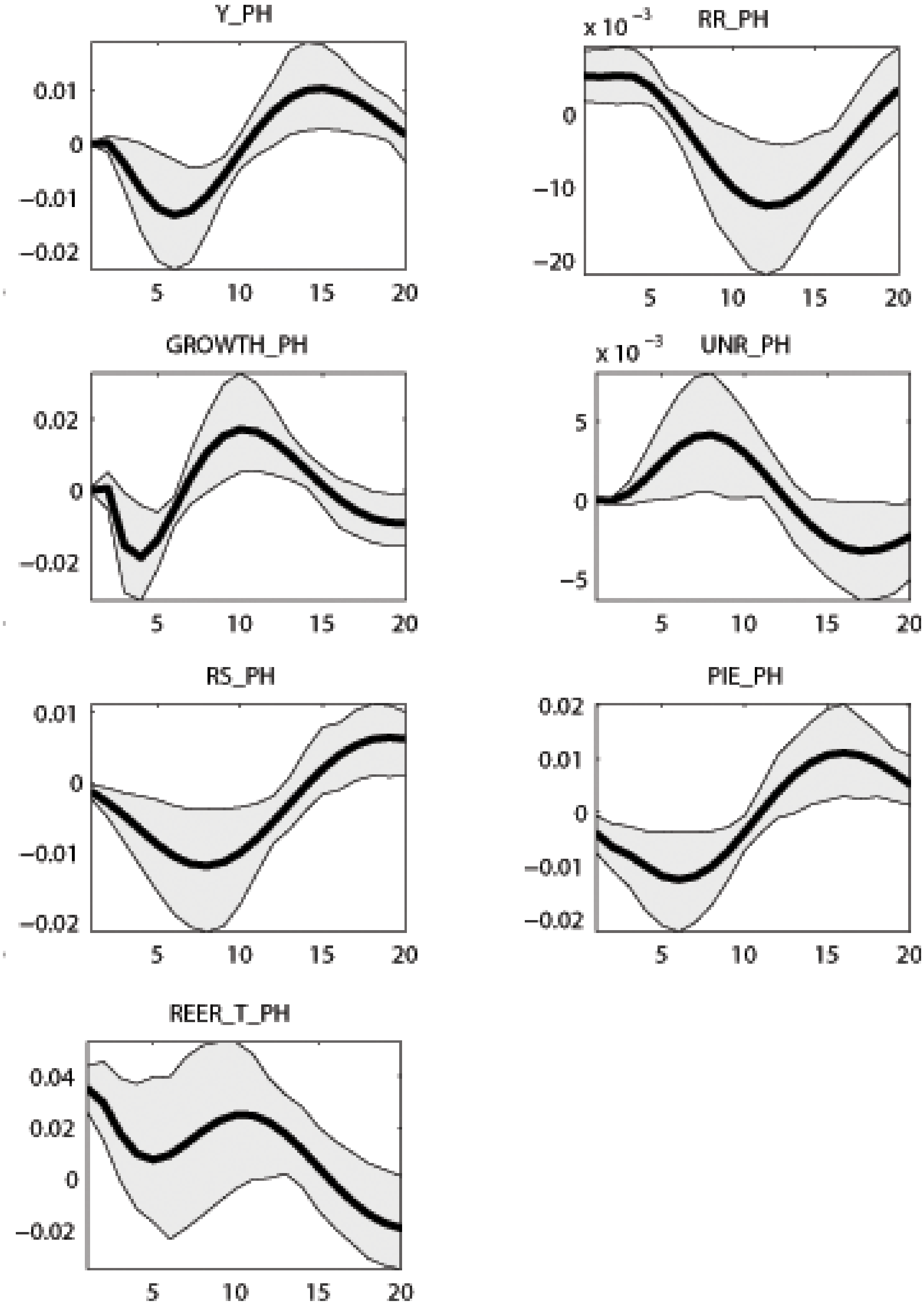


Figure C16: Shock to RES_RS_CH

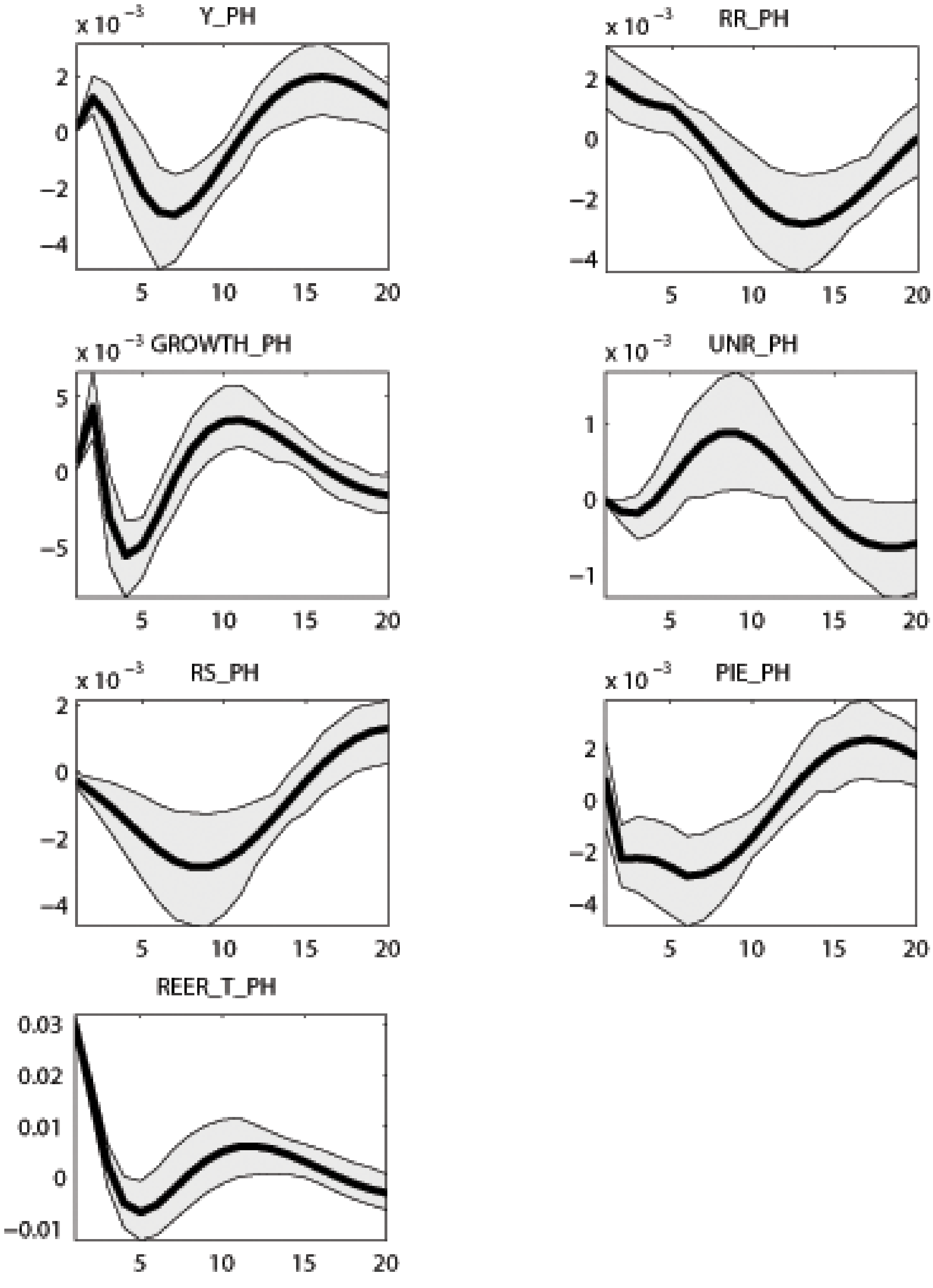


Figure C17: Shock to RES_RS_AS

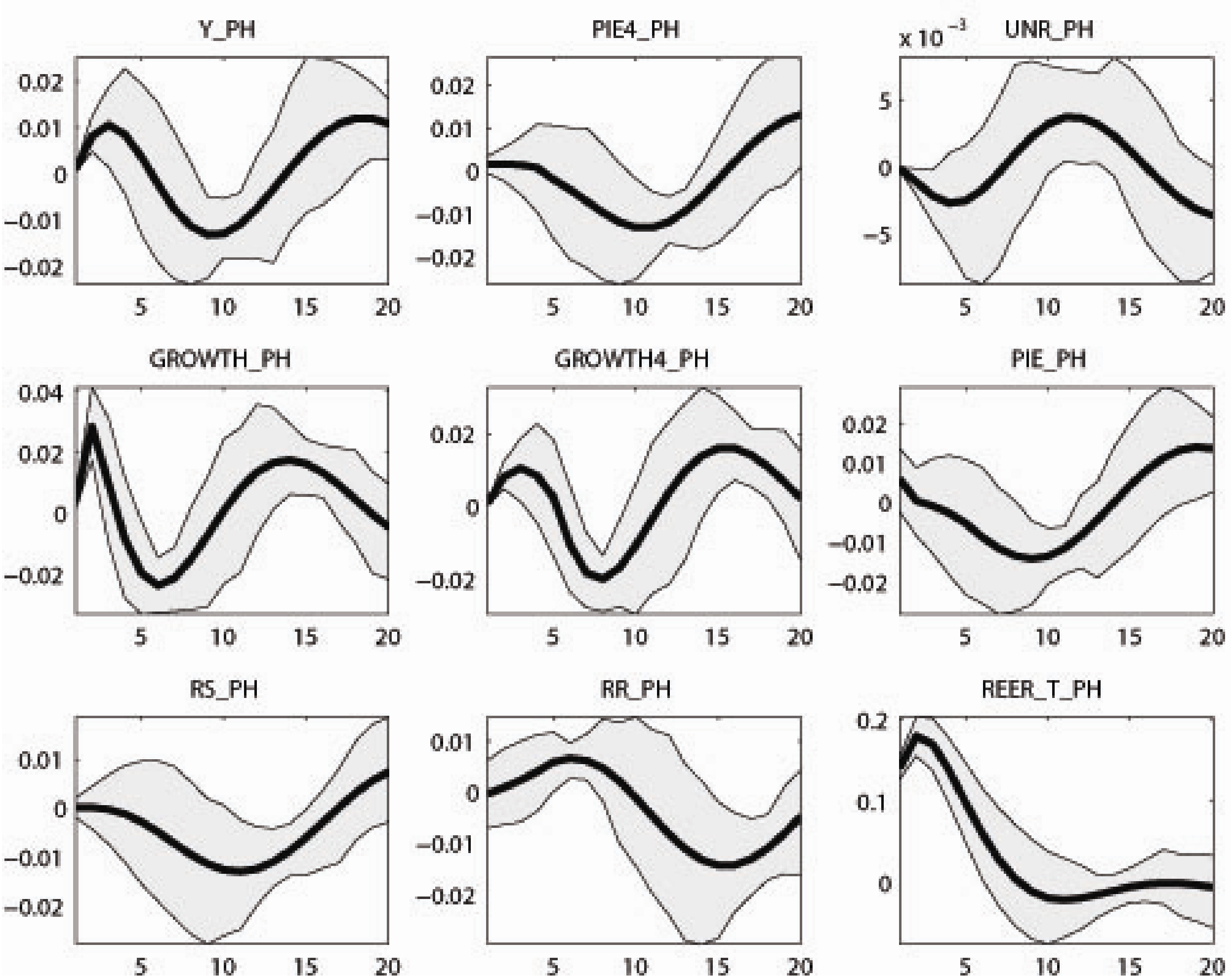


Figure C18: Shock to RES_Y_PH

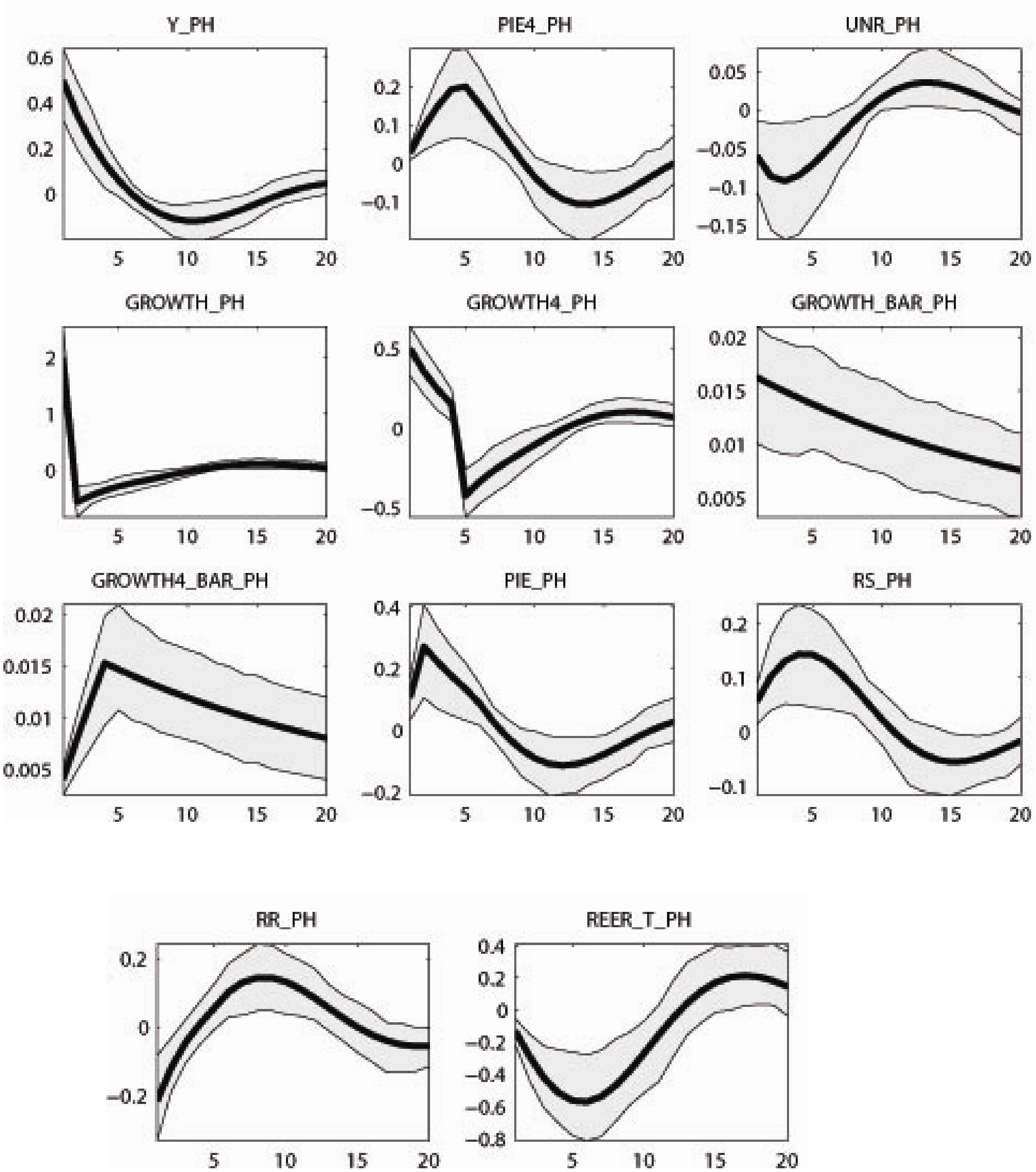


Figure C19: Shock to RES_RS_PH

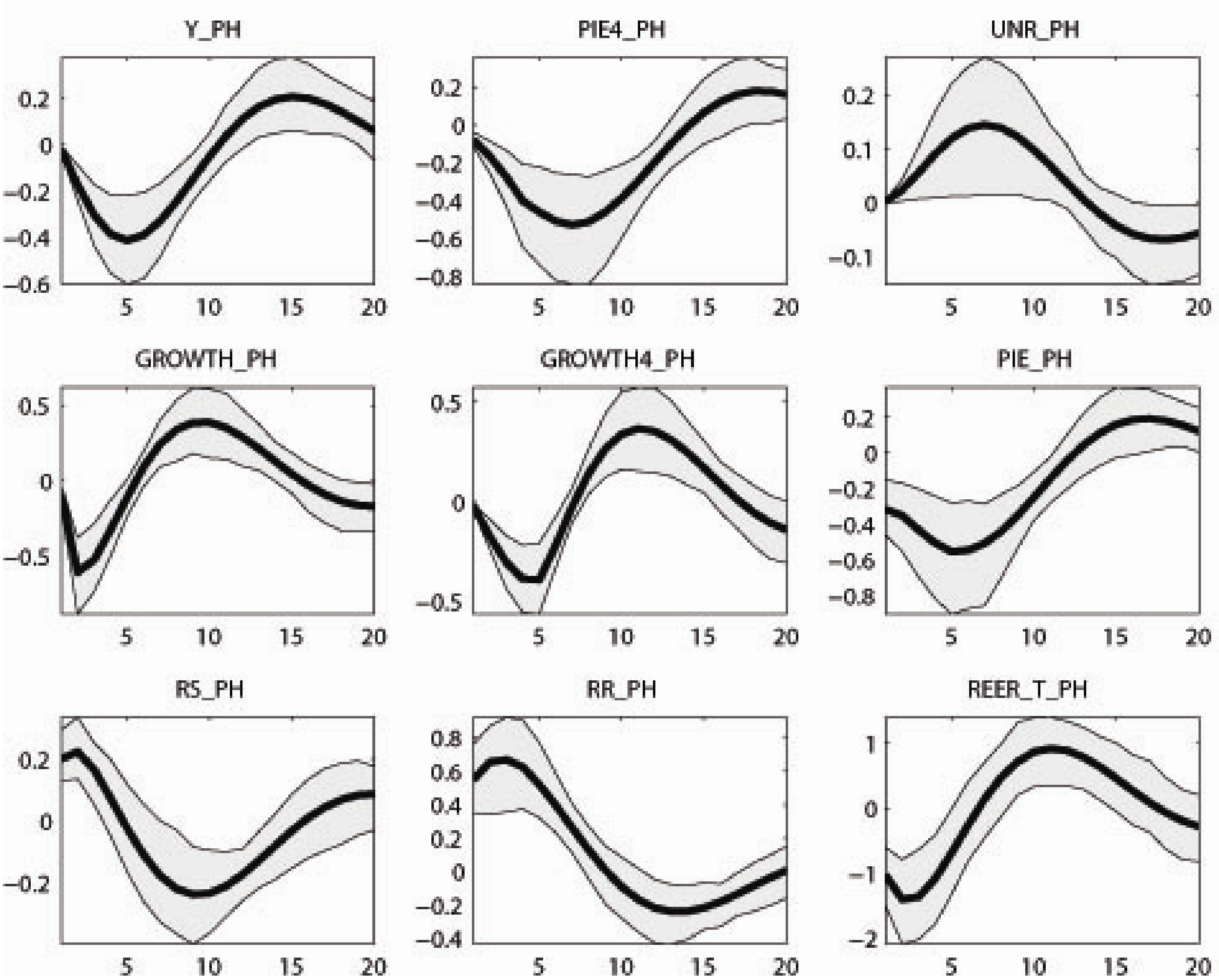
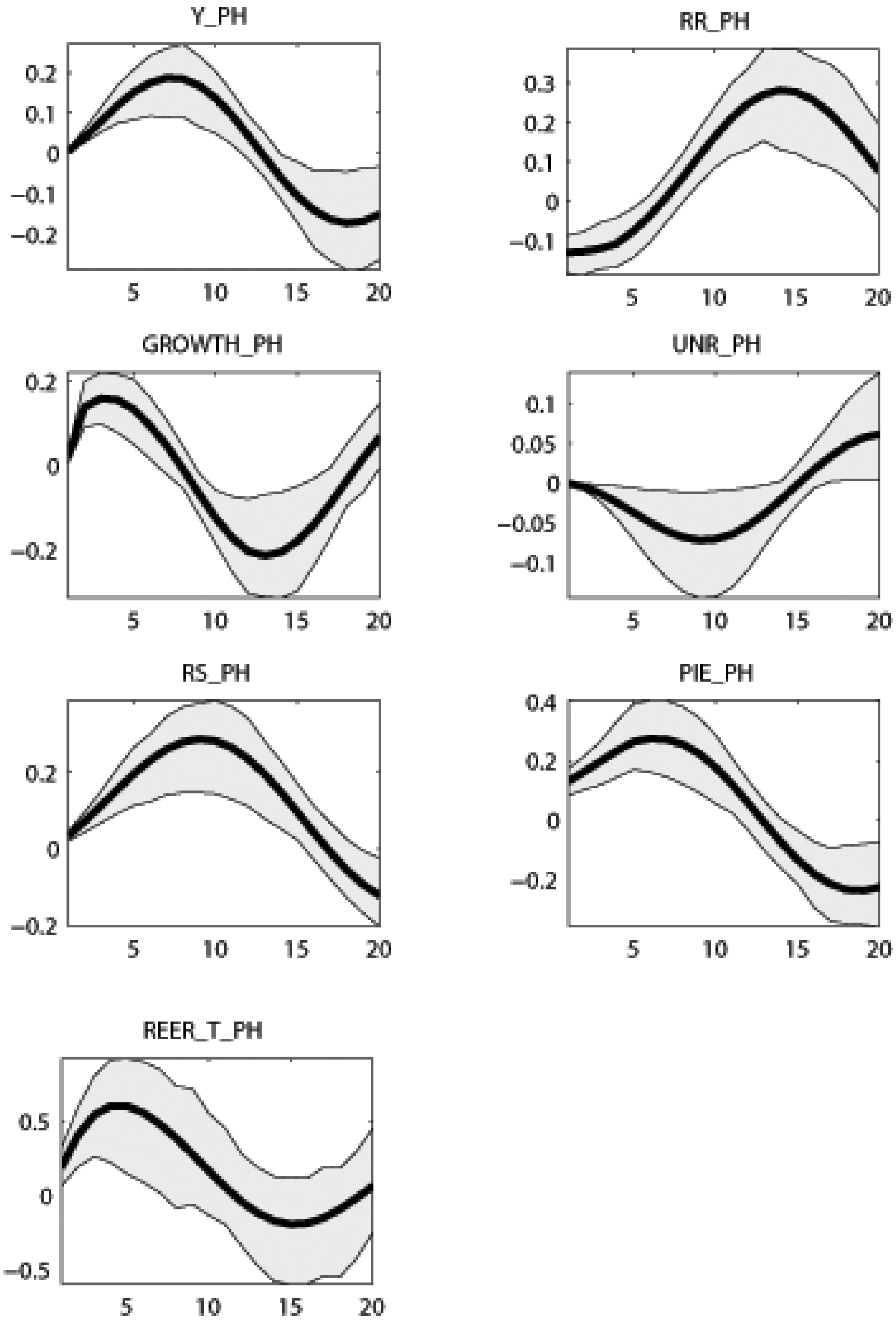


Figure C20: Shock to RES_BLT_US



ENDNOTES

[1] Final Draft. The author greatly acknowledges Jesson Pagaduan and Joy Sinay for the able research assistance, Riandy Laksono for some help with the data, and Ponciano Intal and ERIA for the support and the opportunity. The usual caveat applies.

[2] The cut-off dates here are arbitrarily set to the midpoint of the available data sample. Gong and Kim (2013), which studied different cut-off dates, also reports a generally increasing correlation of output in selected ASEAN countries for later periods.

[3] These are the AMSs with a relatively richer data set.

[4] For the full model, refer to the above cited GPM references, in particular, Andrle, *et al.* (2009), where we based our Dynare program codes on.

[5] Y, output, is defined as 100 times the log of real GDP (i.e., 100*LN(GDP)), while $\bar{Y}$ is 100 times the log of potential output. The quarterly inflation rate, π, at annual rates is defined as 400 times the first difference of the log of CPI, while $\pi 4$ is the year-on-year inflation and is defined as 100 times the difference of the log of the CPI in the current quarter from its value four quarters earlier.

[6] It is well-known that exchange rate volatility has negative impact on trade and investment, and that stabilizing the regional currencies positively influence economic integration and the correlation of macroeconomic variables.

[7] Perhaps future research can explore if a mechanism similar to the Shapley (1953) value can be as one of the factor in allocating rights and responsibilities to the members of the group. The Shapley value is $\psi_i = \sum_C \frac{(n-k)!(k-1)!}{n!}\left[v(C) - v(C-\{i\})\right]$, where k is the size of the coalition C, n is the total players, $v(C)$ is the value of the coalition, $v(C\text{-}\{i\})$ is the value of the coalition without player i, and where the sum is taken over all the coalition C that includes i as a member. This may have to be combined with considerations of equity and achieving inclusive growth within the group, as well as mechanism such as (labor mobility and fiscal transfers) to help ease out the adjustments. Perhaps under certain conditions the cooperative game theory solution may approximate the socially-optimal solution, and some form decentralized group solution can be utilized. Perhaps further research may also explore if group formation of the Buchanan (1965, 1999) type is possible, where members of the group choose the size of the group membership, the amount of the public good, and the incentives (i.e., Pigouvian penalties and subsidies). A cooperative game theoretic formulation of this club theory is available (see, for example, Pauly 1967, 1970) and its specific application to regional public goods in general, and macroeconomic policy coordination is particular, may be explored further.

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