Measuring the Effects of External Shocks on the Asia Pacific Economies

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Overview

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Aim of our research

- Observations
  - Three major "risks" of the world economy
    1. Volatile commodity prices
    2. US Fed has just switched to contractionary monetary policy
    3. China's growth slowdown
  - Countries are tightly linked economically
    - via trade flow and credit flow

- The contributions of this research
  1. Estimate the global model by using the Global VAR (GVAR) at monthly frequency with major Asian countries
  2. Quantify the impacts of "above" three risks to the Asian countries

Global VAR model

- A system of simultaneous equations, consists of:
  1. The i-th country-specific VARX$^*(p,q)$ model (for $i = 1, \ldots, N$)

$$\underbrace{\mathbf{x}_{it} = \mathbf{\Phi}_{i1}\mathbf{x}_{i,t-1}}_{\text{domestic variables}} + \underbrace{\mathbf{\Lambda}_{i0}\mathbf{x}^*_{i,t} + \mathbf{\Lambda}_{i1}\mathbf{x}^*_{i,t-1}}_{\text{foreign variables}} + \underbrace{\mathbf{\Psi}_{i0}\boldsymbol{\omega}_t + \mathbf{\Psi}_{i1}\boldsymbol{\omega}_{t-1}}_{\text{commodity prices}} + \mathbf{u}_{it}$$

     - p =lag length of own (i.e., domestic variables)
     - q =lag length of others (i.e., foreign variables & commodity prices)

  2. a commodity price VARX(p,q) model

$$\boldsymbol{\omega}_t = \boldsymbol{\mu}_0 + \mathbf{\Phi}_1\boldsymbol{\omega}_{t-1} + \underbrace{\mathbf{\Lambda}_1\widetilde{\mathbf{x}}_{t-1}}_{\text{global demand}} + \boldsymbol{\eta}_t$$

     - p =lag length of own (i.e., commodity prices)
     - q =lag length of others (i.e., global demand)

Variables used in this paper

- The domestic variable vector (for $i = 1, \ldots, N$)

$$\mathbf{x}_{it} = \begin{pmatrix} y_{it} \\ p_{it}^{C} \\ p_{it}^{H} \\ r_{it} \\ e_{it} \end{pmatrix} \begin{array}{ll} \leftarrow & 100 \times \log(\text{industrial production}) \\ \leftarrow & 100 \times \log(\text{core CPI}) \\ \leftarrow & 100 \times \log(\text{headline CPI}) \\ \leftarrow & \text{short-term interest rate (\%)} \\ \leftarrow & 100 \times \log(\text{nominal effective exchange rate}) \end{array}$$

  - If the data, say p_{it}^{C}, is entirely missing for i, the variable is eliminated from $\mathbf{x}_{it}$
  - For some countries, r is occasionally missing. If this happens, the values are linearly extrapolated.

- The global variable vector

$$\boldsymbol{\omega}_t = \begin{pmatrix} p_t^{o} \\ p_t^{f} \end{pmatrix} \begin{array}{ll} \leftarrow & 100 \times \log(\text{oil price index}) \\ \leftarrow & 100 \times \log(\text{food price index}) \end{array}$$

- The foreign ("star") variable vector (in country-specific VARX*s)

$$\mathbf{x}_{it}^{*} = \begin{pmatrix} y_{it}^{*} \\ p_{it}^{C*} \\ p_{it}^{H*} \\ r_{it}^{*} \end{pmatrix}, \qquad \mathbf{x}_{it}^{*} = \sum_{j=1}^{N} w_{ij}\mathbf{x}_{jt}, \qquad w_{ii} = 0$$

  - w_{ij} is constructed from the sample averages of the DOT's bilateral trade flows (=export + import) between countries i and j

- The global demand (in the commodity price VARX)

$$\widetilde{\mathbf{x}}_t = \sum_{i=1}^{N} \tilde{w}_i y_{it}$$

  - $\tilde{w}_i$ is constructed from the sample average of PPP-GDP

$$\tilde{w}_i = \frac{\text{GDP}_i}{\sum_{j=1}^{N} \text{GDP}_j}$$

From VARX* to VECMX*

- VARX*(2,2) specification (without $\boldsymbol{\omega}_t$ for simplicity)

$$\begin{aligned}\mathbf{x}_{it} = \mathbf{a}_{i0} + \mathbf{a}_{i1}t + \boldsymbol{\Phi}_{i1}\mathbf{x}_{i,t-1} + \boldsymbol{\Phi}_{i2}\mathbf{x}_{i,t-2} \\ + \boldsymbol{\Lambda}_{i0}\mathbf{x}^*_{i,t} + \boldsymbol{\Lambda}_{i1}\mathbf{x}^*_{i,t-1} + \boldsymbol{\Lambda}_{i2}\mathbf{x}^*_{i,t-2} + \mathbf{u}_{it}\end{aligned}$$

- The corresponding VECMX* can be written as

$$\begin{aligned}\Delta\mathbf{x}_{it} = \mathbf{c}_{i0} - \boldsymbol{\alpha}_i\boldsymbol{\beta}_i'[\mathbf{z}_{i,t-1} - \boldsymbol{\gamma}_i(t-1)] \\ + \boldsymbol{\Lambda}_{i0}\Delta\mathbf{x}^*_{it} + \boldsymbol{\Gamma}_i\Delta\mathbf{z}_{i,t-1} + \mathbf{u}_{it}\end{aligned}$$

where

$$\underset{(k_i+k_i^*)\times 1}{\mathbf{z}_{it}} = \begin{pmatrix}\mathbf{x}_{it} \\ \mathbf{x}^*_{it}\end{pmatrix}$$

Limited review on GVAR

1. Pesaran, Schuermann, and Weiner (2004) (PSW)
   - Development of the GVAR methodology

country	types of economy	treatment of p^o
USA	large-open	endogenous
others	small-open	exogenous

2. Dees, di-Mauro, Pesaran, and Smith (2007)(DdPS)
   - Uses the bootstrapping for constructing the confidence intervals of the IRFs

3. Chudik and Pesaran (2012), Smith and Yamagata (2011)
   - Includes the dominant unit in the GVAR model

Limited review on the risk analysis

1. About the commodity price hike on the inflation
   - Galesi and Lombardi (2009) assess the magnitude of short-run inflationary effects of oil and food price shocks on the inflation rates of developed / emerging economies
   - Monthly data; the pre-crisis period (Jan 1999 to Dec 2007)
2. About the US interest rate hike on the global economy
   - Georgiadis (2015) assesses the global spillovers of US monetary policy shocks
   - Examine how the country characteristics affects the spillover
3. About the impact of China's slowdown on the global economy
   - Ludoric and Rebillard (2015), Inoue, Kaya, and Oshige (2015)
   - Quarterly

Characters of our research

1. Mainly focus on the Asian economy (see the next slide)
   - "8 Asian countries" out of "21 countries and 1 area"
   - Australia and New Zealand are not included. My apologies
2. Higher frequency data (not quarterly, but monthly)
   - Unlike the most of the previous research, which uses the quarterly data, we use the monthly data

Ads	more vivid and timely
DisAds	sometimes has to be constructed, and must be S.A.

3. Comprehensive analysis of the up-to-dated global risks

Countries and regions

- Complete list of countries in our sample

Developed economies (5)
US China Japan
UK Canada

Euro area (7)
Belgium Finland France
Germany Italy Netherlands
Spain

Rest of Western Europe (2)
Norway Sweden

Rest of the emerging Asia (6)
Indonesia Korea Malaysia
Philippines Singapore Thailand

Latin America (4)
Brazil Chile Mexico Peru

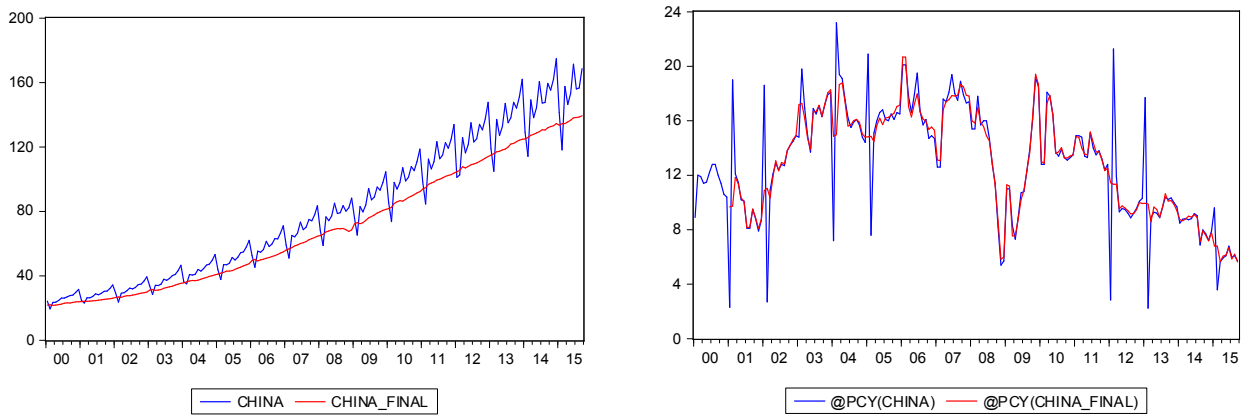
Rest of the world (4)
India South Africa Saudi Arabia
Turkey

- 28 countries $\Rightarrow$ 21 countries and 1 area
- For each of $N = 22$ countries, the VARX* models are estimated

Some difficulties with the Chinese IP data

1. Constructed from the level and the y-on-y growth rate

2. "Lunar" vs "Gregorian" calendar generates "moving holidays"
   - Y-on-Y growth rate of monthly IP (right panel)



note) Blue: actual IP series; Red: seasonally adjusted by authors

   - Reference) Roberts and White (2015) used the dummy variable corrections of the public holidays such as Chinese New Year, the Dragon Boat festival, and the Mid-Autumn festival.

Seasonal adjustments of the data

1. For y, p^C, p^H, examine if the data has seasonal fluctuation
   - Transform the data in difference (ex. Δy_{it} for the IP series)
   - Regress Δy_{it} on a set of monthly dummies and a constant
   - Test the joint exclusion of monthly coefficients by F-test
   - If the test rejects at 10% level, we conclude that the seasonality exists

2. Seasonal adjustment by X12-ARIMA method
   - Apply X12 to the differenced series (i.e. Δy_{it}) with the Additive Outlier option
   - Using the seasonally adjusted series, construct a level series

Estimation steps

1. Confirm that all series are $I(1)$.

2. For the country-specific VARX*(p, q) model
   - Set $p^{\max} = q^{\max} = 2$. Decide the optimal lag length by AIC.
   - Assume that the VECM as a default specification. Set type-IV CI, and decide the CI rank by the trace test

3. For the commodity price VARX(p, q) model
   - Set $p^{\max} = q^{\max} = 2$. Decide the optimal lag length by AIC.
   - Assume that the VECM as a default specification. Set type-IV CI, and decide the CI rank by the trace test

4. Check the dynamic stability in the co-integrating space by Persistence Profiles (PP)
   - If PP does not reach the level less than 0.1 in 24 months, the corresponding CV is eliminated.
   - Euro(2), Norway(1), Saudi Arabia(1), Turkey(1)
5. Modify the CI rank, and redo the dynamic analysis
6. Conduct a series of specification tests, such as:
   - Serial correlation
   - Weak exogeneity
   - Contemporaneous correlations

Impact elasticities

- Impact elasticities
  - the contemporaneous variation of a domestic variable due to a 1 unit change in its corresponding foreign-specific counterpart
  - identify general co-movements among variables across different countries

	ip	cpiC	cpiH	r
BRAZIL	0.65 *		0.22 *	0.19 *
CANADA	0.25 ***	0.18	0.91 ***	0.37 ***
CHILE	0.11	0.84 **	0.64 ***	0.13
CHINA	0.00		0.36	−0.21
EURO	0.54 ***	0.08	0.40 ***	0.15 *
INDIA	0.44 ***		−0.15	−0.56 *
INDONESIA	0.23		0.16	0.10
JAPAN	0.14	0.22	0.25 ***	0.01
KOREA	0.63 ***	0.29 **	0.19	0.16 ***
MALAYSIA	0.39 ***		0.43	0.05
MEXICO	0.23 **	−0.18	0.05	0.20
NORWAY	0.21	1.25 ***	0.81 ***	0.64 ***
PERU	0.34		0.27 *	0.69
PHILIPPINES	0.17		0.27 **	0.40 **
SAUDI ARABIA	0.19		0.19	
SINGAPORE	1.41 ***		0.44 ***	0.27
SOUTH AFRICA	0.71 ***		0.30 *	0.14
SWEDEN	0.60 ***	1.41 ***	1.01 ***	0.22 *
THAILAND	0.51		1.07 ***	0.32 *
TURKEY	2.07 ***	0.13	1.28 ***	1.76
UNITED KINGDOM	0.44 ***	0.29	0.47 ***	0.77 ***
USA	0.18 *	0.08	0.84 ***	

- ＊＊＊:1%, ＊＊:5%, ＊:10%

External shock-1: Commodity price hike

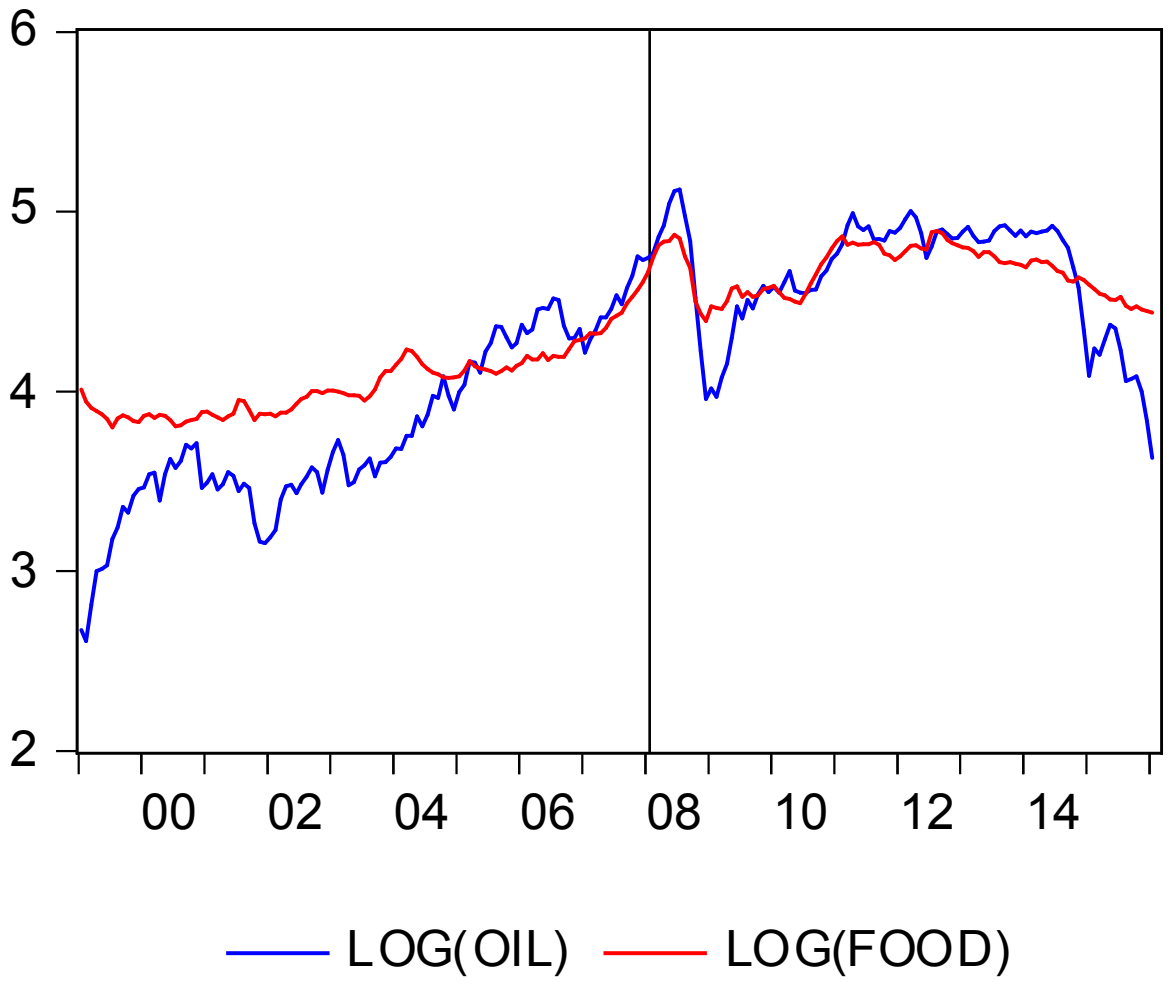
- Two questions
  1. Do two external shocks (i.e. oil price hike and food price hike) have different inflationary impacts?
  2. Is there a significant pass-through of external shocks to the core inflation?

- Generalized Impulse Response Functions (GIRFs)

$$\mathcal{GIRF}(\mathbf{x}_t; u_{i\ell t}, n) = E(\mathbf{x}_{t+n}|u_{i\ell t} = \sqrt{\sigma_{ii,\ell\ell}}, \mathcal{I}_{t-1}) - E(\mathbf{x}_{t+n}|\mathcal{I}_{t-1})$$

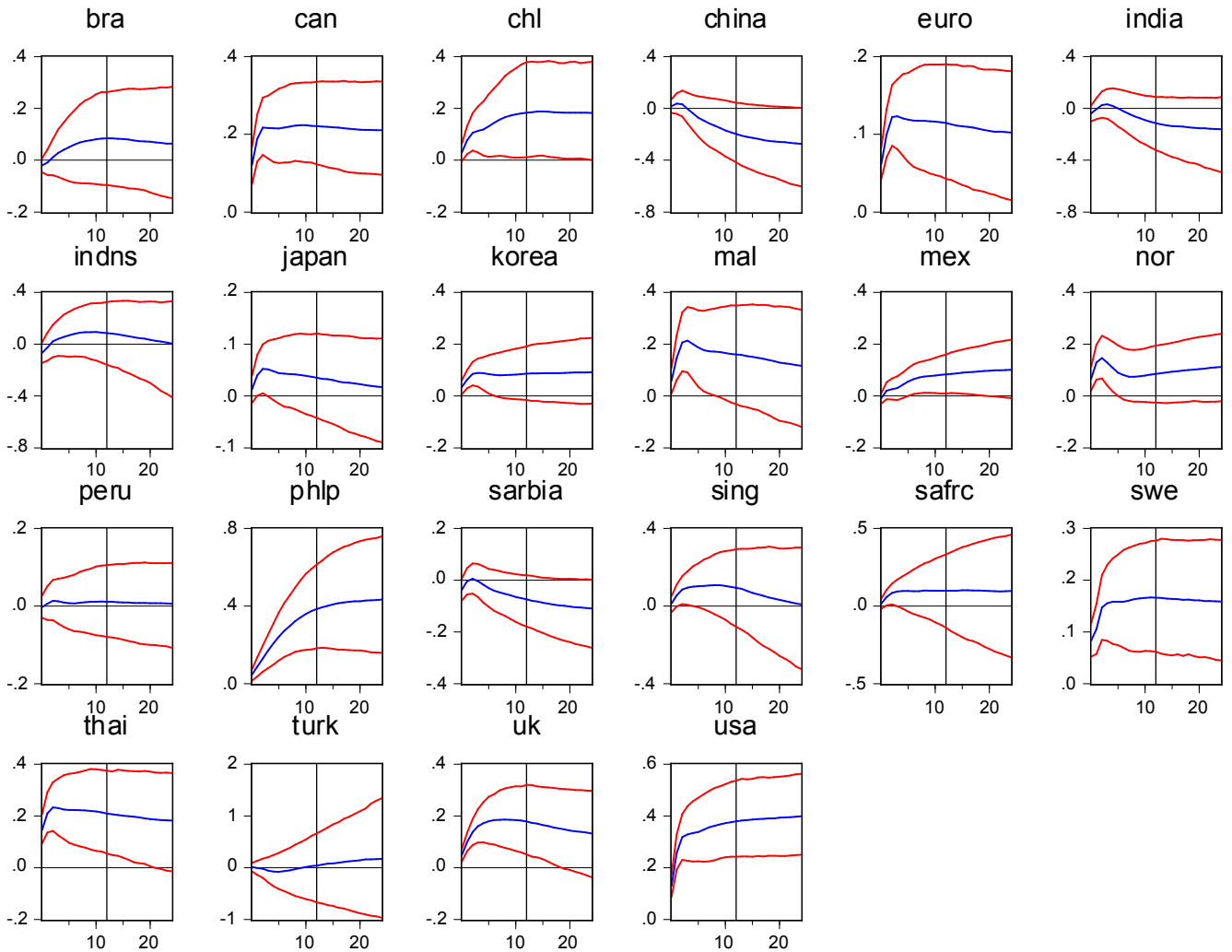
  - $\mathcal{I}_{t-1}$ is the information set at time $t-1$
  - $\sigma_{ii,\ell\ell}$ is the diagonal elements of the variance-covariance matrix $\mathbf{\Sigma}_u$, corresponding the ℓ-th equation in the i-th country.
  - GIRFs are invariant to the ordering of the variables

Commodity prices since year 2000



Do two shocks have different inflationary impacts?

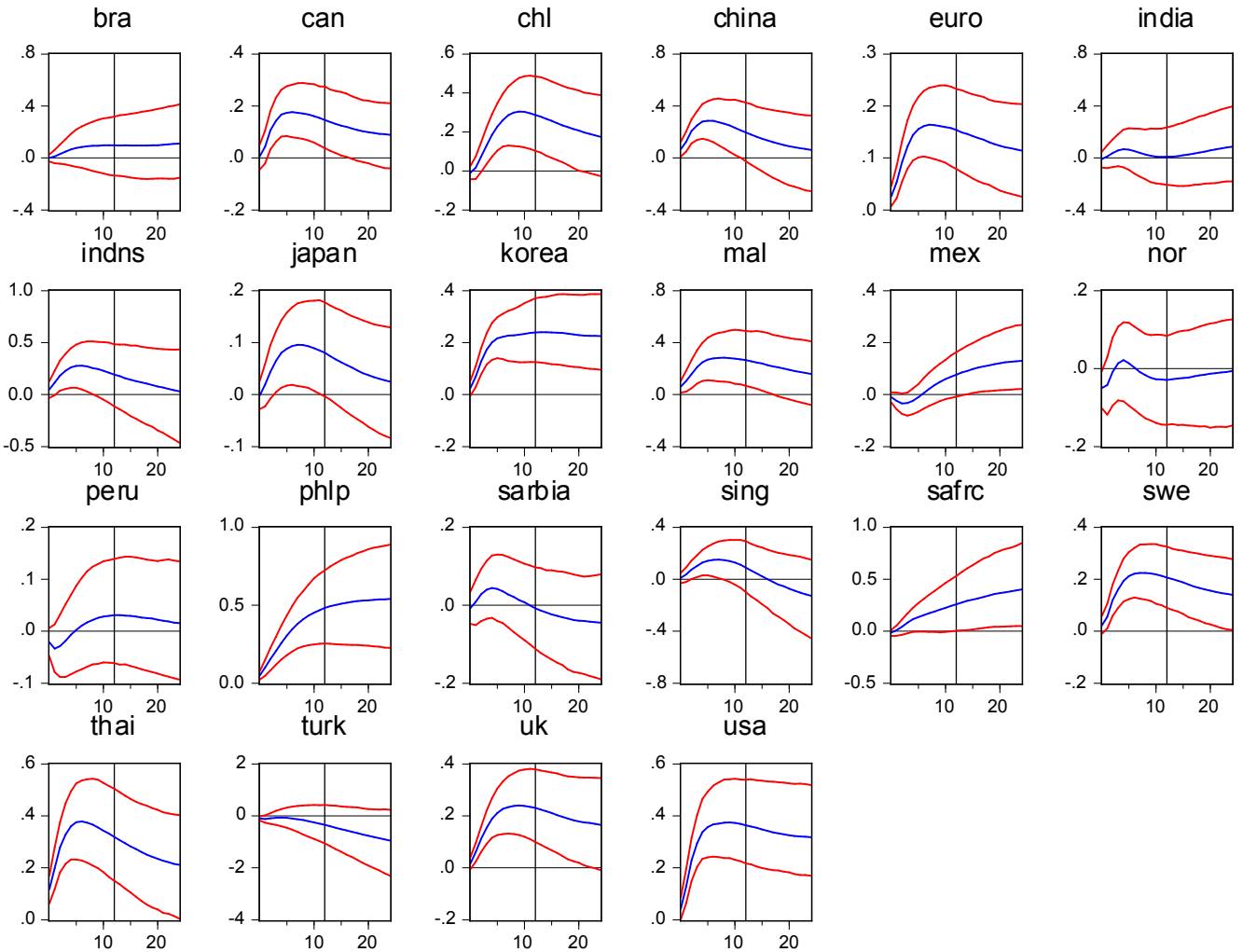
- 1SD of Oil price hike → Headline CPI



Tentative summary-1

- On the impact of oil price hike to the headline CPI
  - A positive, long-run, and significant response are observed for:
    - Canada, Chile, Euro, Mexico, Philippines, Sweden, Thailand, UK, and USA
  - A positive, short-run, and significant response are observed for:
    - Japan, Korea, Malaysia, Norway, and Singapore
  - Indonesia's response is insignificant, reflecting the oil price subsidy

- 1SD of Food price hike $\rightarrow$ Headline CPI

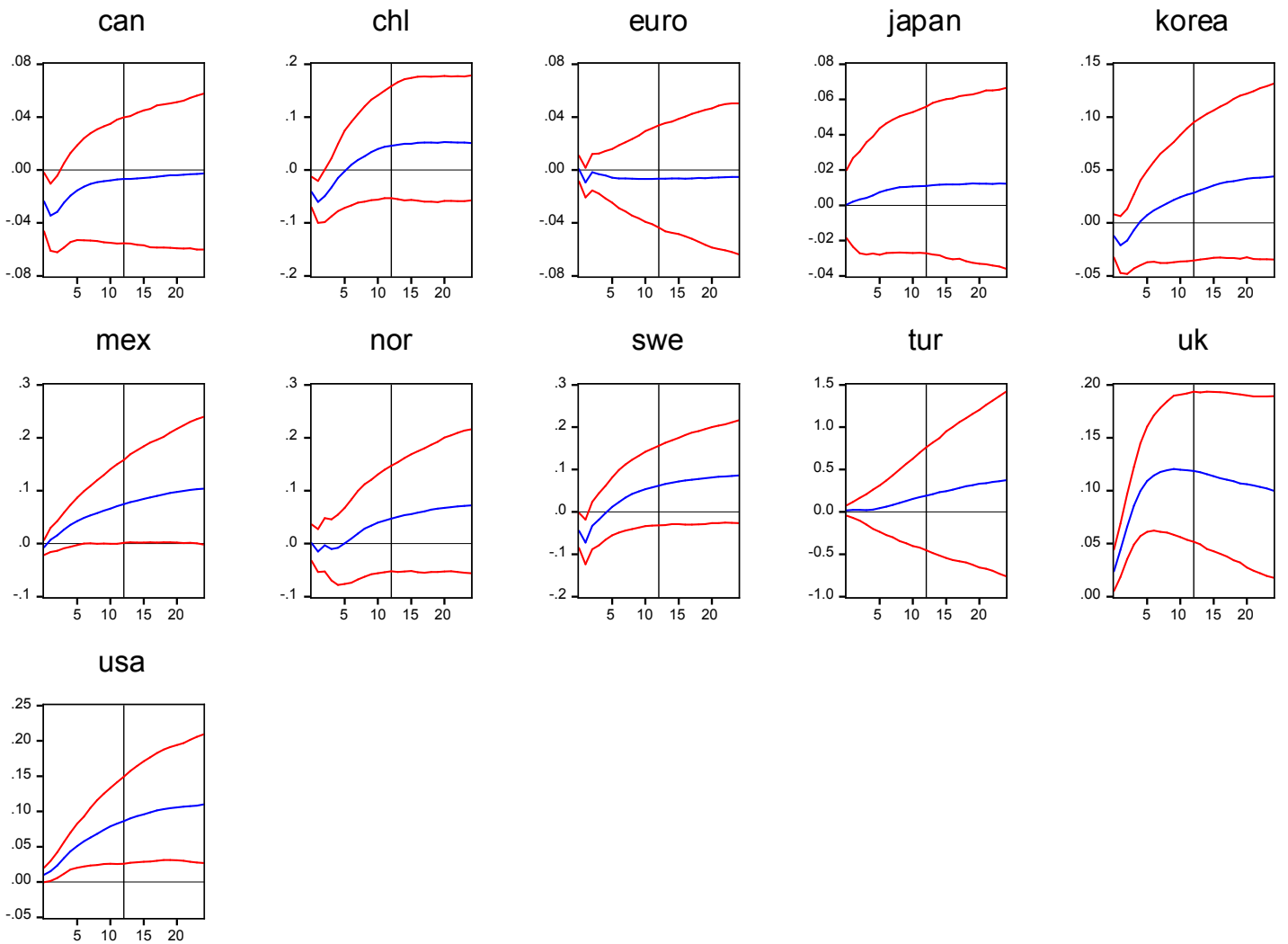


Tentative summary-2

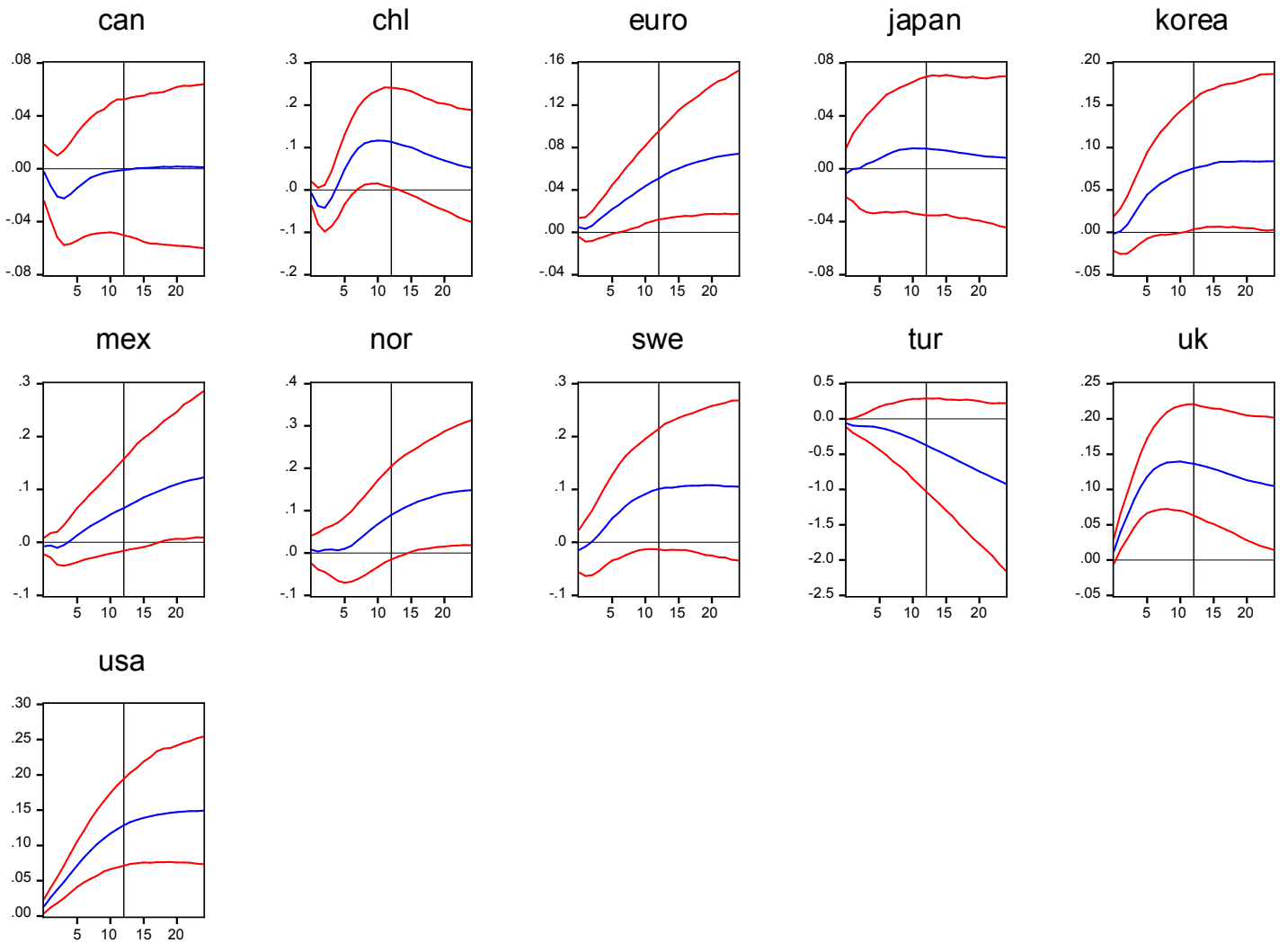
- On the impact of food price hike to the headline CPI
  - A positive, long-run, and significant response are observed for:
    - Korea, Philippines, and Thailand
  - A positive, short-run, and significant response are observed for:
    - Indonesia, Japan, Malaysia, and Singapore

Pass-through to the core inflation?

- 1SD of Oil price hike $\rightarrow$ Core CPI



- 1SD of Food price hike → Core CPI



Tentative summary-3

- Core CPI data is available for Japan and Korea only
- A significant impact of an oil price hike to the core CPI is observed for
  - Mexico, UK, and USA
- For the effect of a food price hike on the Core:
  - Korea becomes significant
  - Japan is still insigificant

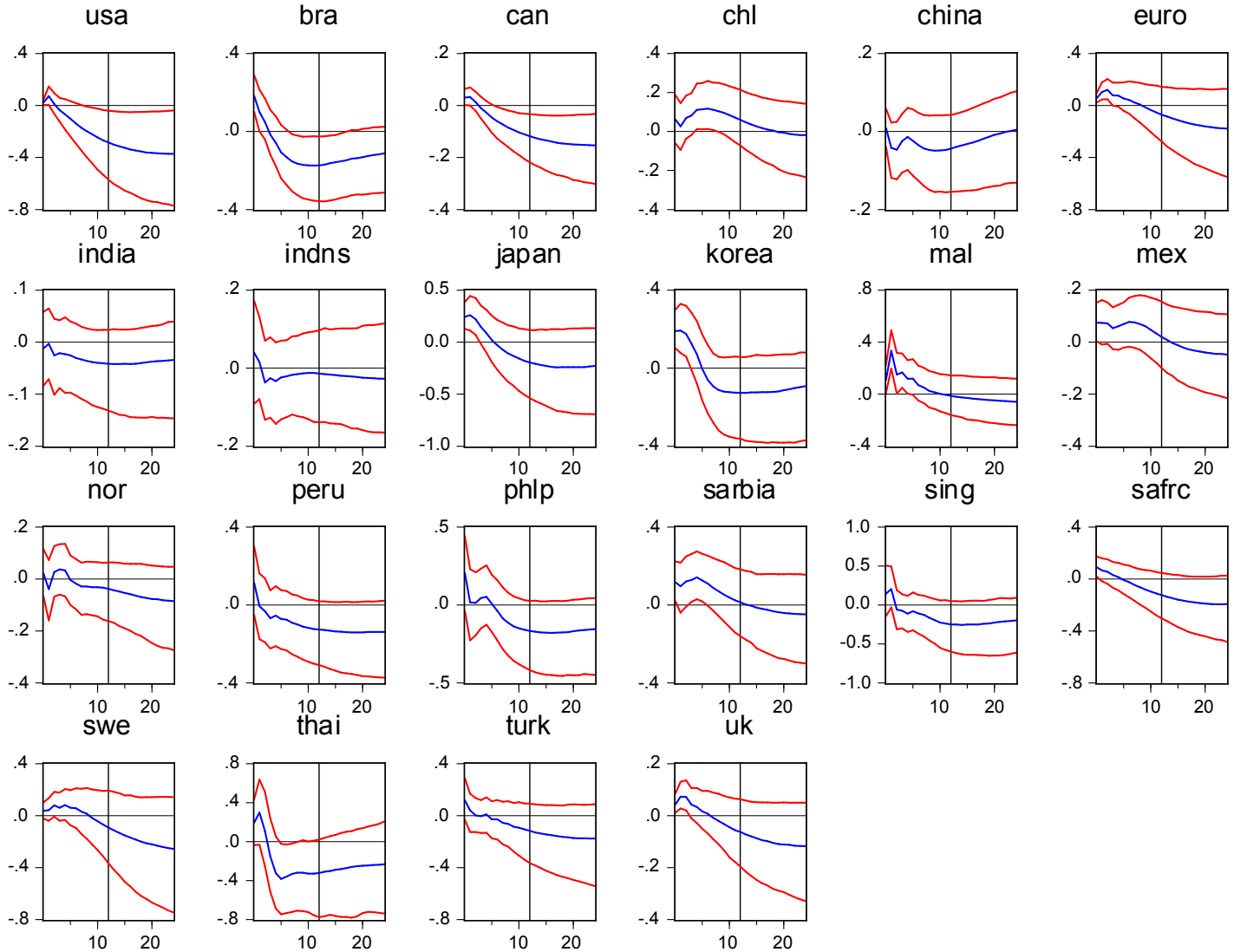
External shock-2: US monetary policy shock

- The Structural GIRFs (SGIRFs)

$$\mathcal{SGIRF}(\mathbf{x}_t; \mathbf{v}_{\ell t}, n) = E(\mathbf{x}_{t+n} | \mathbf{e}_\ell' \mathbf{v}_t = \sqrt{\mathbf{e}_\ell' \Sigma_{\mathbf{v}} \mathbf{e}_\ell}, \mathcal{I}_{t-1}) - E(\mathbf{x}_{t+n} | \mathcal{I}_{t-1})$$

- 1 SD shock of US interest rate $= 0.1927\%$

- 1SD up of US interest rate → IP



Tentative summary-4

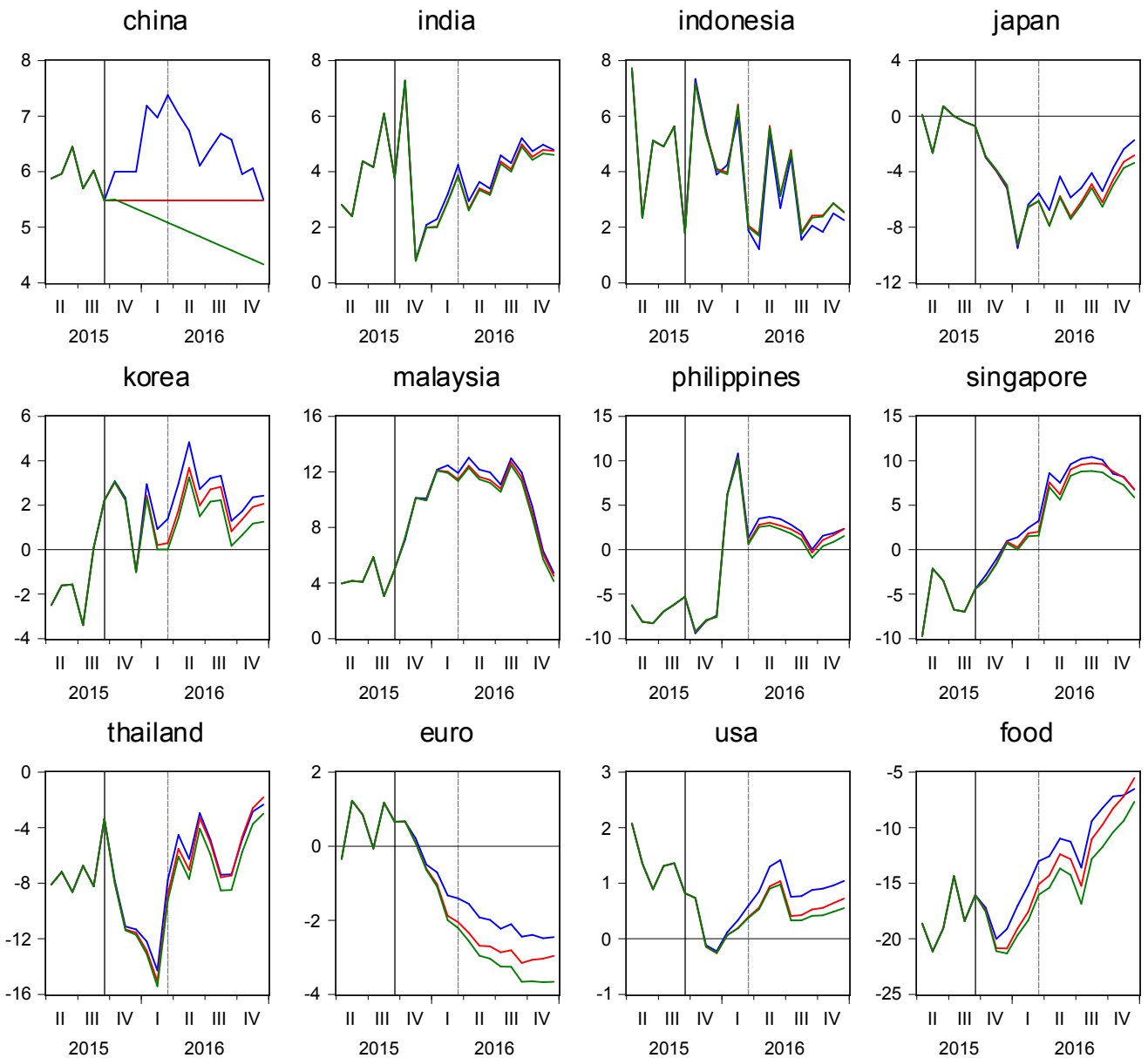
- US's IP drops siginificantly
- The median responses are negative for:
  - China, India, Indonesia, Singapore, and Thailand (within 3 months after the shock)
  - Japan, Korea, Malaysia, and Philppines (after 6-9 months of the shock)
- The significant (including the marginally significant) negative effects are observed for Philippines, Singapore, and Thailand

External shock-3: China's growth slowdown

- Scenario analysis
  1. IMF's Oct 2015 WEO projections (2015 avg=6.8 %, 2016 avg=6.3 %)
  2. Keeping the y-on-y growth rate of Sep 2015 (approx. 5.5%)
  3. Gradual slowdown of y-on-y growth rate from 5.5 % (in Sep 2015) to 4.5 % (in Sep 2016)

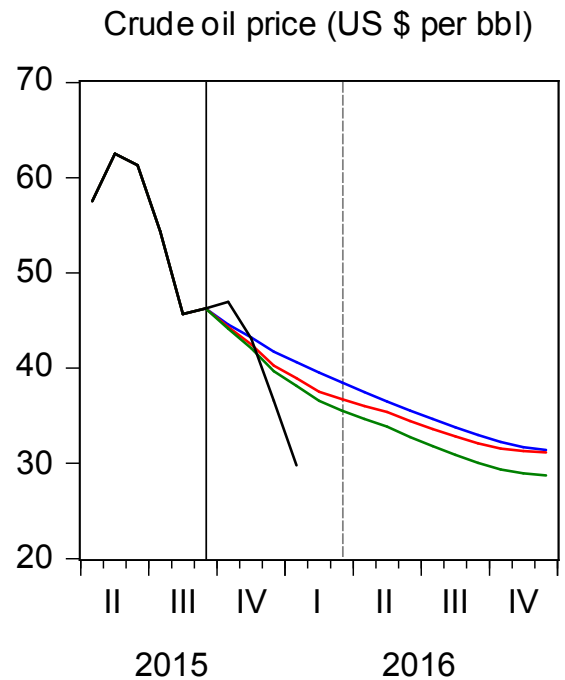
- Conditional forecast

- Three scenarios of China's IP growth rate (y-on-y)



Tentative summary-5

- For Japan, Korea, and Euro, their growth rates are more than 1% lower
- Conditional forecast of the crude oil price



  - Supply side is not modeled yet

Aim of this research

1. Estimate the global model by using the Global VAR (GVAR)
   - including 8 Asian countries
   - at monthly frequency for the period Jan 2000 - Sep 2015
2. Quantify the impacts of three risks to Asian countries
   1. Volatile commodity prices
   2. US Fed's contractionary monetary policy
   3. China's growth slowdown

Summary of our findings

1. The impact of commodity price fluctuations
   - On the headline CPI
     - Oil price hike $\rightarrow$ Headline CPI$\uparrow$ for 6/8 Asian countries
     - Food price hike $\rightarrow$ Headline CPI$\uparrow$ for 7/8

	only in the short-run	even in the long-run
oil	Japan, Korea Malaysia, Singapore	Philippines, Thailand
food	Indonesia, Japan Malaysia, Singapore	Korea, Philippines Thailand

   - On the core CPI
     - Pass-through effect is less clear for Japan
     - For Korea, the pass-through of p^f to Core is significant

2. The impact of US monetary policy change
   - An interest rate hike has negative impacts on most of the Asian economies
   - The median responses are negative for:
     - China, India, Indonesia, Singapore, and Thailand (within 3 months after the shock)
     - Japan, Korea, Malaysia, and Philppines (after 6-9 months of the shock)
   - In sum
     - Negative but not clear impact: China, Indonesia
     - In a short-run: Thailand
     - One-year later: Japan, Korea, Philippines, Singapore, Malaysia
3. The impact of China's growth slowdown

Leftovers

1. Give economic meanings to the CI relations (See Dees, Holly, Pesaran, and Smith, 2007)

$$
\begin{aligned}
e_{it} + p_{it}^{H*} - p_{it}^{H} &= a_{i1} + \zeta_{i1,t} && \text{PPP} \\
y_{it} - y_{it}^{*} &= a_{i2} + \zeta_{i2,t} && \text{Growth convergence} \\
r_{it} - \Delta p_{it}^{H} &= a_{i3} + \zeta_{i3,t} && \text{Fisher equation} \\
r_{it} - r_{it}^{*} - E(\Delta e_{i,t+1}^{*}) &= a_{i4} + \zeta_{i4,t} && \text{UIP}
\end{aligned}
$$

2. Link matrices, w_{it} and $\tilde{w}_i$, can be modified in several ways:
   - introduce time-varying features reflecting the evolution of trade structure
   - use of other information, such as the capital flows
3. Make the parameter time-varying, such as regime-switching
4. Include Australia and New Zealand into our dataset
   - For these two countries, only the quarterly IP is available
   - Use of the mixed frequency estimation method?

Thank you very much

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