Effects of U.S. Quantitative Easing on Emerging Market Economies

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Motivation

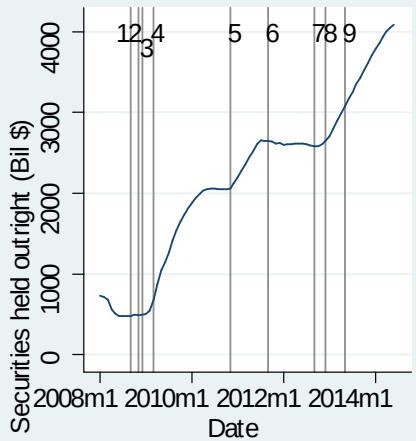
- After 2008, with the short-term interest rate at the ZLB, the Federal Reserve engaged in QE policy
- Active empirical literature on the effects (if any) of QE
- Literature largely focusses on domestic implications of QE
- Much popular discussion on spillovers to emerging markets
  - "Fragile Five" countries (Brazil, India, Indonesia, South Africa, and Turkey) thought to be particularly vulnerable
  - Were "Fragile Five" countries affected differently from the rest?

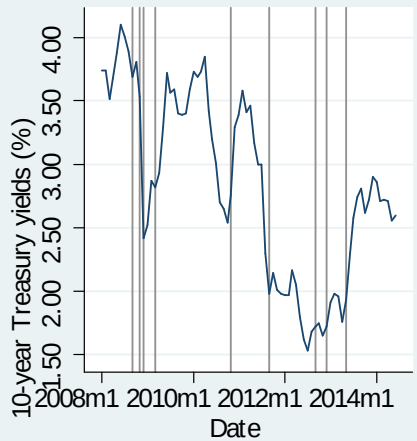
Motivation

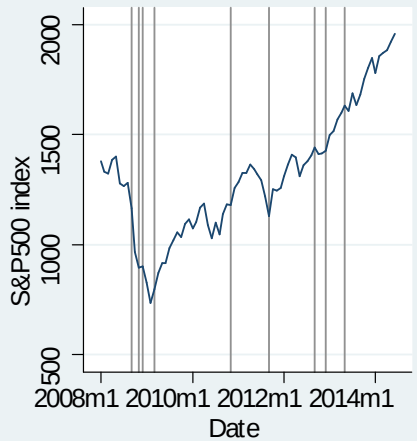
- Literature largely focusses on "announcement effects" of QE
  - Effects around narrow 1/2-day windows following policy changes
  - Advantages: can establish causality/exogeneity
  - Disadvantages: high-frequency financial variables only; dynamic effects?
- Develop a framework suitable for
  - Inferring both real and financial implications of QE
  - Analyzing dynamic effects
  - Studying both domestic effects and emerging market spillovers

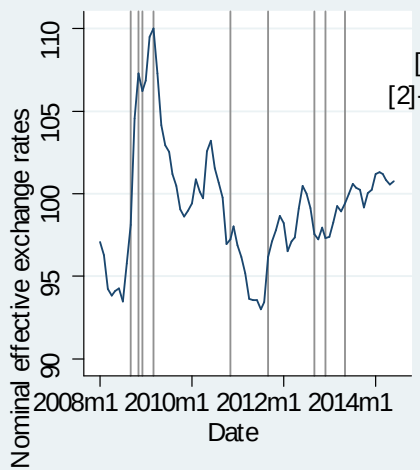
Motivation

US variables





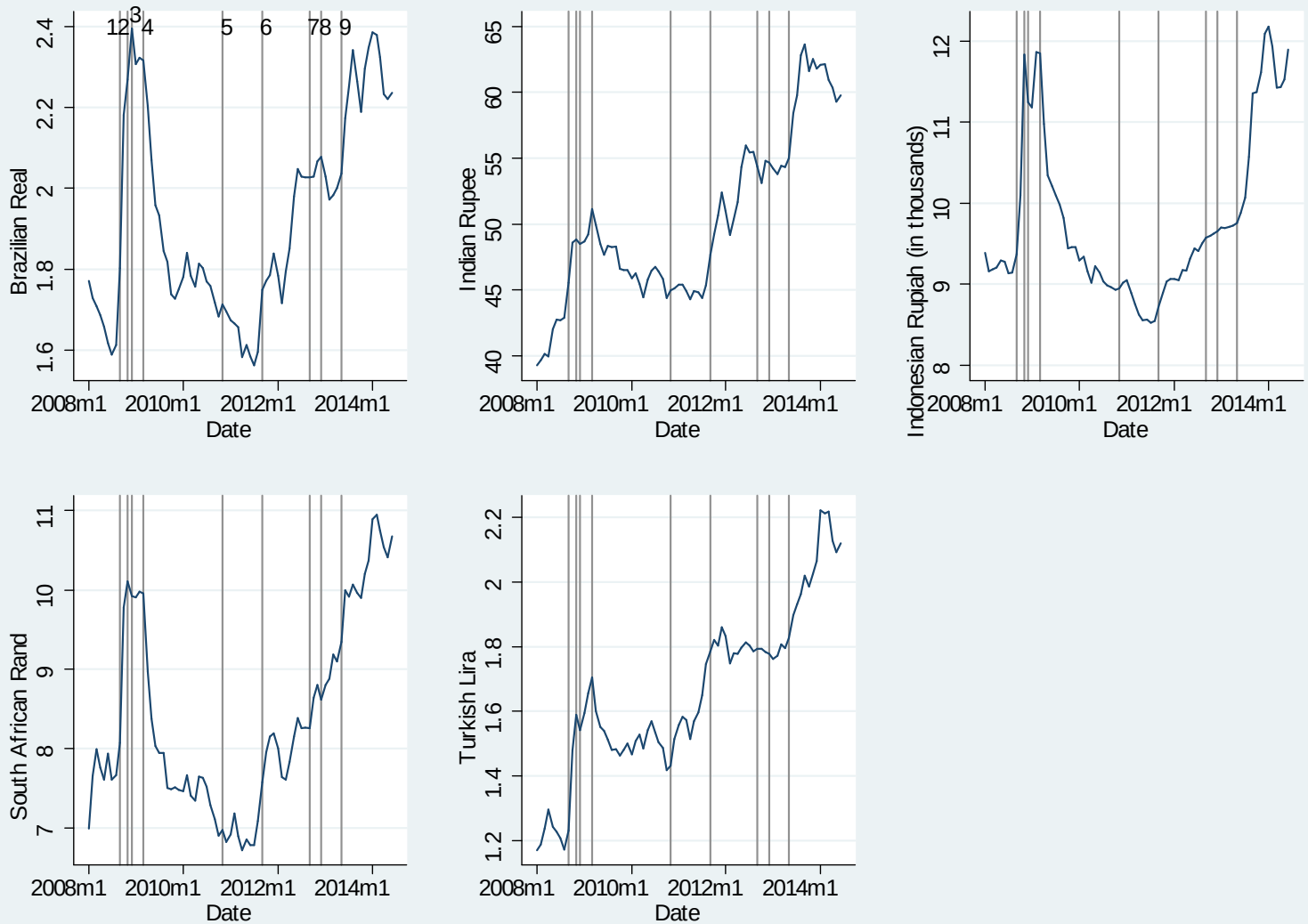




Notes:
[1] Sep 2008 Lehman Brothers
[2]-[4] Nov, Dec 2008 and Mar 2009, QE1
[5] Nov 2010, QE2
[6] Sep 2011, MEP
[7]-[8] Sep, Dec 2012, QE3
[9] May 2013, Taper scare

Motivation

Exchange rates against USD



Our Approach

- Identified monthly BVAR with US data
  - Balance sheet variable as a policy instrument from 2008 to mid-2014
  - Macro variables: output and consumer prices
  - Financial variables: govt bond and equity prices
  - Zero non-recursive restrictions to identify a US QE shock
- Given the identified US QE shock, assess effects on emerging markets
  - Focus first on the "Fragile Five" countries and then extend to others
  - Financial variables: exchange rates, bond and equity prices, capital flows
  - Macro variables: output, consumer prices, trade flows

Related Literature

- Announcement effects
  - Gagnon et al (2010); Krishnamurthy and Vissing-Jorgensen (2011)
- VAR based identification
  - Gambacorta et al (2014); Baumeister and Benati (2011); Wright (2011)
- International effects of US QE policies
  - Neely (2010); Chen et al (2011); Glick and Leduc (2011); Bauer and Neely (2013)
- Effects on emerging markets/Fragile Five
  - Eichengreen and Gupta (2013); Dahlhaus and Vasishtha (2014); Aizenman et al (2014)

VAR Framework

- Asset side component of the Fed's balance sheet as policy instrument
  - Securities held outright by the Fed
  - Measure of size and not composition of assets
  - Approach similar to Gambacorta et al (2014)
- A "reaction function" similar to conventional monetary policy
  - The Fed responds systematically to the state of the economy
  - Isolate the non-systematic component (shock)
  - Fed observes current long-term Treasury yields while setting policy

VAR Framework

- Consider a VAR model

$$A_0 y_t = A^+(L) y_t + \varepsilon_t$$

- Use (non-recursive) short-run restrictions for identification
  - Sims and Zha (2006a,b) and Leeper, Sims, and Zha (1996)
- Identify structural shock $\varepsilon_{QE,t}$ with restrictions on A_0
- Bayesian inference with a Minnesota-type prior

US QE Shock Identification

- A_0 matrix (similar to Sims and Zha (2006b))

	Industrial production	PCE deflator	Securities held-outright	10-year Treasury yields	S&P500 index
Prod1	X				
Prod2	X	X			
I	X	X	X	X	X
F	X	X	a_1	a_2	
MS			a_3	a_4	

- "X": the corresponding coefficient of A_0 is not restricted at all
- Blanks: the corresponding coefficient of A_0 is restricted to zero
- Liquidity Priors: $Corr\left(a_1, a_2\right) = 0.8$ and $Corr\left(a_3, a_4\right) = -0.8$

Spillover Effects of QE Shock

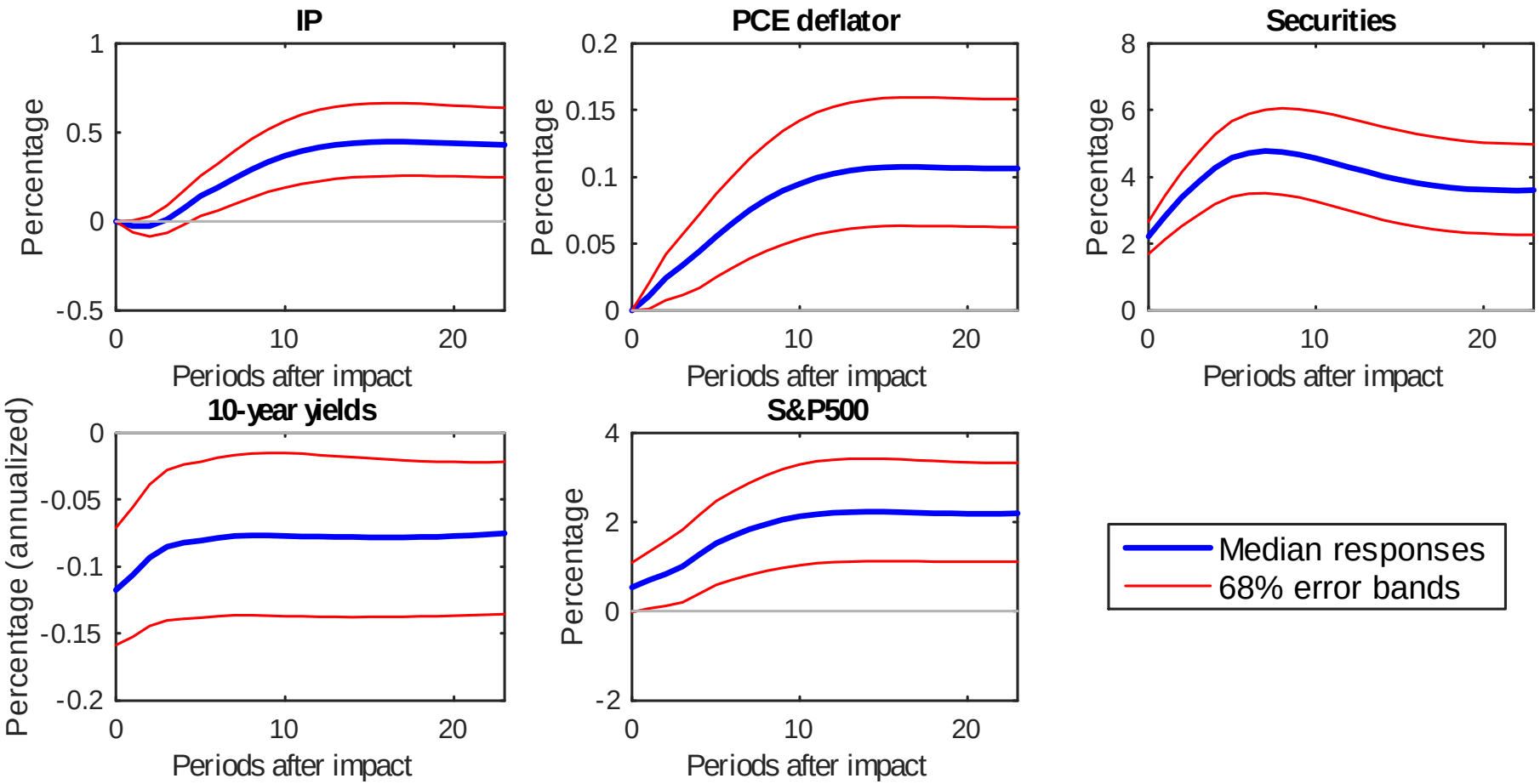
- Extract the US QE shock and assess dynamic effects on emerging market economies with country specific BVARs
  - Bayesian inference with a Minnesota-type prior
- Effectively assume a "block exclusion" structure

$$z_t = B_1 z_{t-1} + \cdots + B_p z_{t-p} + D_0 \varepsilon_{QE,t} + \cdots + D_q \varepsilon_{QE,t-q} + u_t$$

- Specification
  - Baseline: 4 variable (IP, CPI, 3 month interest rate and USD exchange rate) VAR with the US QE shock as an exogenous variable
  - VAR controls for domestic dynamics and shocks
  - After baseline estimation, one additional variable at a time

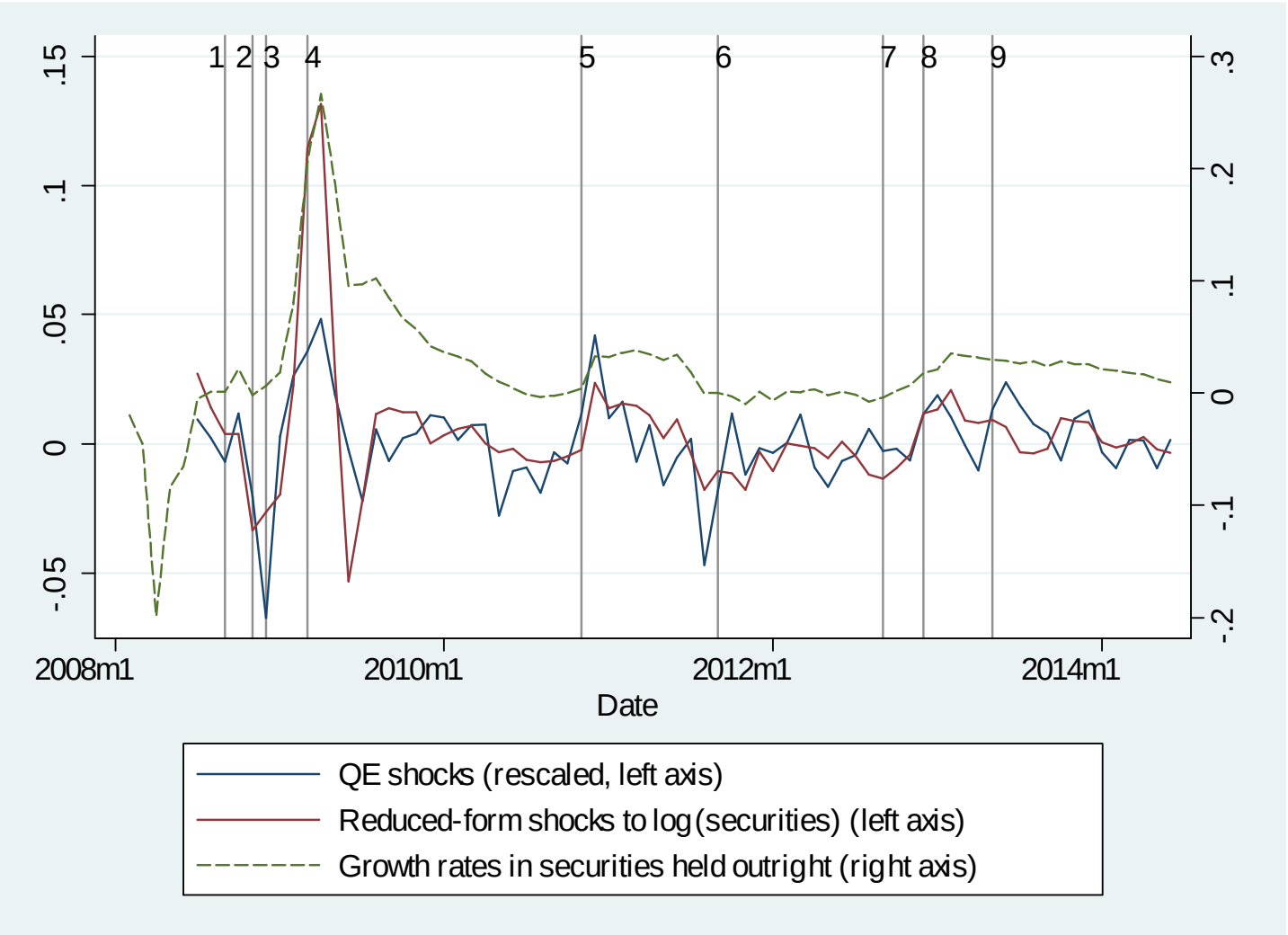
US QE Shock

IRFs of US variables



US QE Shock

Shock series and changes in securities held outright



US QE Shock

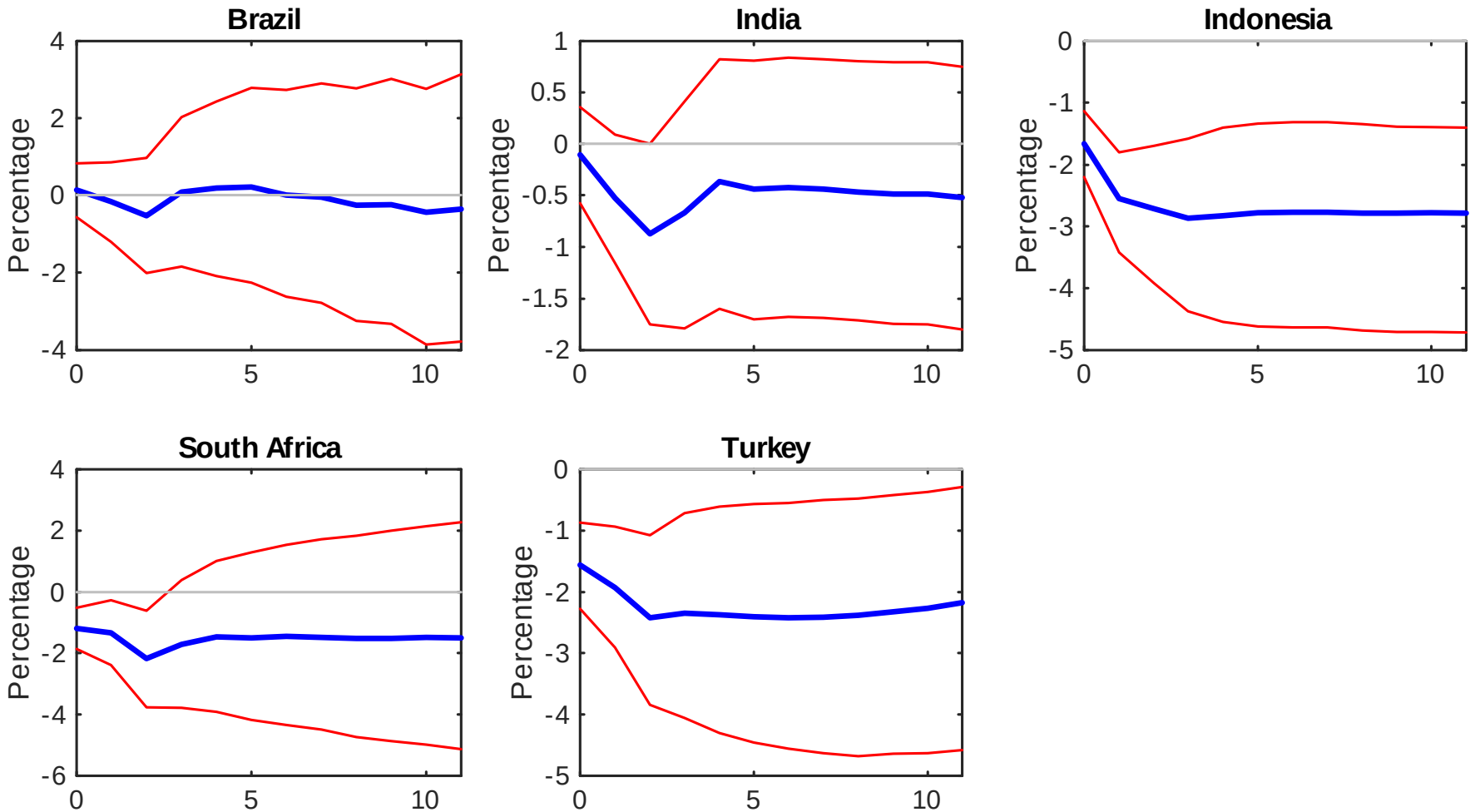
Variance decomposition of US variables

- What is the contribution of the US QE shock?
- Mean and [16%, 84%] quantile

	Industrial production	PCE deflator	Securities held-outright	10-year Treasury yields	S&P500 index
Impact	0.00	0.00	0.55	0.31	0.03
	[0.00, 0.00]	[0.00, 0.00]	[0.33, 0.78]	[0.1, 0.51]	[0.00, 0.06]
3 month	0.01	0.03	0.51	0.17	0.06
	[0.00, 0.01]	[0.00, 0.05]	[0.29, 0.74]	[0.02, 0.33]	[0.01, 0.12]
6 month	0.04	0.07	0.50	0.17	0.12
	[0.00, 0.08]	[0.02, 0.13]	[0.28, 0.72]	[0.01, 0.33]	[0.02, 0.21]
12 month	0.15	0.15	0.38	0.18	0.18
	[0.04, 0.26]	[0.05, 0.26]	[0.19, 0.57]	[0.02, 0.36]	[0.04, 0.33]

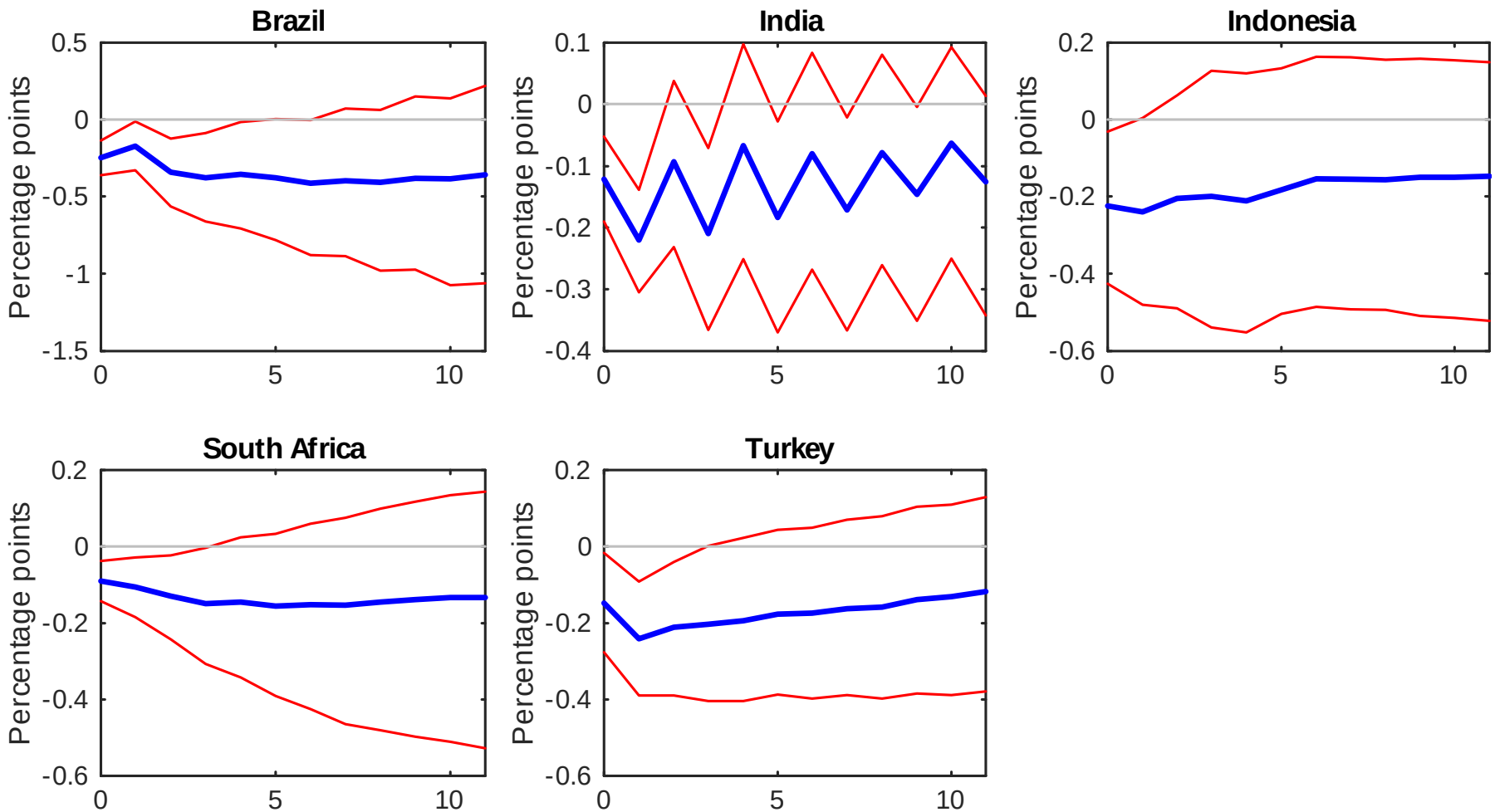
Spillover Effects of QE Shock

USD exchange rate: Fragile five



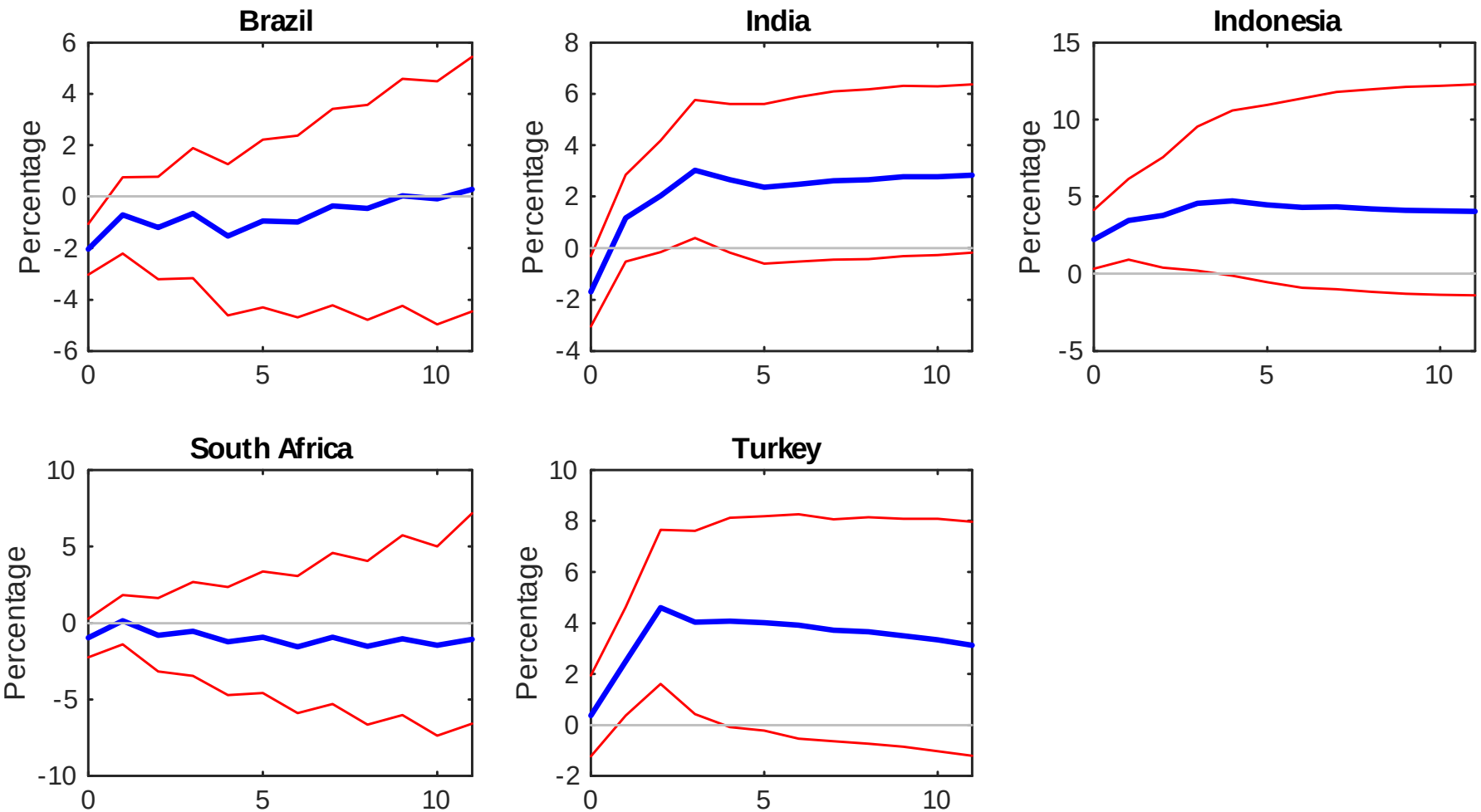
Spillover Effects of QE Shock

Long-term interest rate: Fragile five



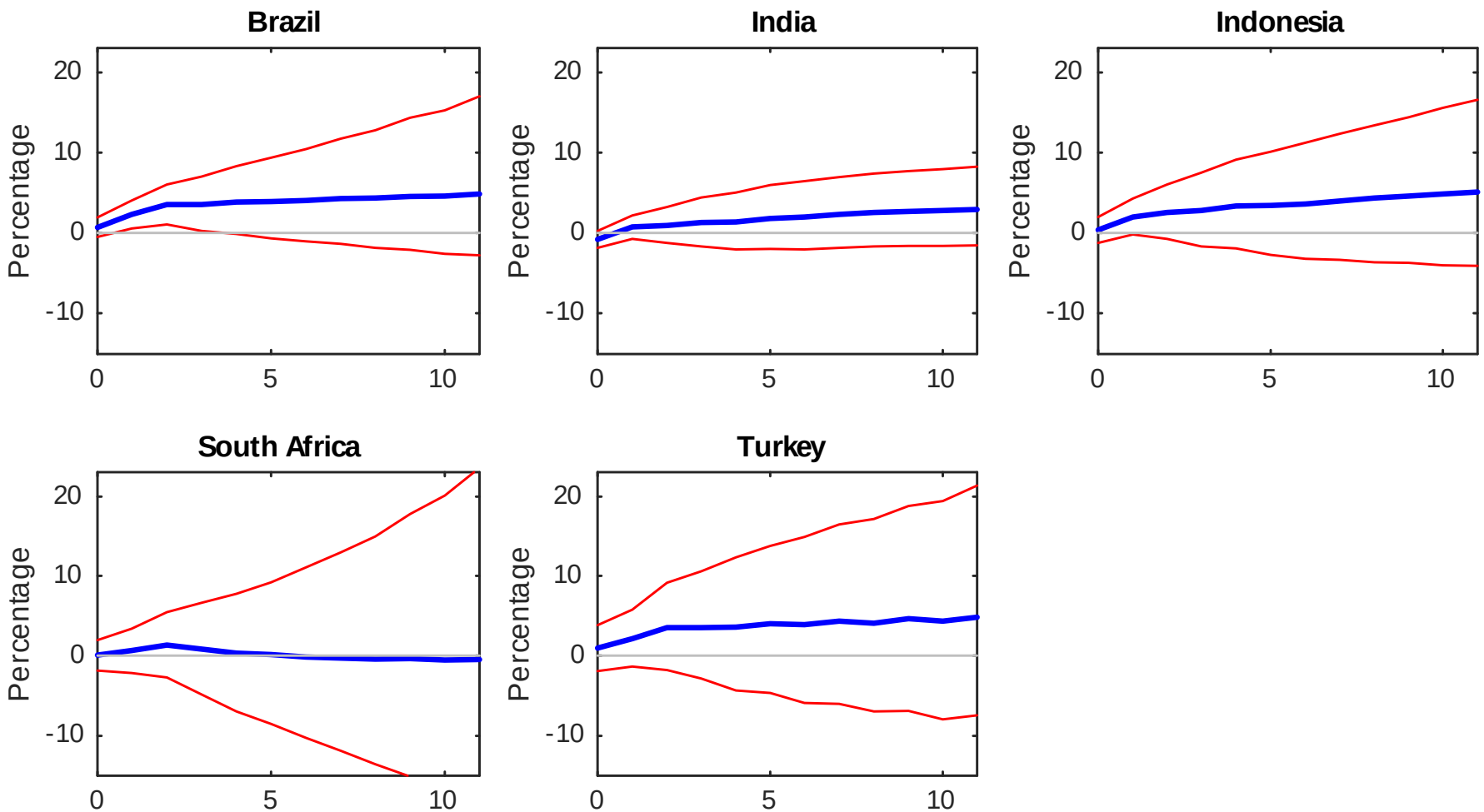
Spillover Effects of QE Shock

Stock price: Fragile five



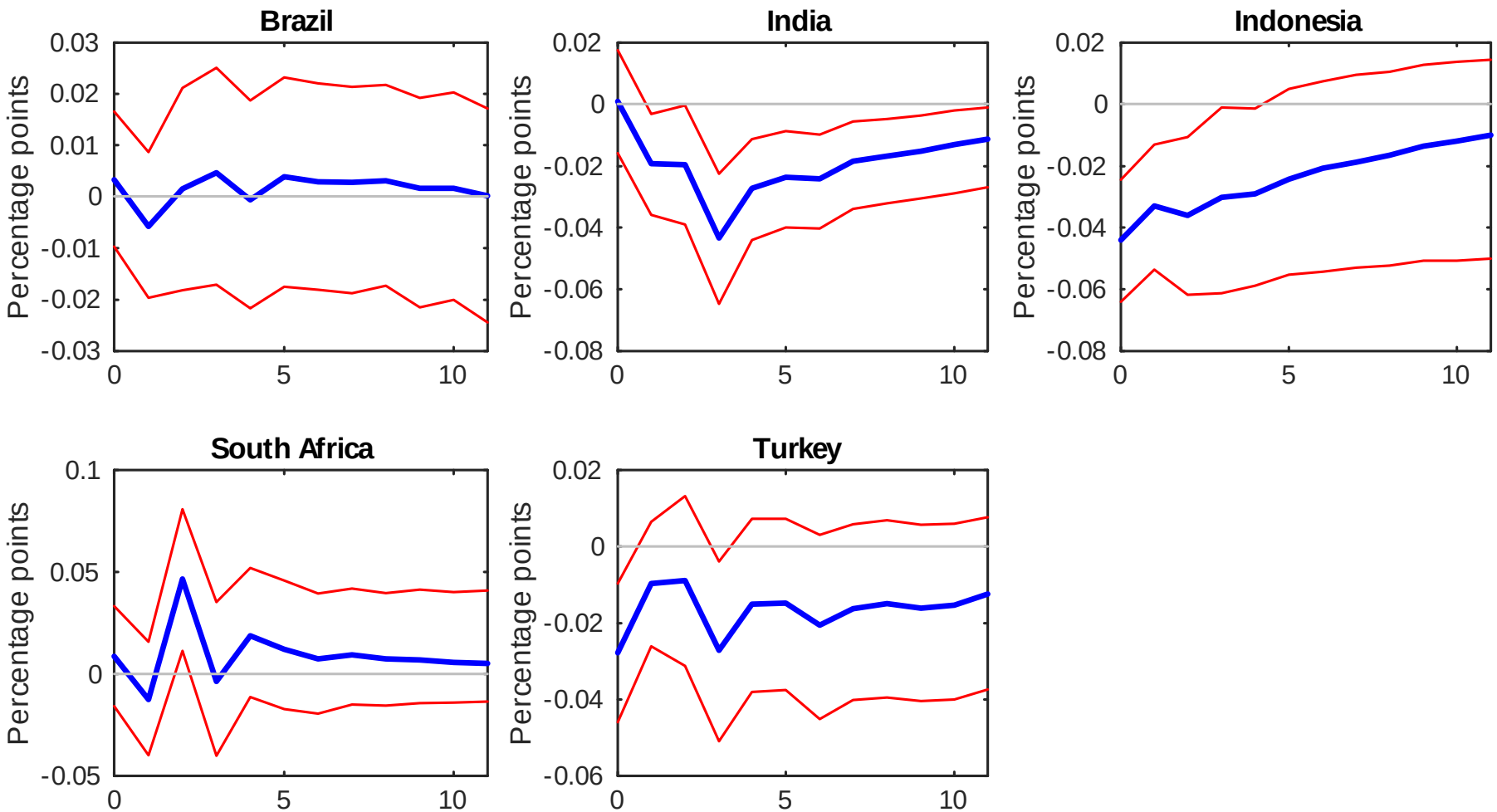
Spillover Effects of QE Shock

Equity flows: Fragile five



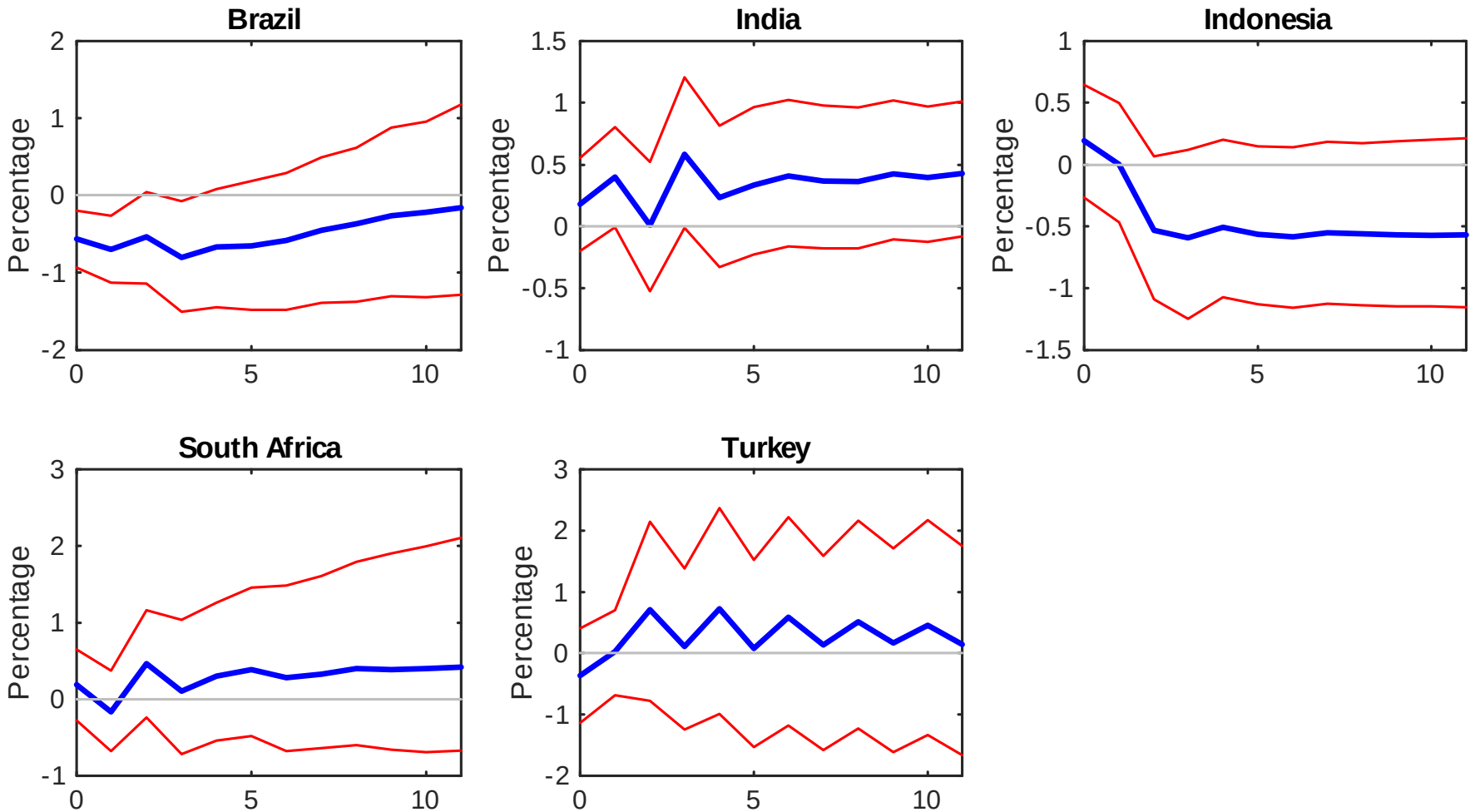
Spillover Effects of QE Shock

Net exports (US): Fragile five



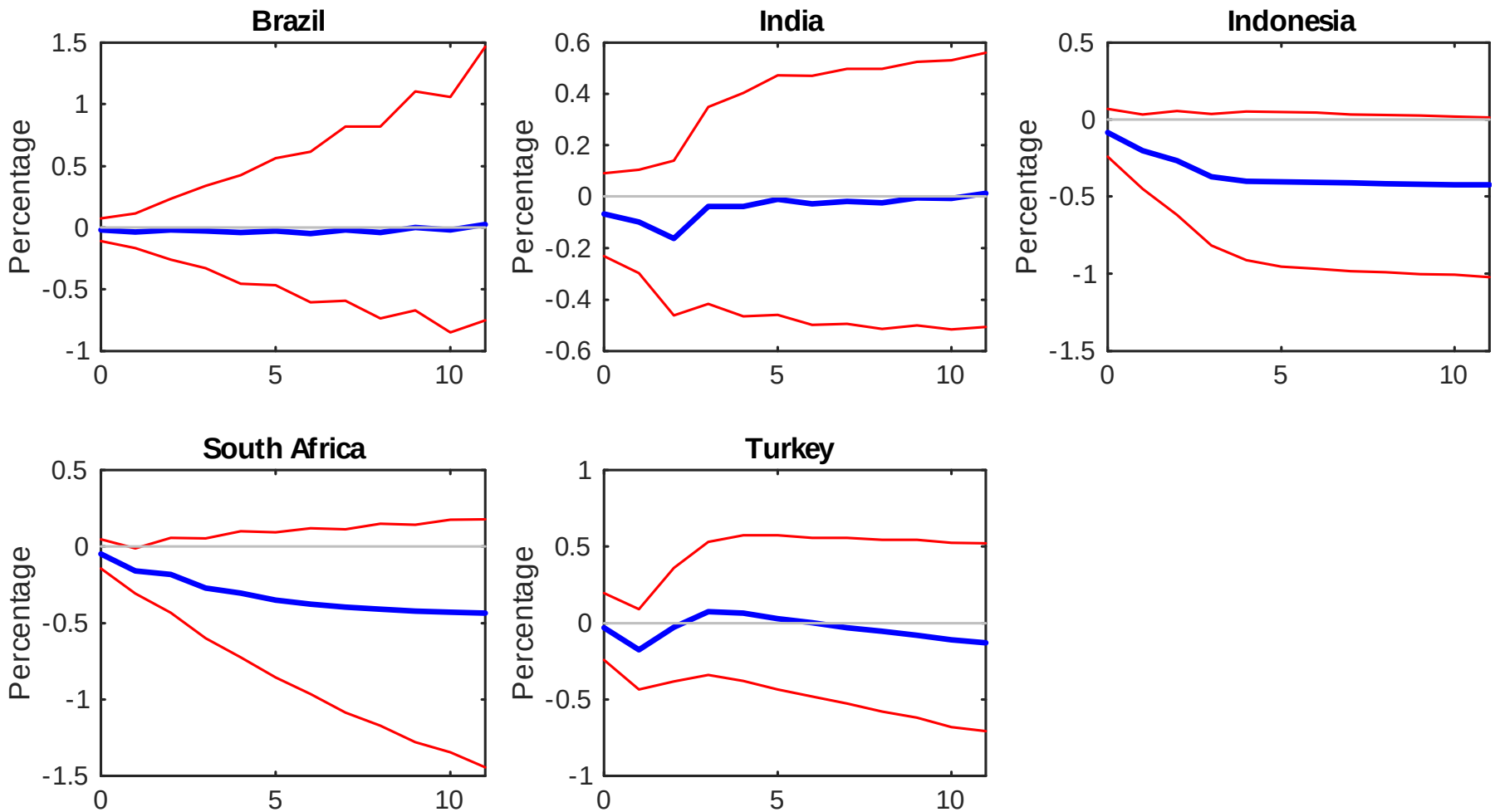
Spillover Effects of QE Shock

Output: Fragile five



Spillover Effects of QE Shock

CPI: Fragile five

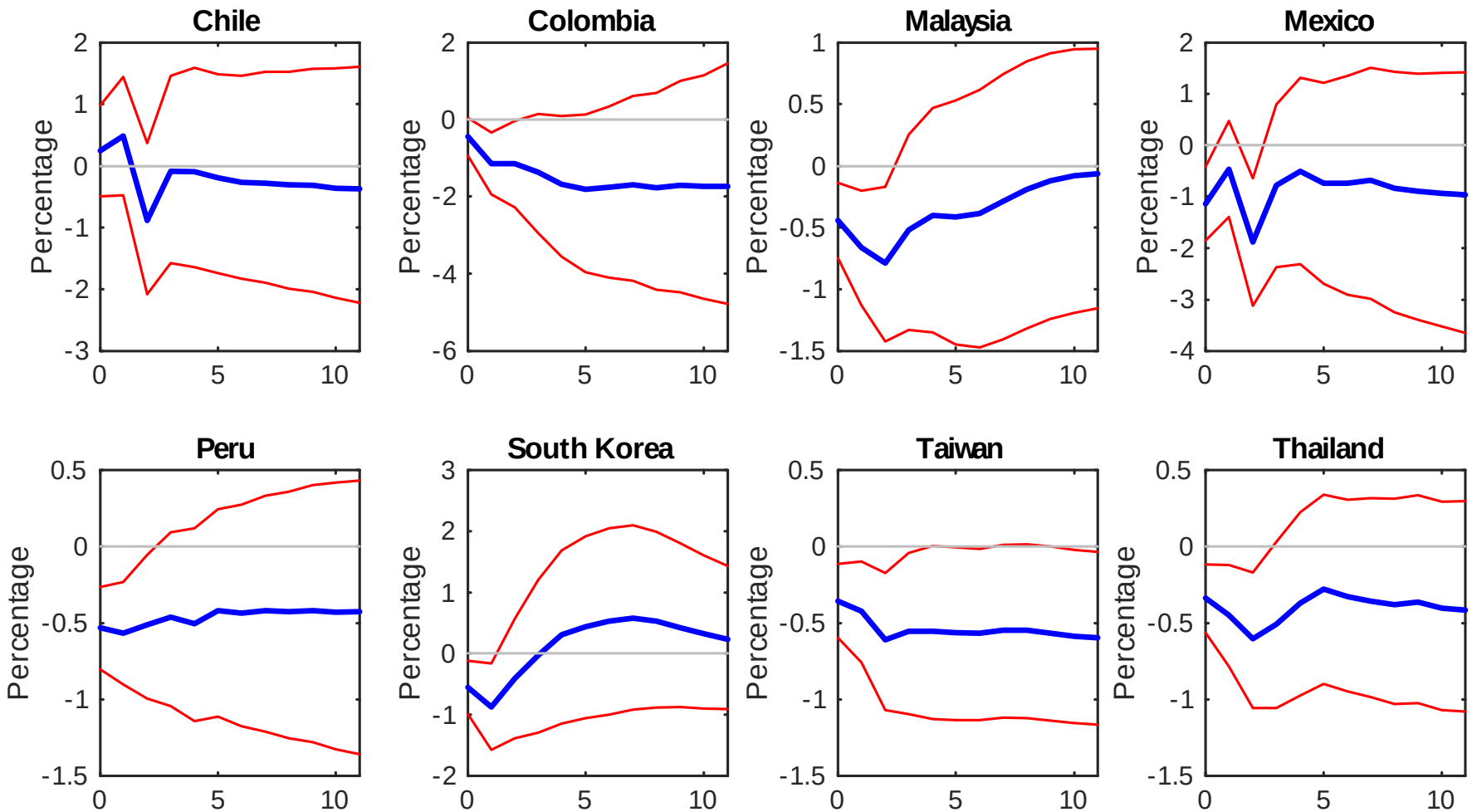


Spillover Effects of QE Shock

- Now consider other emerging market economies
- Were the "Fragile Five" different?
  - Qualitative or quantitative differences?
- Extended sample: Chile, Colombia, Malaysia, Mexico, Peru, South Korea, Taiwan, and Thailand
- Same specification for the country specific BVARs

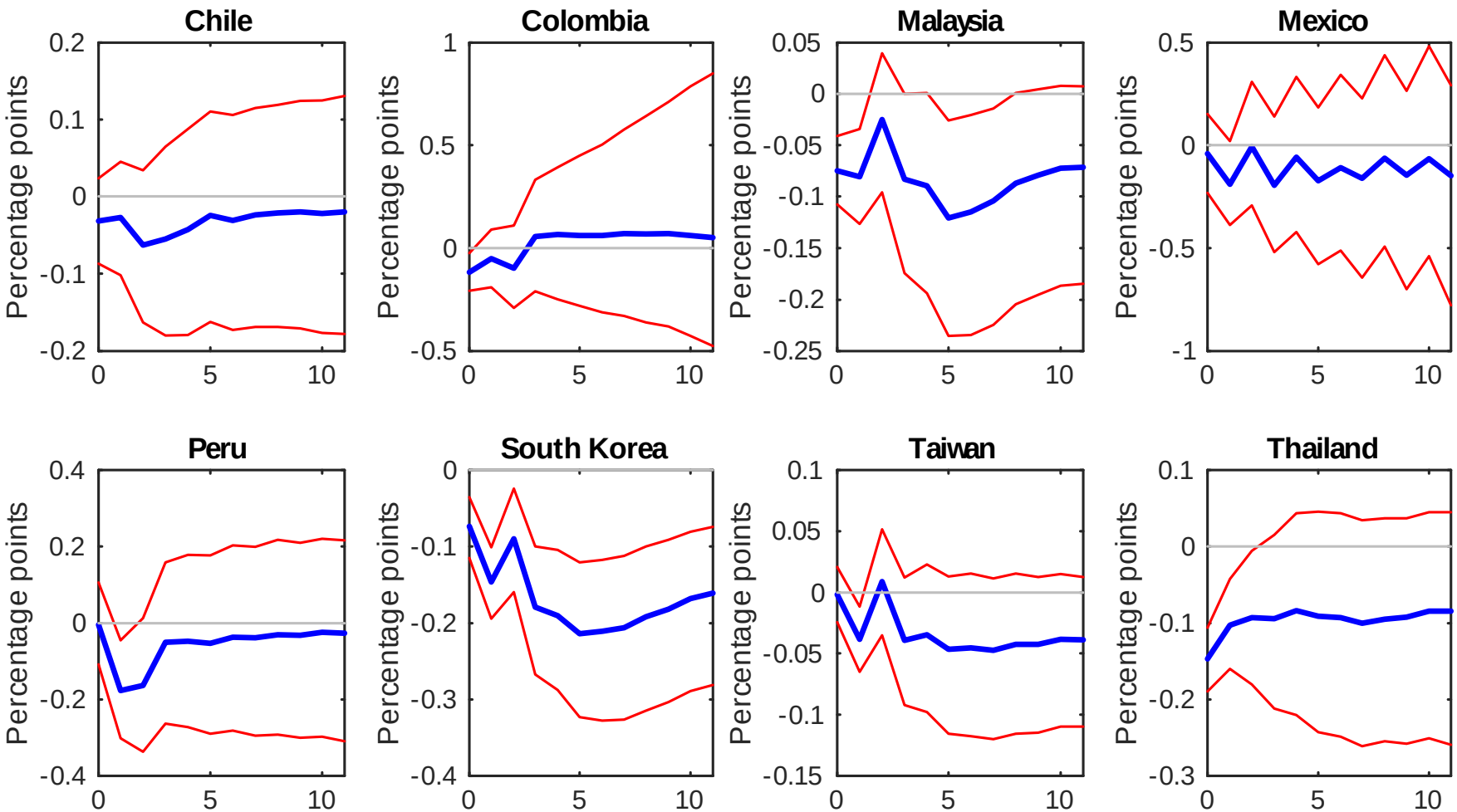
Spillover Effects of QE Shock

USD exchange rate: Other countries



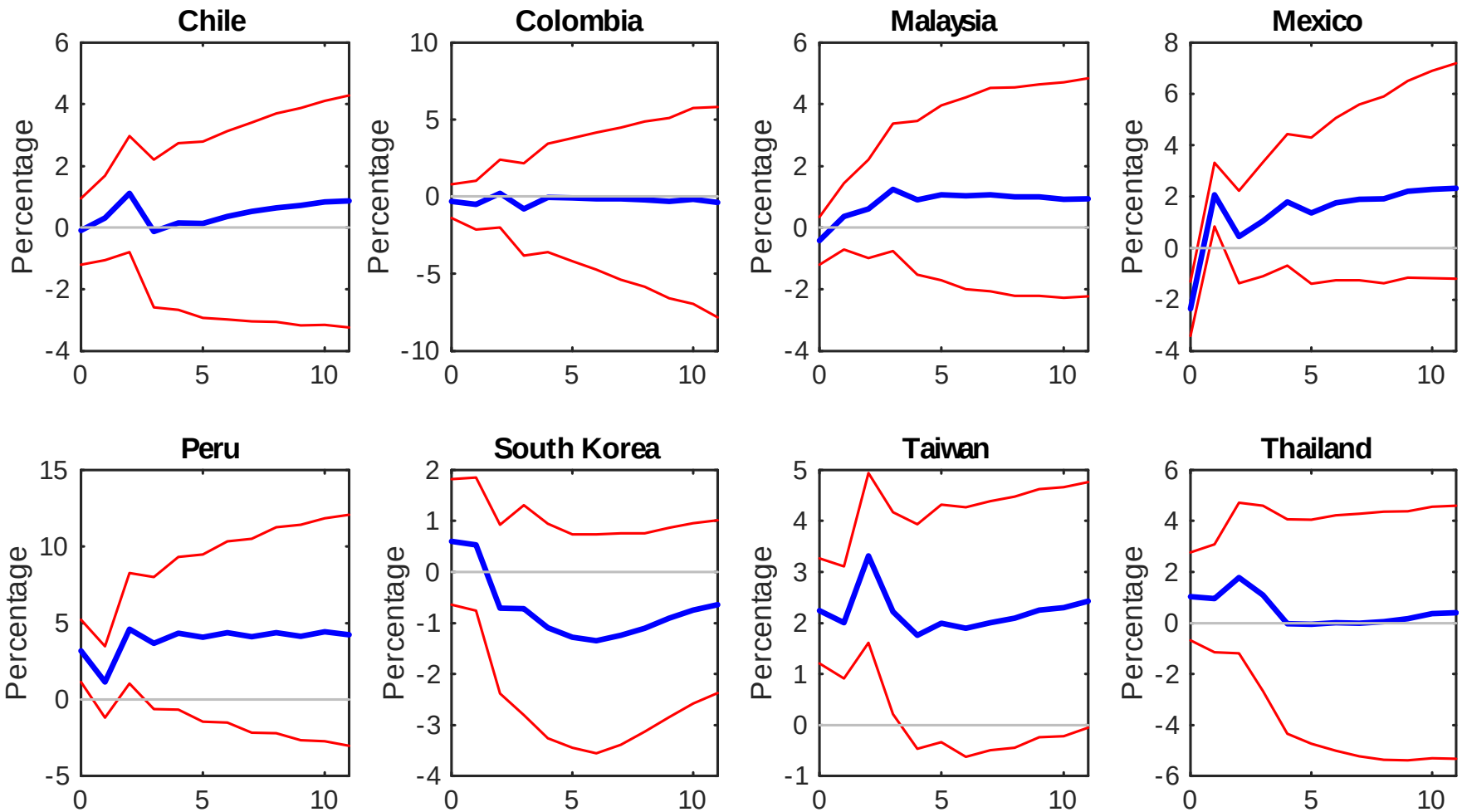
Spillover Effects of QE Shock

Long-term interest rate: Other countries



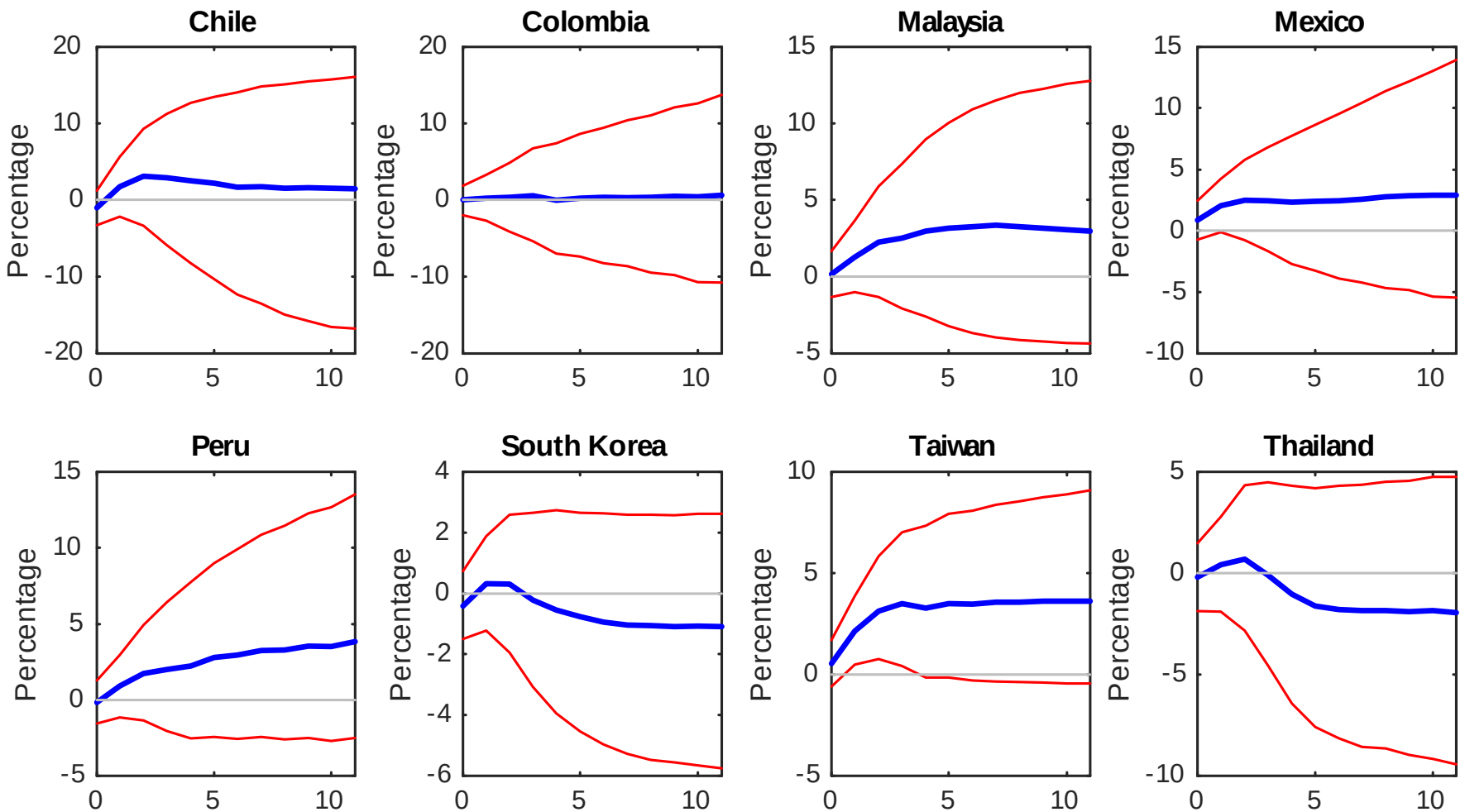
Spillover Effects of QE Shock

Stock price: Other countries



Spillover Effects of QE Shock

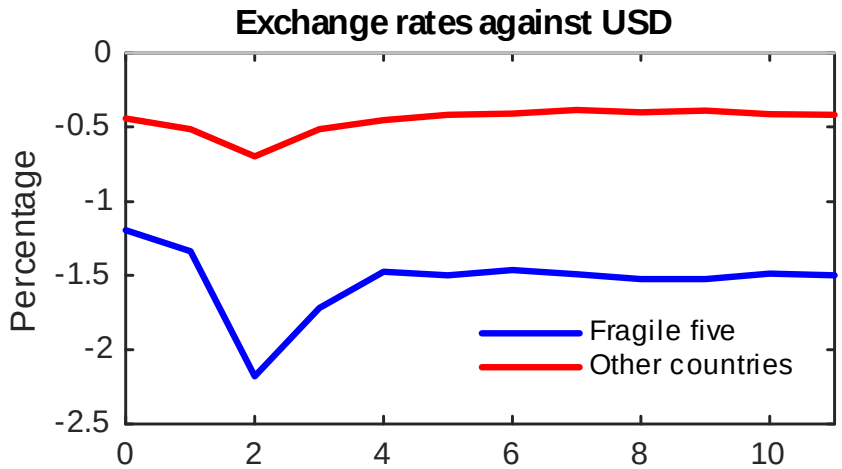
Equity flows: Other countries

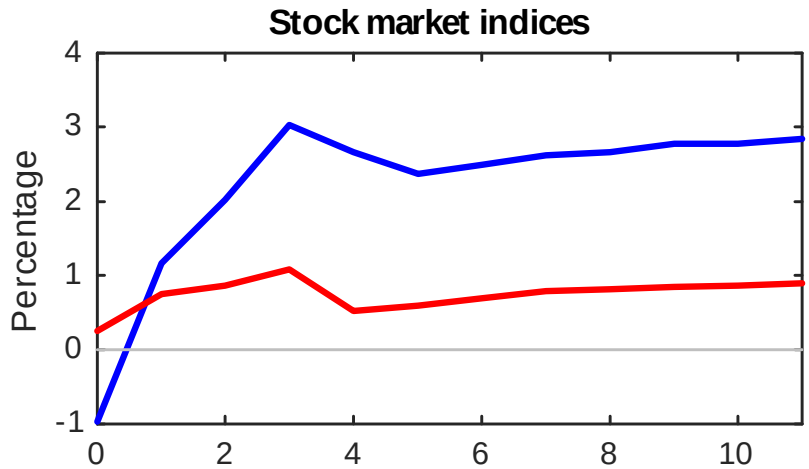


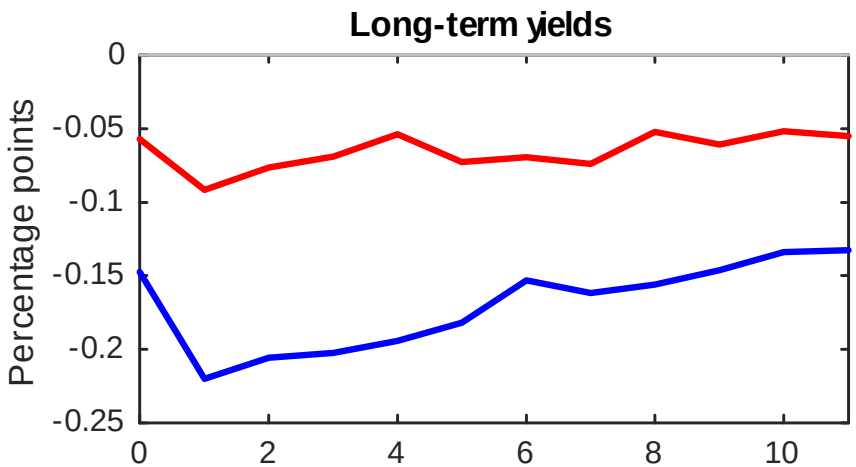
Comparison of Spillover Effects

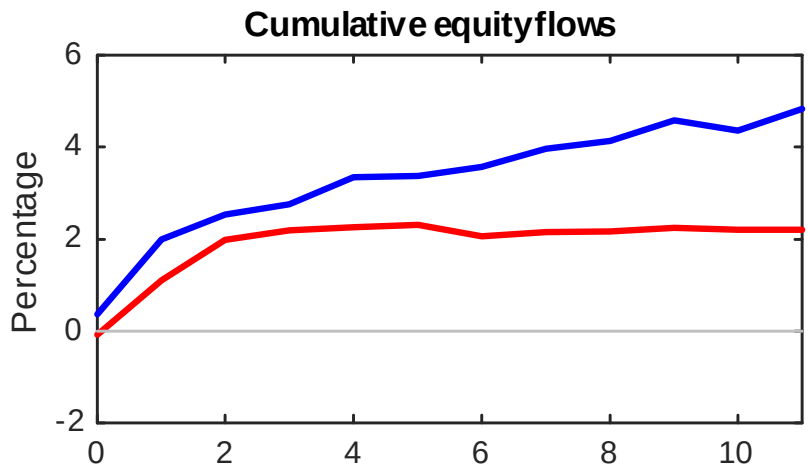
Medians of the two groups

- Fragile five countries respond more









Pooled Spillover Effects

Panel VAR

- Estimate the average effect of the US QE shock with a panel BVAR
  - Allow for dynamic heterogeneity
  - Random coefficient approach that partially pools the cross-section
  - Bayesian inference with a Minnesota-type prior
- Consider for country i,

$$z_{i,t} = B_{i,1} z_{i,t-1} + \cdots + B_{i,p} z_{i,t-p} + D_{i,0} \varepsilon_{QE,t} + \cdots + D_{i,q} \varepsilon_{QE,t-q} + u_{i,t}$$

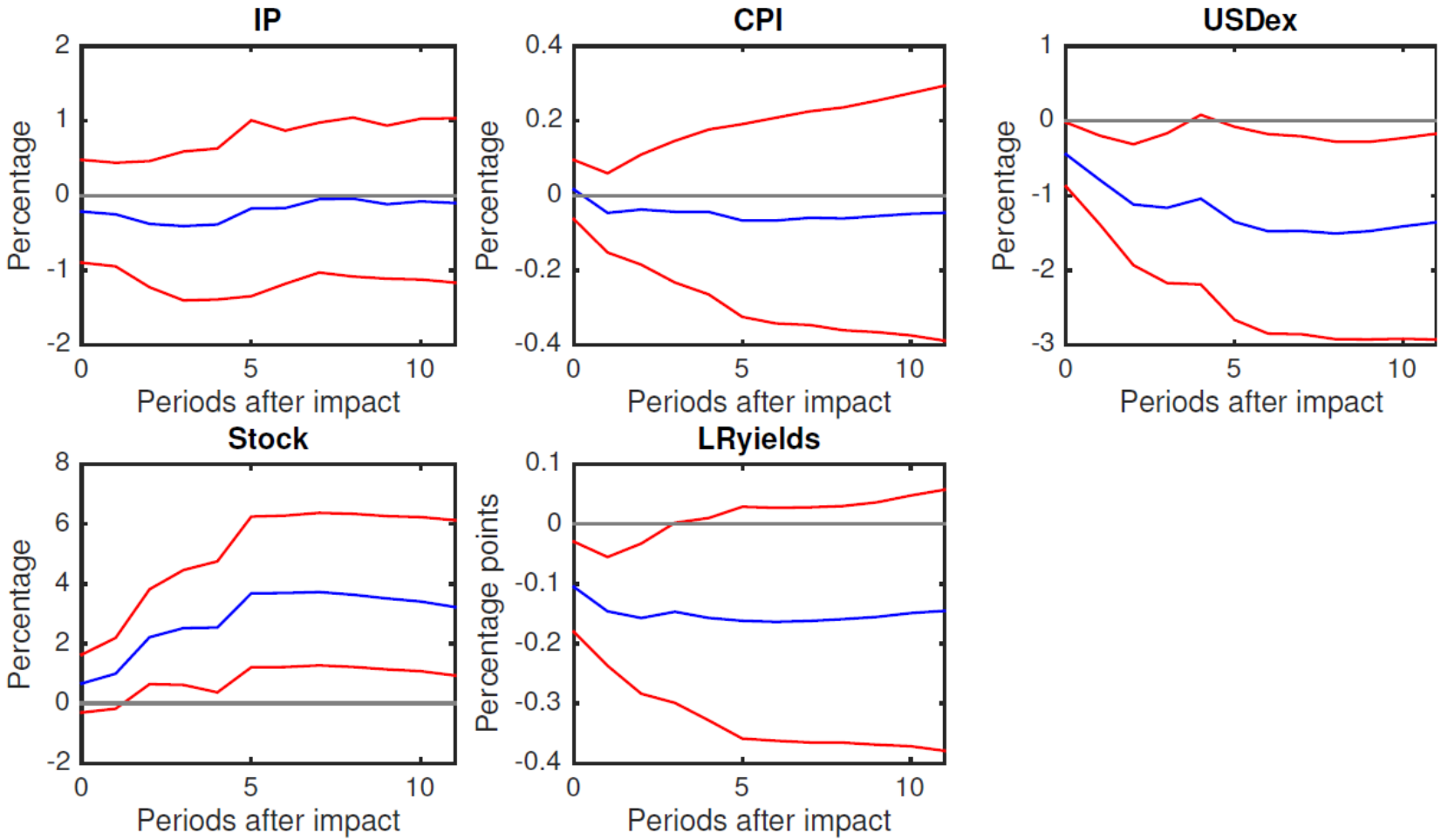
with $u_{i,t} \sim N(0, \Sigma_i)$, where

$$\begin{aligned} B_{i,j} &= \bar{B}_j + v_{B_{i,j}} \\ D_{i,k} &= \bar{D}_k + v_{D_{i,k}} \end{aligned}$$

with $v_{B_{i,j}} \sim N\left(0, \Omega_{B_{i,j}}\right)$ and $v_{D_{i,k}} \sim N\left(0, \Omega_{D_{i,k}}\right)$

Pooled Spillover Effects

Panel VAR



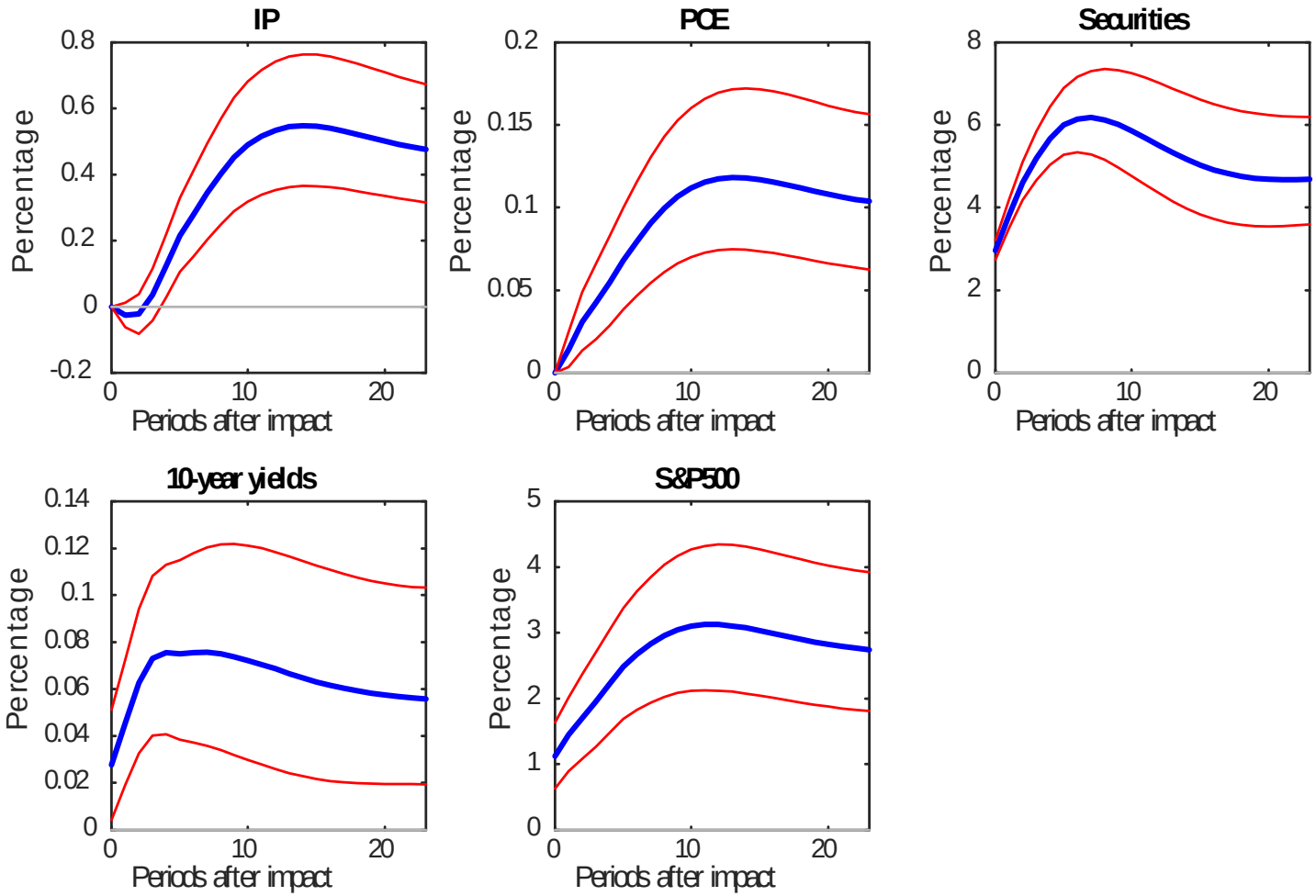
Extensions/Robustness

- Recursive short-run restrictions in US VAR?
- Extended 7 variable US VAR
  - Additional corporate yields and asset prices
- Alternate measures of output, prices, and long-term Treasury yields in baseline US VAR

Robustness

Recursive identification-1

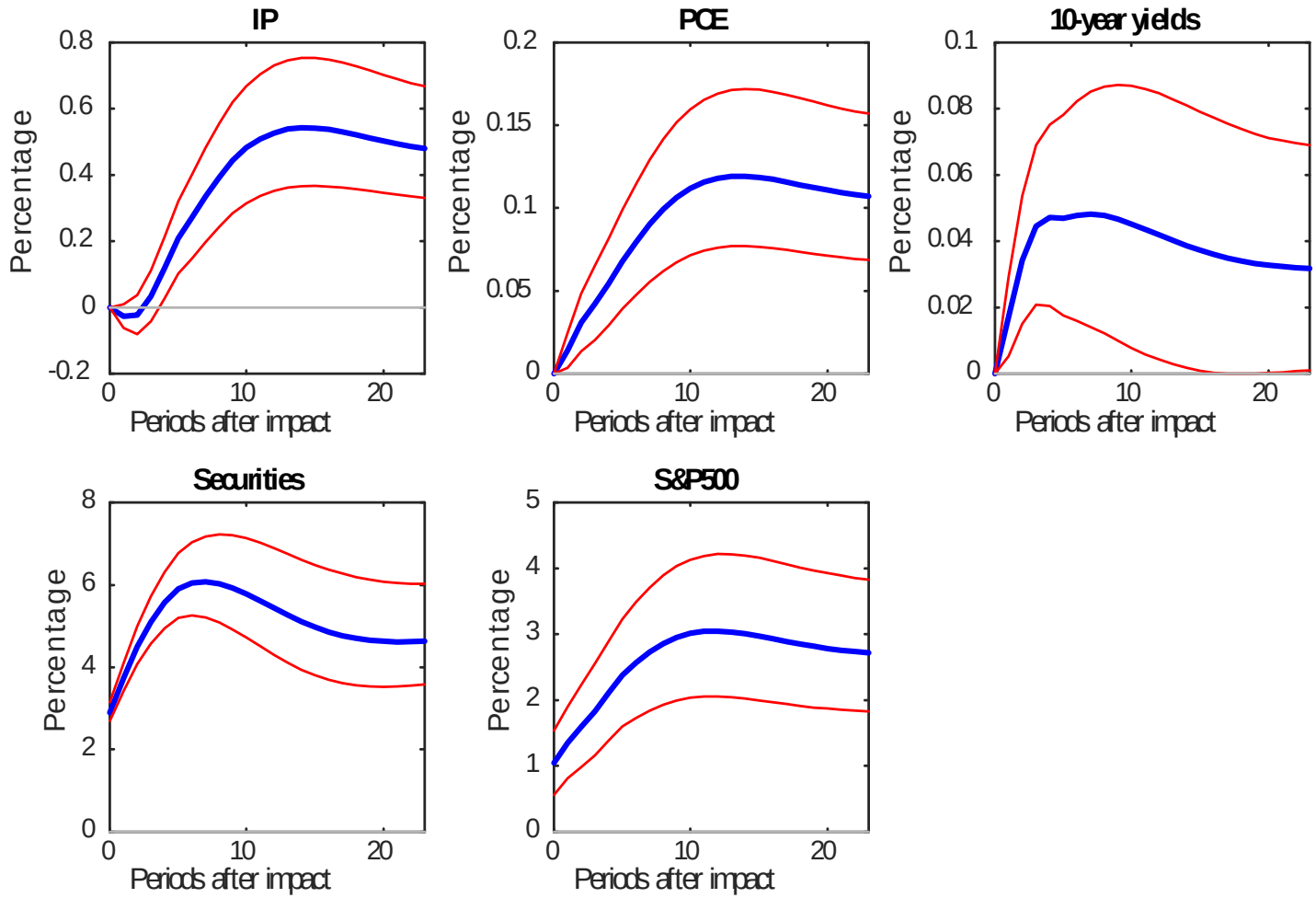
- Inference on long-term yields different



Robustness

Recursive identification-2

- Inference on long-term yields different



Robustness

Extended US QE Shock Identification

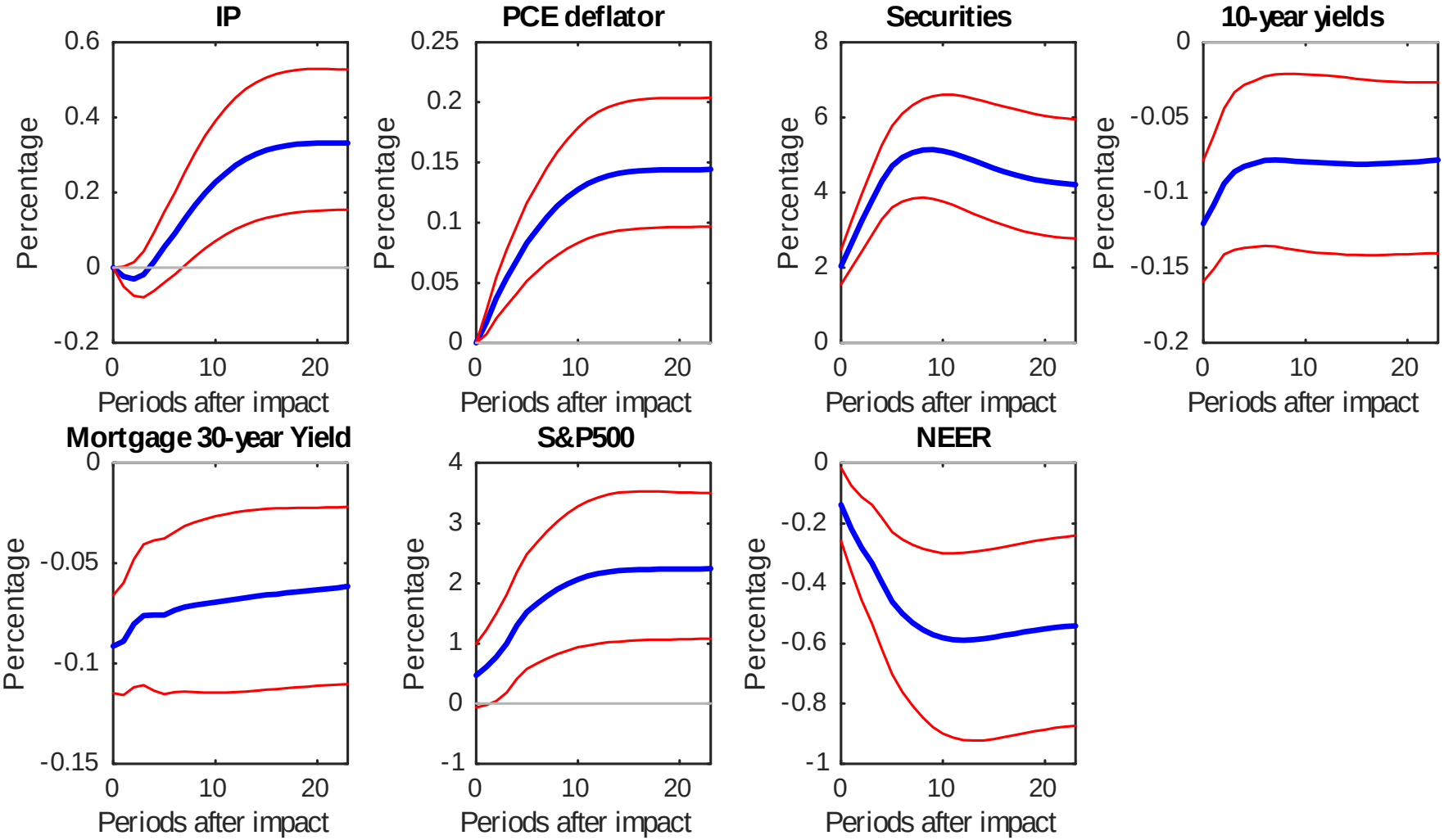
- Extended 7-variable VAR A_0 matrix

	Ind prod	PCE deflator	Securities held	10-year Treas yields	Private yields	S&P500 index	Additional asset price
Prod1	X						
Prod2	X	X					
I	X	X	X	X	X	X	
I	X	X	X	X	X	X	X
F	X	X	a_1	a_2			
F	X	X	X	X	X		
MS			a_3	a_4			

- Private sector yields (BofA Merrill Lynch US corporate 10-15 year index; 30 year conventional mortgage rate)
- Additional asset prices (Effective exchange rate; Core Logic house price index)

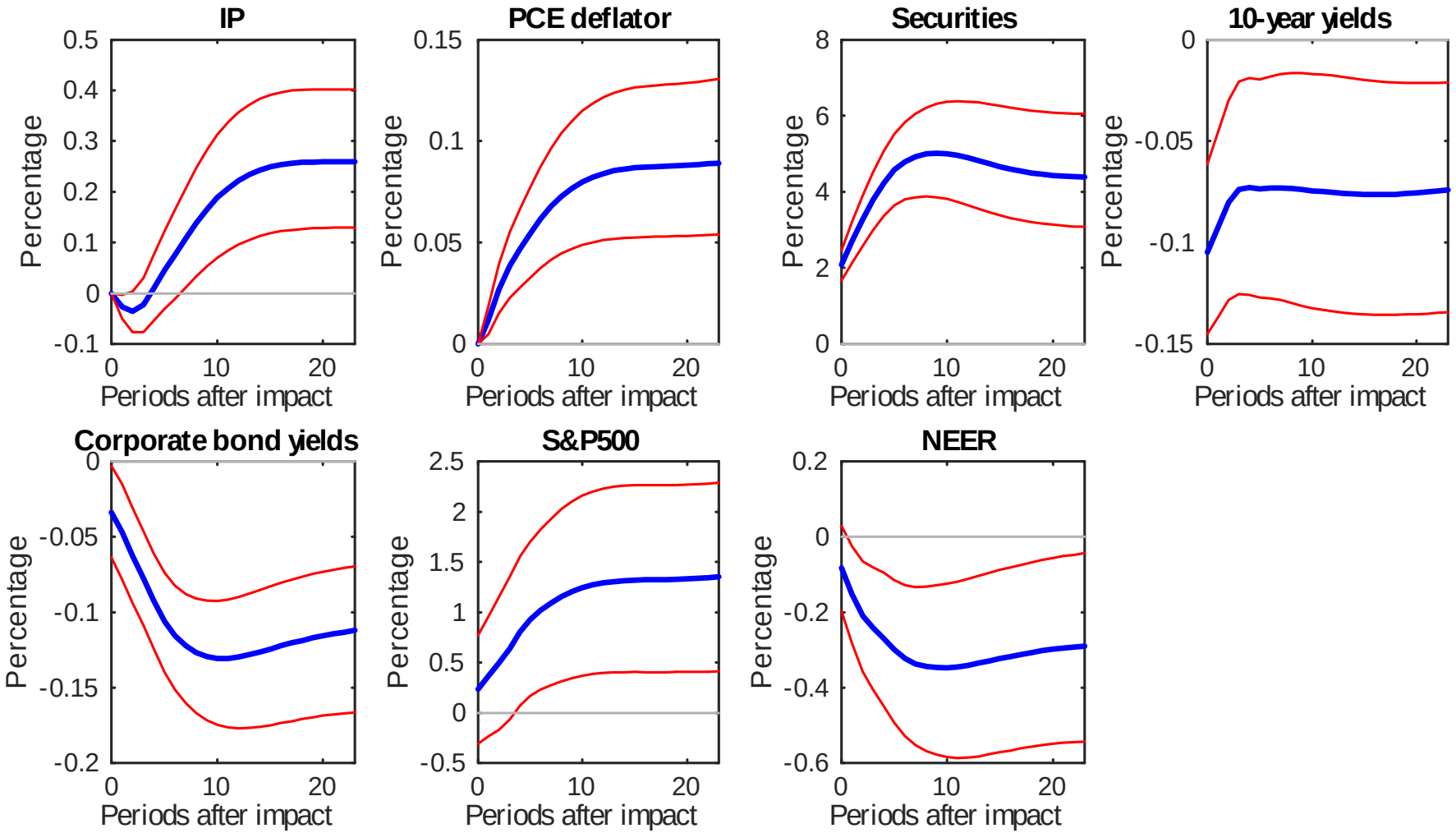
Robustness

Extended VAR



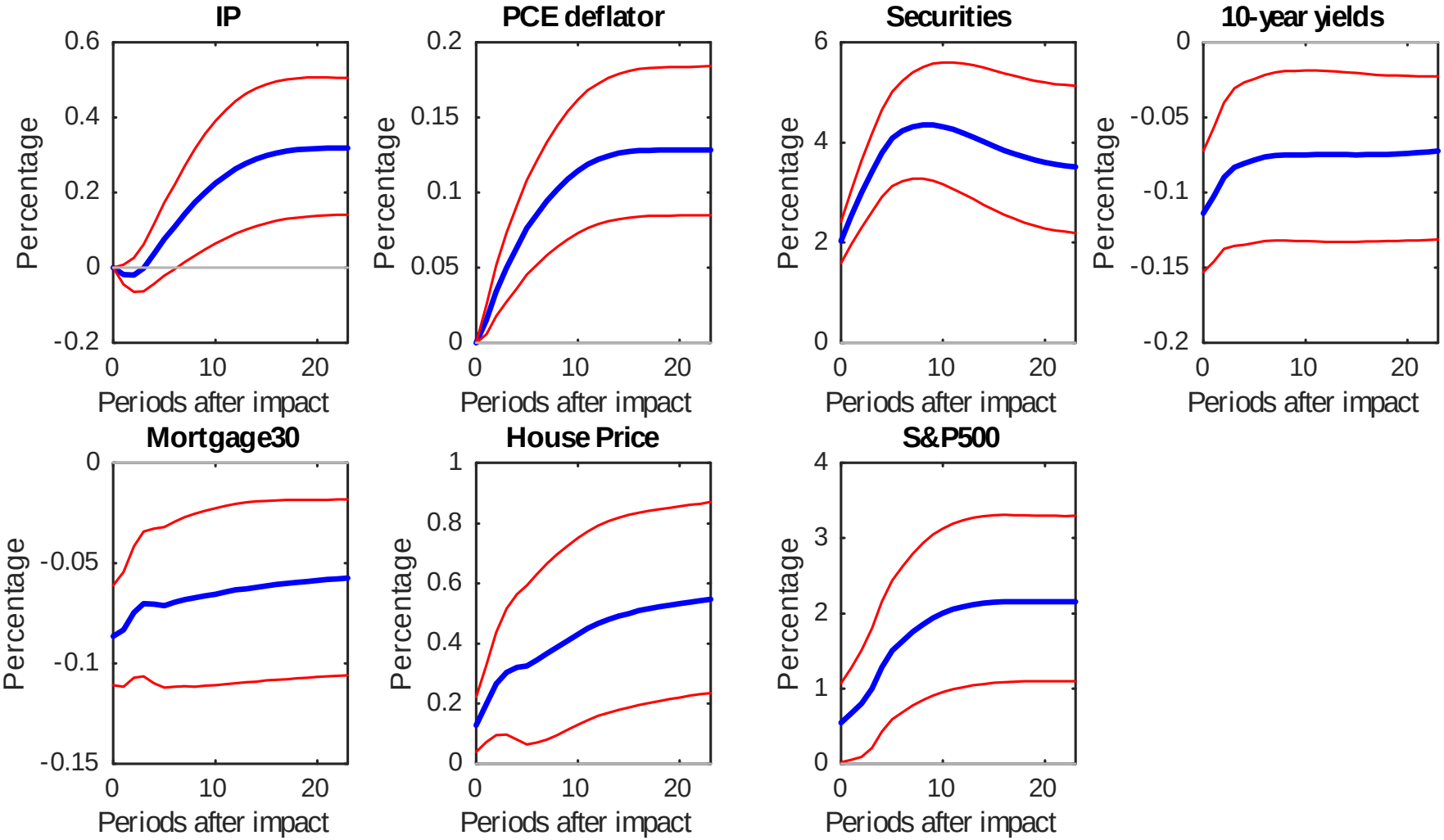
Robustness

Extended VAR



Robustness

Extended VAR



Summary of Domestic Effects of U.S. QE Shock

- Strong and consistent effect on both financial and real variables
- QE shock is estimated to
  - Increase IP and PCE Deflator
  - Lower long-term yields
  - Increase stock price
  - Depreciate the USD

Summary of Spillover Effects of U.S. QE Shock

- Relatively strong and mostly consistent effects on financial variables
  - Appreciation against USD
  - Reduction in long term yield
  - Stock market boom
  - Positive effect on equity flows
- Weak effects on macro variables
  - Some evidence on reduction of net exports to the US (Fragile Five)
  - No significant effect on IP or CPI
- Fragile Five countries respond more strongly than others

Theoretical Channels

- Our results might be consistent with "reaching for yield" or "risk-taking" channel of monetary policy transmission
  - Borio and Zhu (2012), Bruno and Shin (2014)
- Extend open economy models to account for results here
- Some unconventional monetary policy channels in the literature
  - Central bank expands credit intermediation: Gertler and Karadi (2011)
  - Increases (otherwise scarce) collateral: Williamson (2012)
  - Signalling under discretion: Bhattarai, Eggertsson, and Gafarov (2015)

Future Work

- "Systematic" policy effect evaluation
- Control for anticipation of QE policy
- Spillovers to small-open developed countries (e.g. Canada, Australia, New Zealand, ...)?