The macroeconomic effects of macroprudential policy: Evidence from a narrative approach

Diego Rojas

World Bank and UMBC

Carlos Vegh

Johns Hopkins University and NBER

Guillermo Vuletin

World Bank

Financial frictions: Macroeconomic implications and policy options for emerging economies

THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP
Latin America & the Caribbean
Opportunities for All

Road map

1. Motivation and sneak peek of our findings

2. Reserve requirement data

3. Evidence from traditional identification strategy

4. New measures of reserve requirement and interest shock

5. Evidence from new identification strategy

6. Final thoughts

Road map

1. Motivation and sneak peek of our findings

2. Reserve requirement data

3. Evidence from traditional identification strategy

4. New measures of reserve requirement and interest shock

5. Evidence from new identification strategy

6. Final thoughts

Big picture

- Intense debate on the pros and cons of using macroprudential policy, broadly defined as the use of prudential tools, such as reserve or capital requirements, to deal with systemic risk, credit/financial cycle, and macroeconomic stabilization purposes.

- There is a blossoming theoretical literature (e.g., Korinek, 2011; Bianchi and Mendoza, 2012 and 2018; Bianchi, Lui, and Mendoza, 2016; Mendoza, 2016; Jiménez et al., 2017; Cizel et al., 2019; Meeks, 2017; Aikman et al., 2019; Ottonello et al., 2021; Bengui et al., 2021).

- The empirical evidence on the determinants and effects of macroprudential policy has been rather limited, mainly because of the absence of readily-available panel datasets on macroprudentiel tools for long spans of time and the lack of proper/frontier identification strategies.

Some previous efforts

- When focusing on studies concerning the effect of macroprudential policy, most studies typically analyze the impact on domestic credit conditions (e.g., Montoro and Moreno, 2011; Terrier et al, 2011; Crowe, Dell'Ariccia, Igan, and Rabanal, 2013; Lim et al, 2011; Tovar, Garcia-Escribano, and Vera Martin, 2012).

- However, the effectiveness of macroprudential policy as a macroeconomic stabilizing tool is still very much an open question.

- Using 52 countries dating back to 1970, Federico, Vegh, and Vuletin (2014) find that macroprudential policy follows a countercyclical behavior (e.g., central banks reduce reserve requirements during episodes of capital outflows and output contractions), typically acting as a substitute of monetary policy which, unlike industrial countries, is generally procyclical (e.g., increasing central bank interest rates during episodes of capital outflows and output contractions):

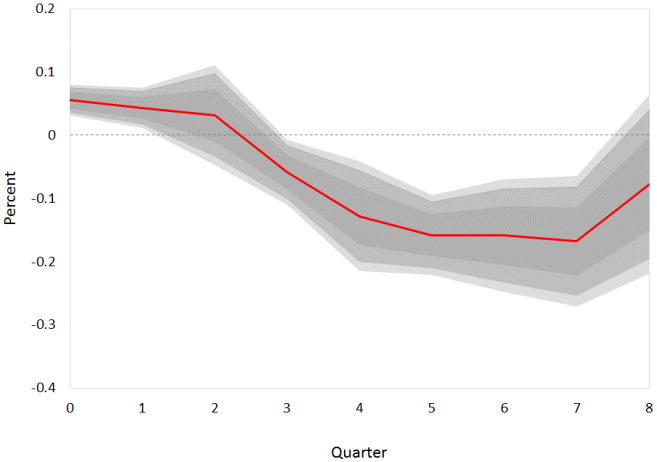# Cumulative response to a 1pp. increase in terms of trade shock
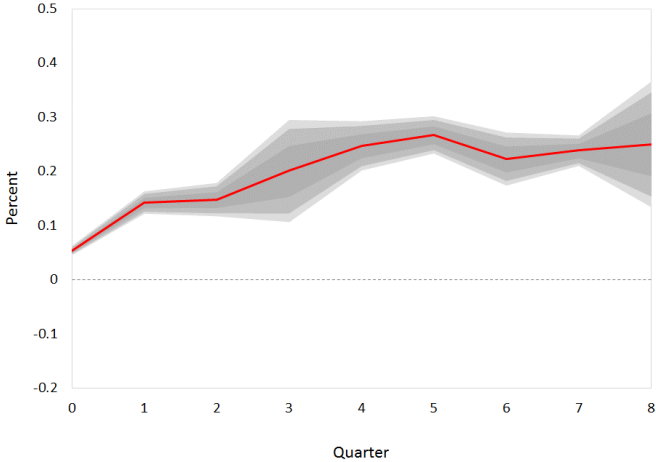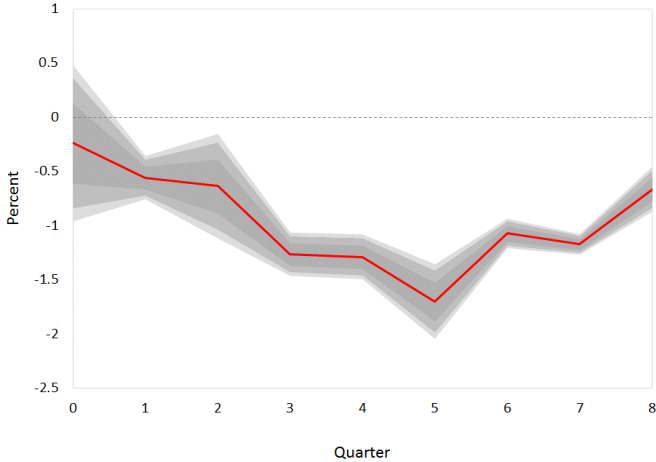
ΔTOT → ΔGDP

ΔTOT → exchange rate
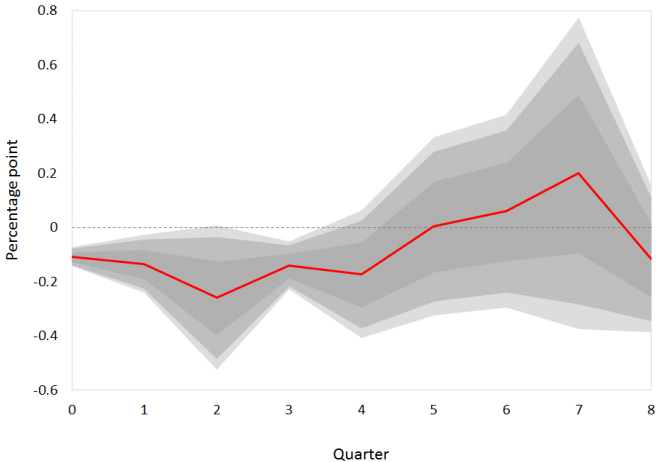
ΔTOT → inflation

ΔTOT → Δi$^{central\ bank}$

ΔTOT → ΔRR

Cumulative response to a 1pp. increase in terms of trade shock

ΔTOT → ΔGDP

ΔTOT → exchange rate

ΔTOT → inflation

ΔTOT → Δi^{central bank}

ΔTOT → ΔRR

↓TOT:
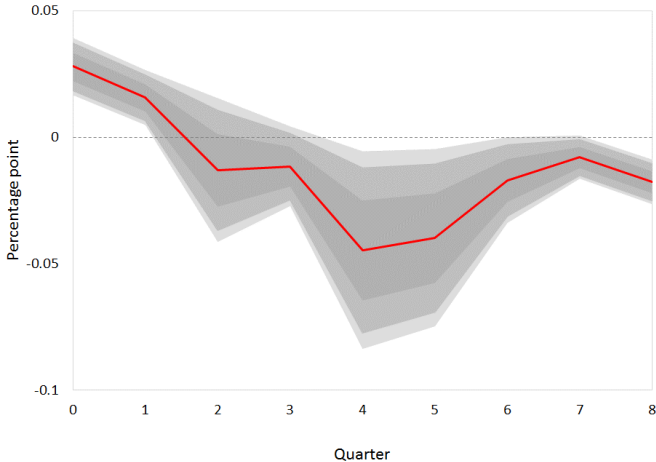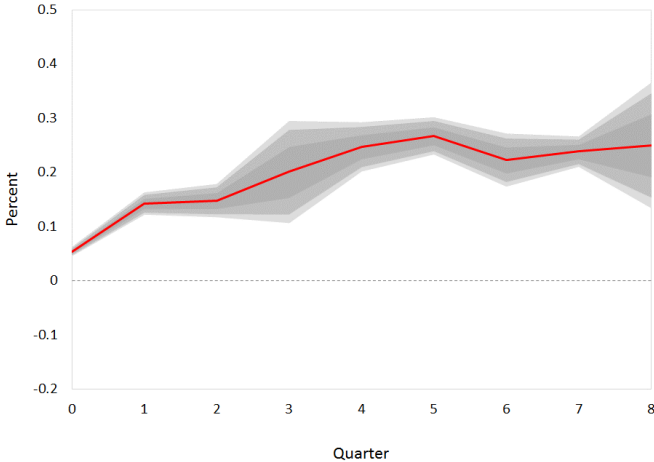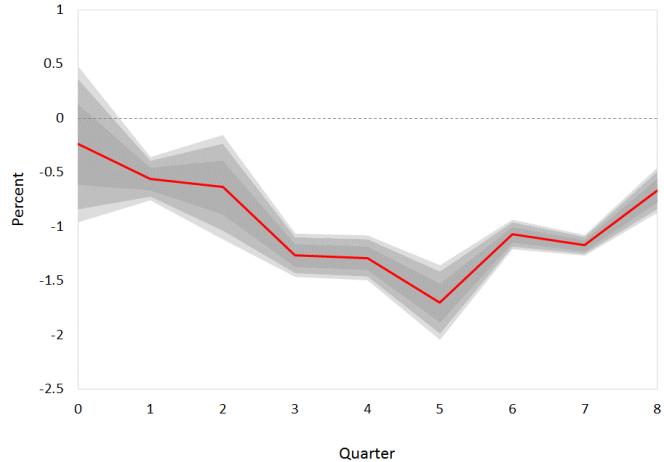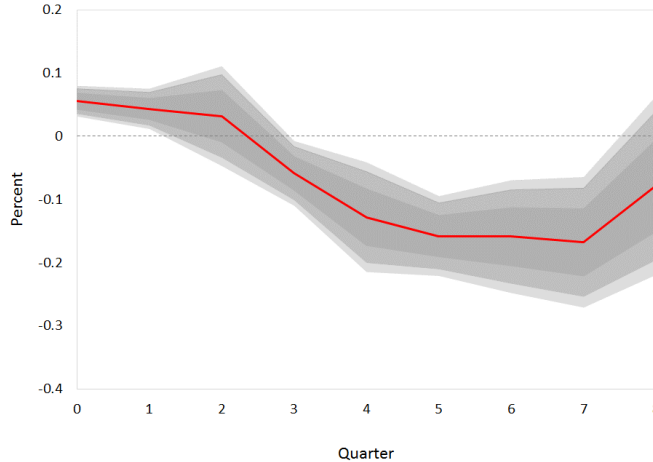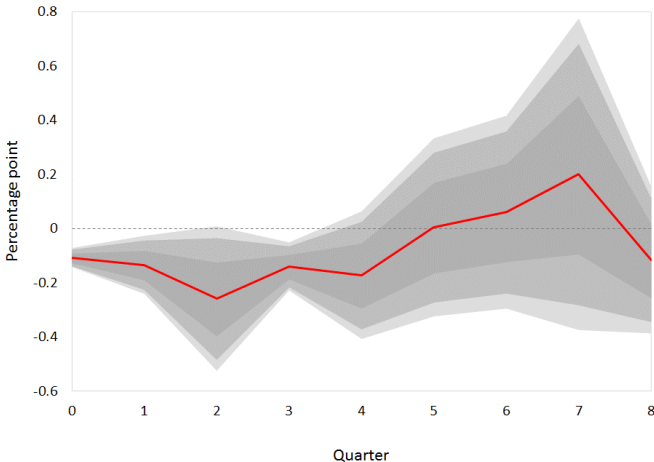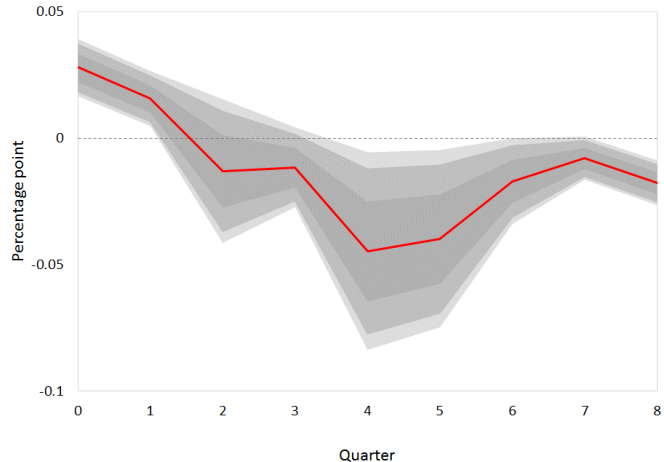
↓ GDP
↑ E (depreciation)
↑ inflation
↑ i^{central bank}
↓ RR

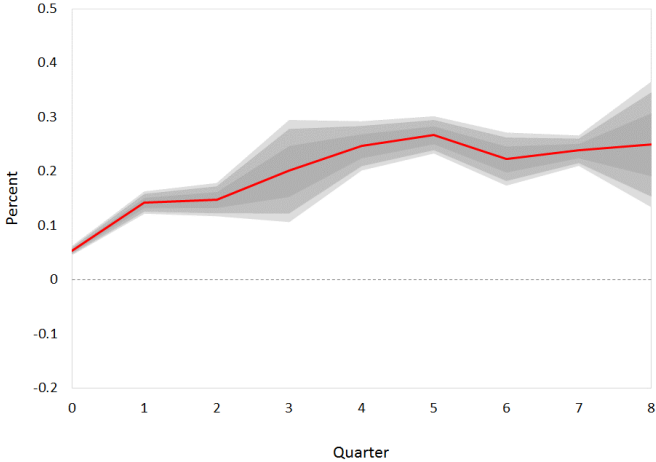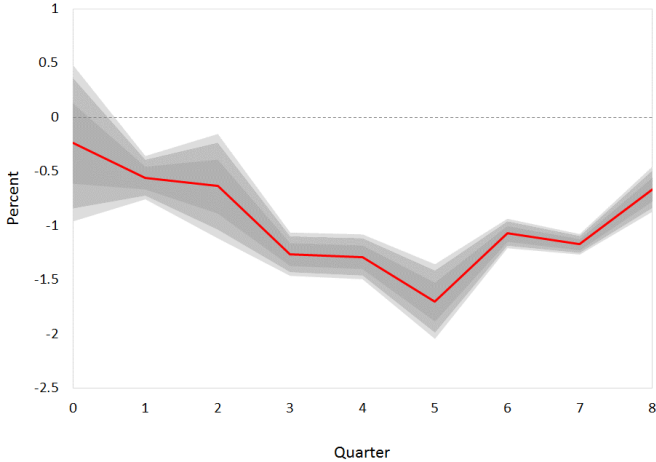# Cumulative response to a 1pp. increase in terms of trade shock

ΔTOT → ΔGDP
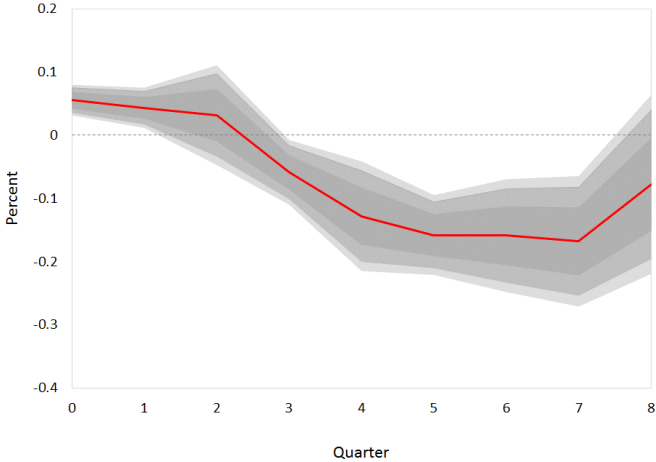
ΔTOT → exchange rate

ΔTOT → inflation

ΔTOT → Δi$^{central\ bank}$

ΔTOT → ΔRR

↓TOT:
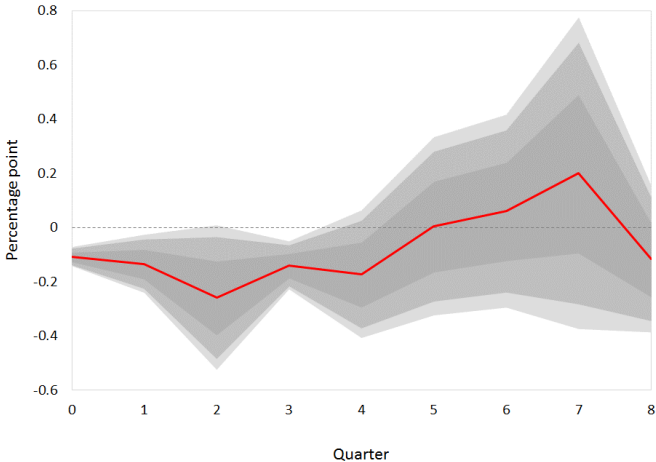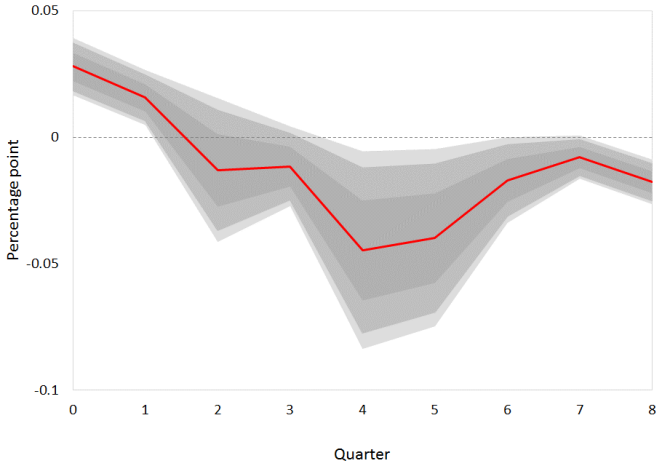
↓ **GDP**
↑ E (depreciation)
↑ inflation
↑ i$^{central\ bank}$ **(procyclical)**
↓ **RR (countercyclical)**

Our proposal and sneak peek of our findings

- Commonly used policy tool: legal reserve requirement.

- Measurement issues: legal reserve requirement and effective reserve requirement.

- Identification of exogenous shocks:

  - Narrative for Δreserve requirement à la Romer and Romer (2010).

  - Using forecast for $\Delta i^{central\ bank}$ à la Romer and Romer (2004).

- For 3 Latin American countries:
  Argentina (1990:1-2018:1), Brazil (1994:3-2018:2), and Uruguay (1990:1-2018:2).

- Sneak peek of our findings:

  - ΔGDP/ΔRR≥0 when _NOT_ property identified!

  - ΔGDP/ΔRR<0 when property identified.

Road map

1. Motivation and sneak peek of our findings

2. Reserve requirement data

3. Evidence from traditional identification strategy

4. New measures of reserve requirement and interest shock

5. Evidence from new identification strategy

6. Final thoughts

Varieties of legal reserve requirements

Argentina (maturity and currency)
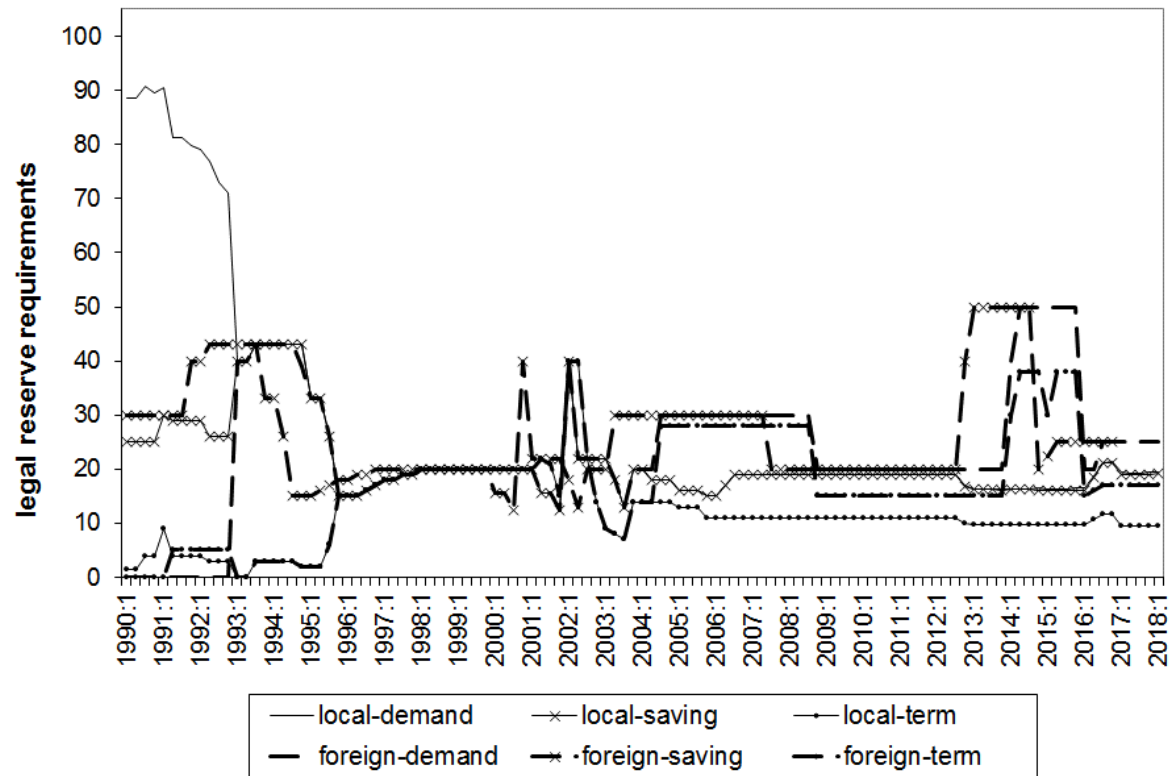
Brazil (maturity)
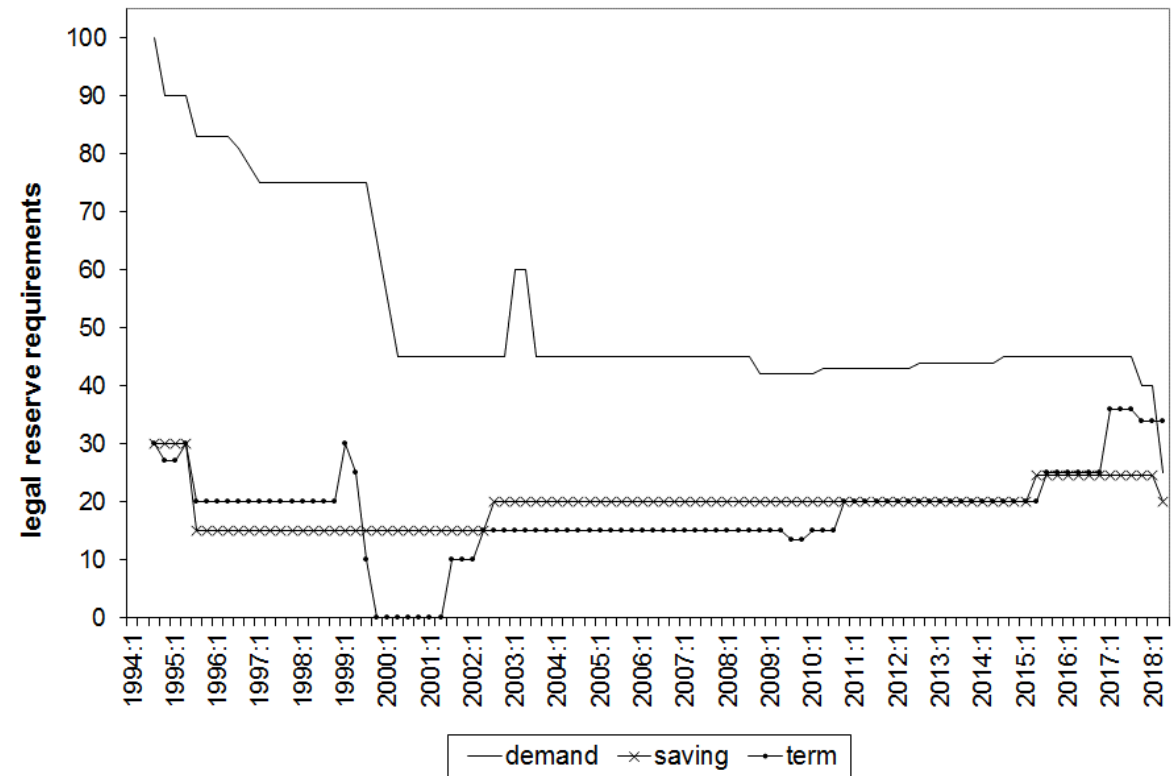
Varieties of legal reserve requirements

Uruguay (maturity and currency)
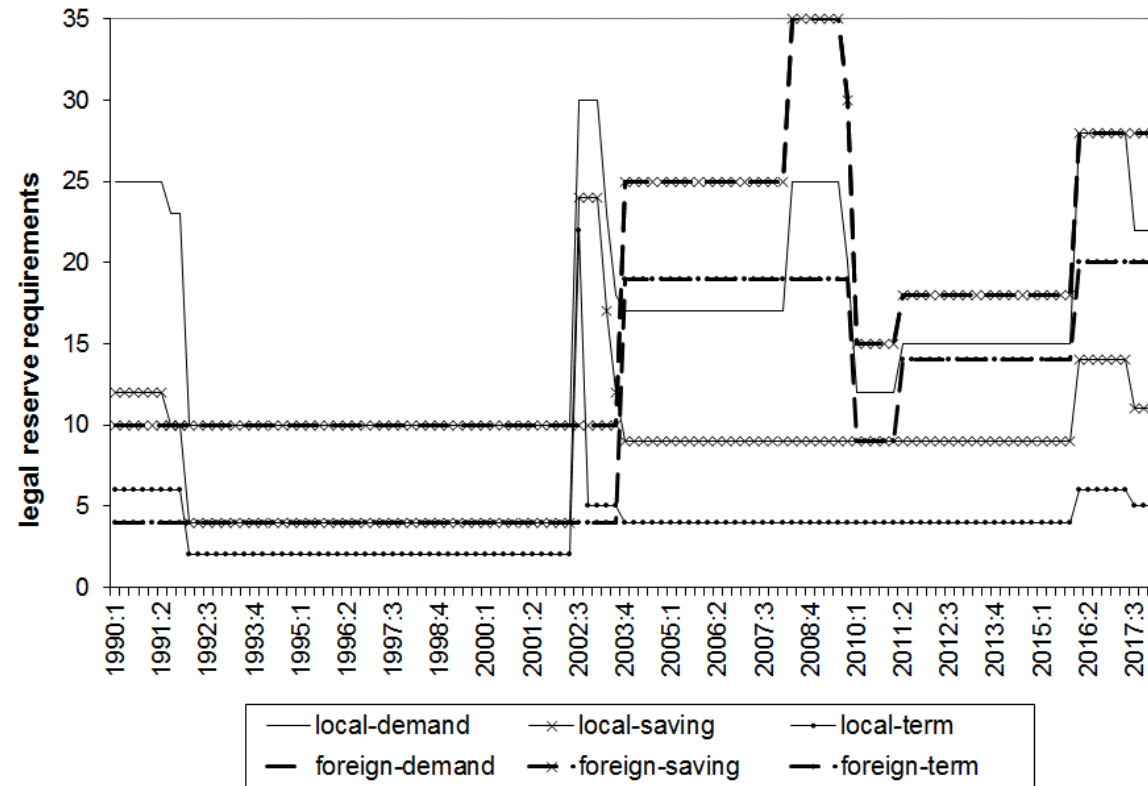
Frequency of change

- For our sample:

	total	
Argentina (1990:1-2018:1)	49	→ Once every 7 months
Brazil (1994:3-2018:2)	31	→ Once every 9 months
Uruguay (1990:1-2018:2)	13	→ Once every 26 months
Total	93	→ Once every 10 months

- Other emerging economies, on average, once every 2 years.

- Industrial economies, on average, once every 12 years.

Long-run properties of legal reserve requirements

Argentina (Mean and SD)
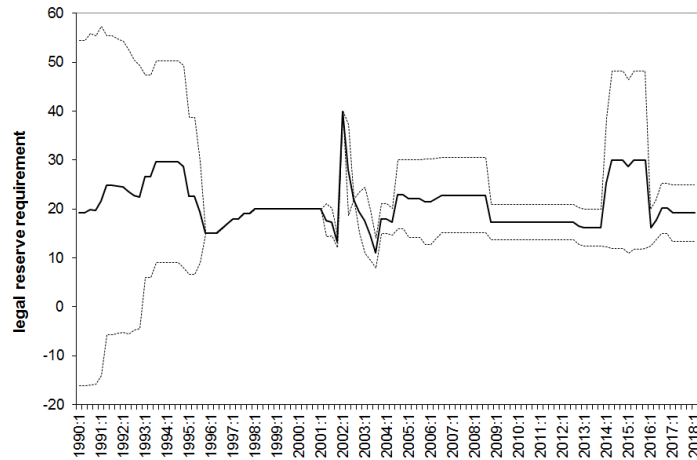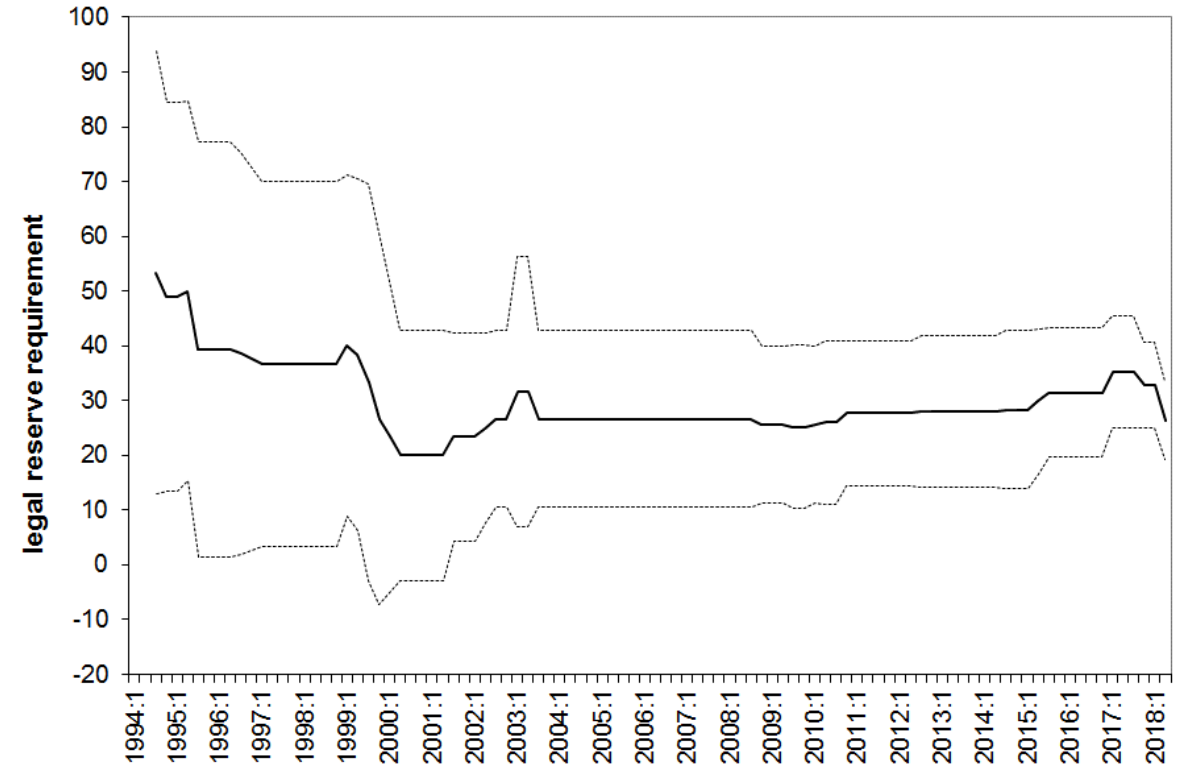
Brazil (Mean and SD)

Uruguay (Mean and SD)

Long-run properties of legal reserve requirements

Argentina (Mean and SD)

Uruguay (Mean and SD)

Brazil (Mean and SD)

Long-run properties of legal reserve requirements

Argentina (Mean and SD)

Brazil (Mean and SD)

Uruguay (Mean and SD)

v

Short-run properties of legal reserve requirements

- High synchronization at quarterly frequency:

Argentina

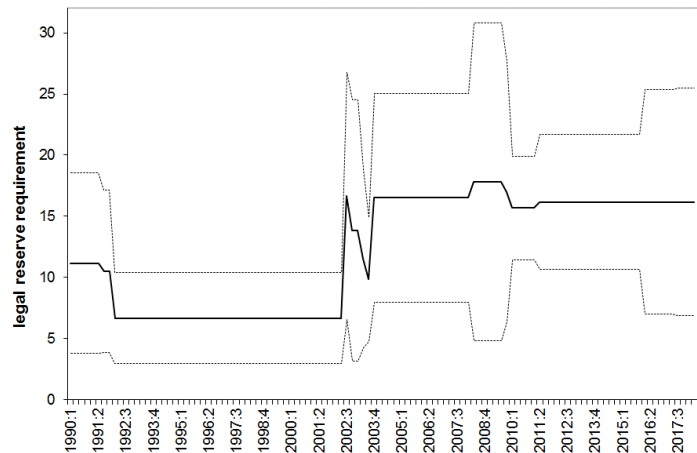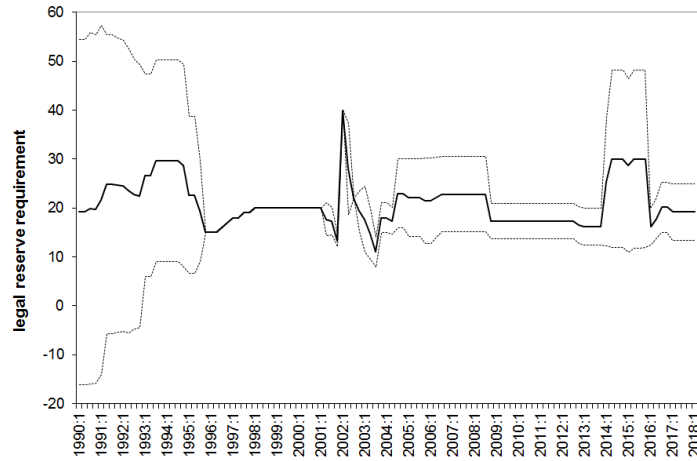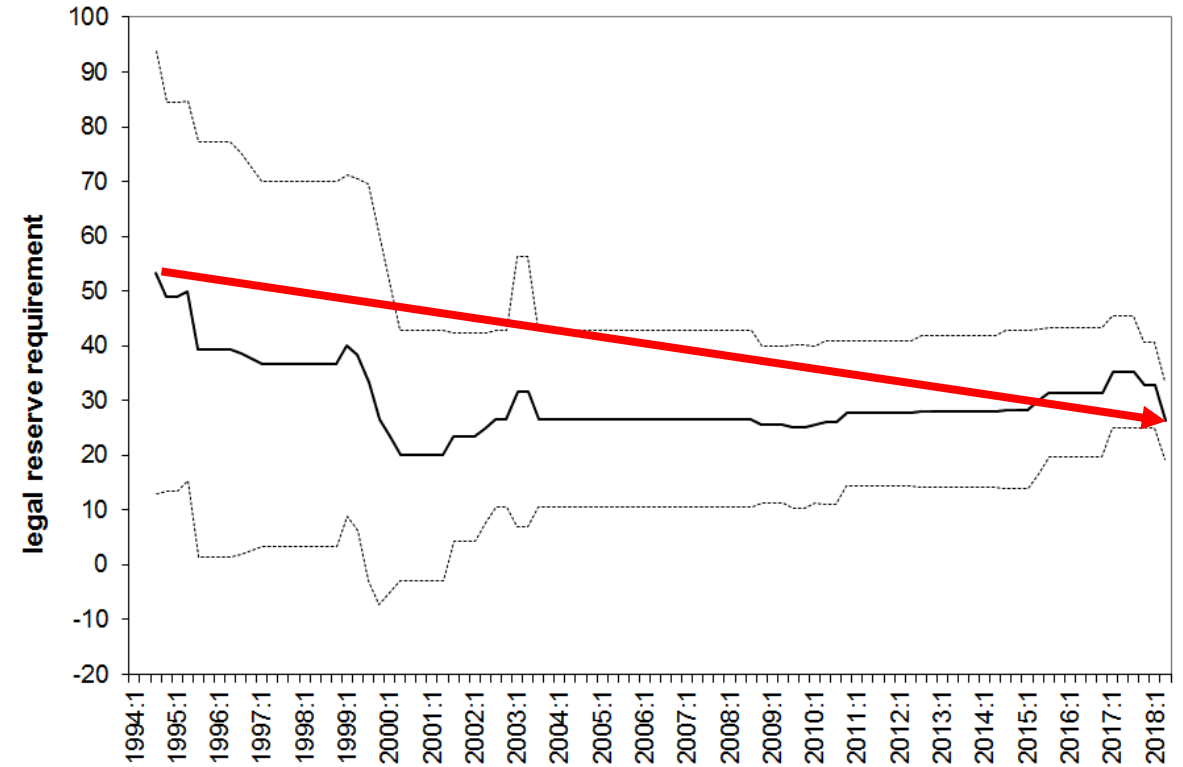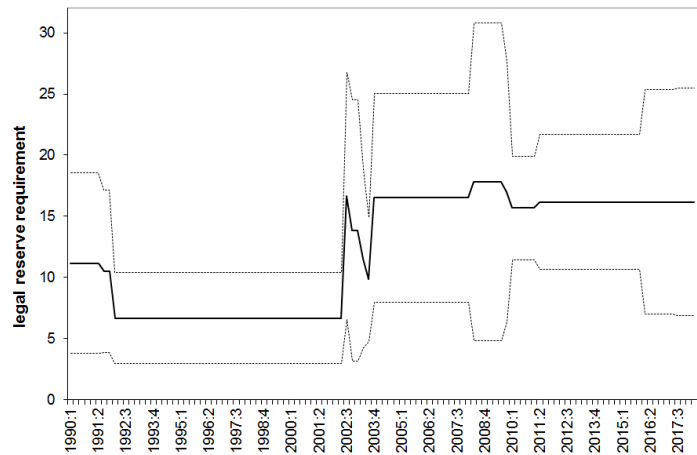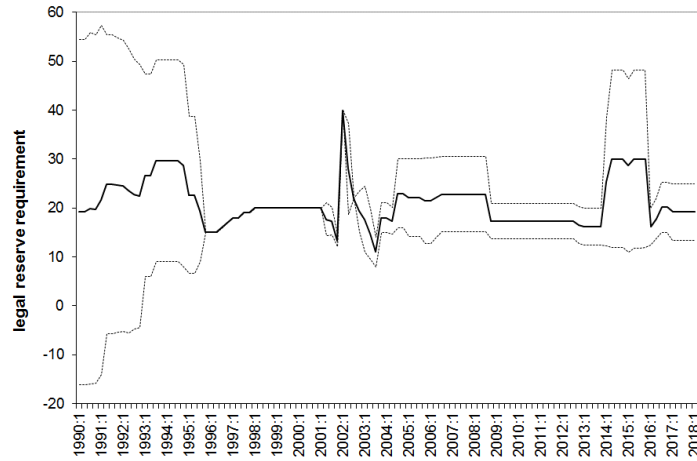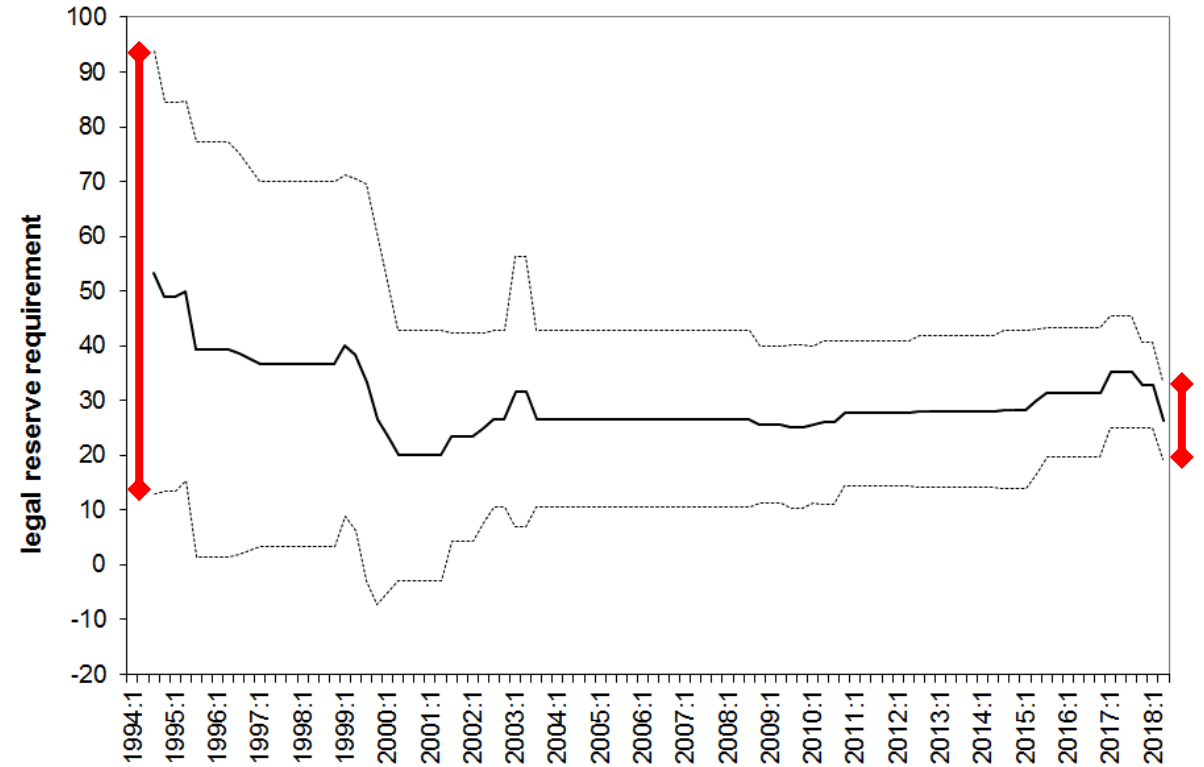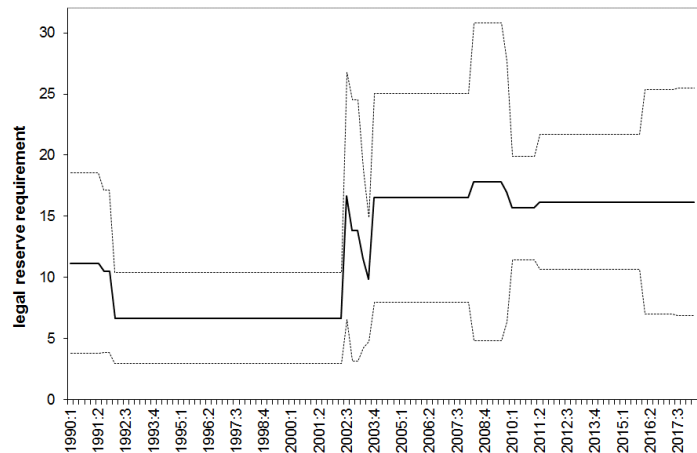|	Δ local-demand RR	Δ local-saving RR	Δ local-term RR	Δ foreign-demand RR	Δ foreign-saving RR	Δ foreign-term RR	Δ average RR
Δ local-demand RR	1						
Δ local-saving RR	0.52***	1					
Δ local-term RR	0.44***	0.43***	1				
Δ foreign-demand RR	0.68***	0.68***	0.33***	1			
Δ foreign-saving RR	0.42***	0.70***	0.31***	0.99***	1		
Δ foreign-term RR	0.30***	0.27***	0.67***	0.71***	0.68***	1	
Δ average RR	0.65***	0.77***	0.64***	0.92***	0.91***	0.77***	1

Brazil

	Δ demand RR	Δ saving RR	Δ term RR	Δ average RR
Δ demand RR	1			
Δ saving RR	0.29***	1		
Δ term RR	0.22**	0.30***	1	
Δ average RR	0.78***	0.62***	0.72***	1

Uruguay

	Δ local-demand RR	Δ local-saving RR	Δ local-term RR	Δ foreign-demand RR	Δ foreign-saving RR	Δ foreign-term RR	Δ average RR
Δ local-demand RR	1						
Δ local-saving RR	0.86***	1					
Δ local-term RR	0.57***	0.70***	1				
Δ foreign-demand RR	0.42***	0.01	0.01	1			
Δ foreign-saving RR	0.42***	0.01	0.01	1	1		
Δ foreign-term RR	0.25***	-0.03	-0.01	0.88***	0.88***	1	
Δ average RR	0.86***	0.63***	0.56***	0.76***	0.76***	0.66***	1

Effective legal reserve requirement measures

- Effective legal reserve requirement:

$$
\begin{aligned}
effective\ RR_t &= \sum_i RR_{it}\omega_{it}, & i = 1, ..., N \\
\omega_{it} &\equiv \frac{Deposit_{it}}{Total\ deposits_t},
\end{aligned}
$$

- Effective constant legal reserve requirement:

$$
\begin{aligned}
effective\ constant\ RR_t &= \sum_i RR_{it} \times \overline{\omega}_i, & i = 1, ..., N \\
\overline{\omega}_i &\equiv \frac{1}{T}\sum_t \frac{Deposit_{it}}{Total\ deposits_t} & t = 1, ..., T
\end{aligned}
$$

Effective legal reserve requirement measures

- Effective legal reserve requirement:

$$\text{effective } RR_t = \sum_i RR_{it}\omega_{it}, \qquad i = 1, ..., N$$

$$\omega_{it} \equiv \frac{Deposit_{it}}{Total\ deposits_t},$$

- Effective constant legal reserve requirement:

$$\text{effective constant } RR_t = \sum_i RR_{it} \times \overline{\omega}_i, \qquad i = 1, ..., N$$

$$\overline{\omega}_i \equiv \frac{1}{T}\sum_t \frac{Deposit_{it}}{Total\ deposits_t} \qquad t = 1, ..., T$$

Road map

Panel VAR

- $\Delta Y_{i,t} = \alpha_i + A(l)\Delta Y_{i,t-1} + \mu_{i,t},$

  where ΔY includes ΔRGDP, inflation, ΔECRR[all], and ΔIR[all].

ΔIR[all] → ΔGDP
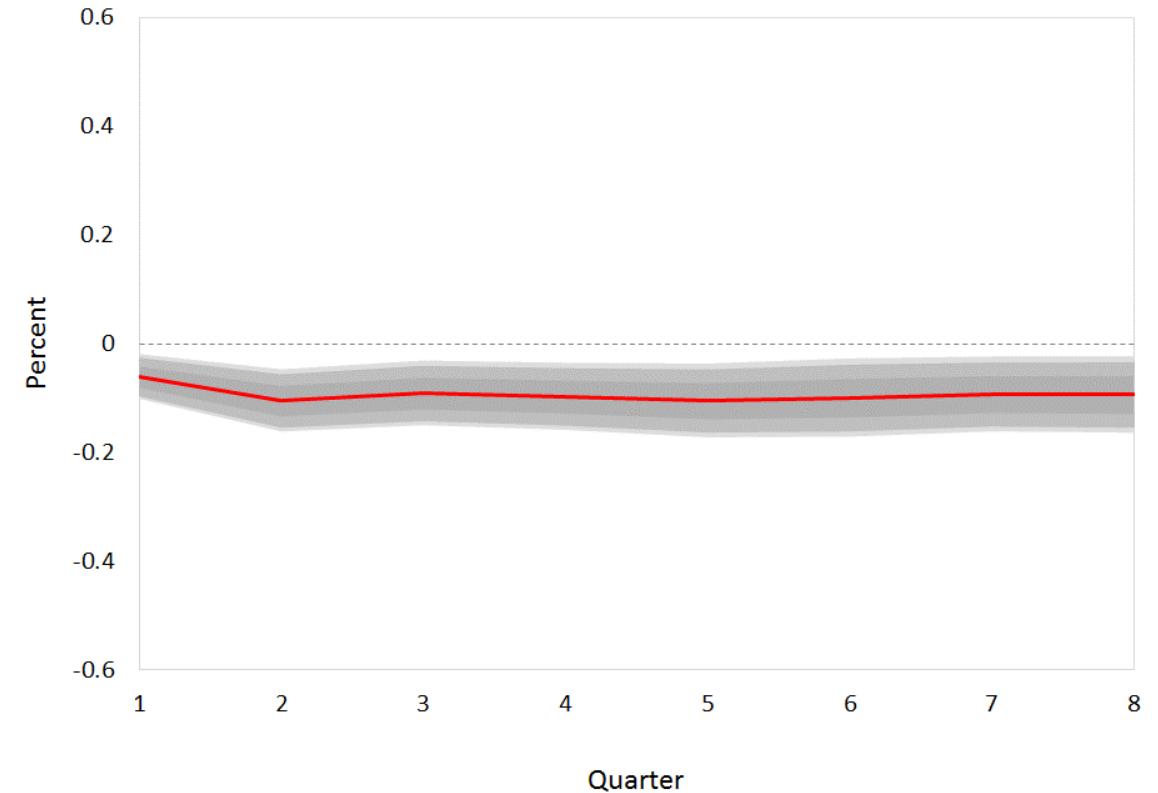
Panel VAR

- $$\Delta Y_{i,t} = \alpha_i + A(l)\Delta Y_{i,t-1} + \mu_{i,t},$$

  where ΔY includes ΔRGDP, inflation, ΔECRR[all], and ΔIR[all].

$\Delta IR^{all} \rightarrow \Delta GDP$

Panel VAR

- $$\Delta Y_{i,t} = \alpha_i + A(l)\Delta Y_{i,t-1} + \mu_{i,t},$$

  where ΔY includes ΔRGDP, inflation, ΔECRR^{all}, and ΔIR^{all}.

ΔECRR^{all} → ΔGDP

ΔIR^{all} → ΔGDP

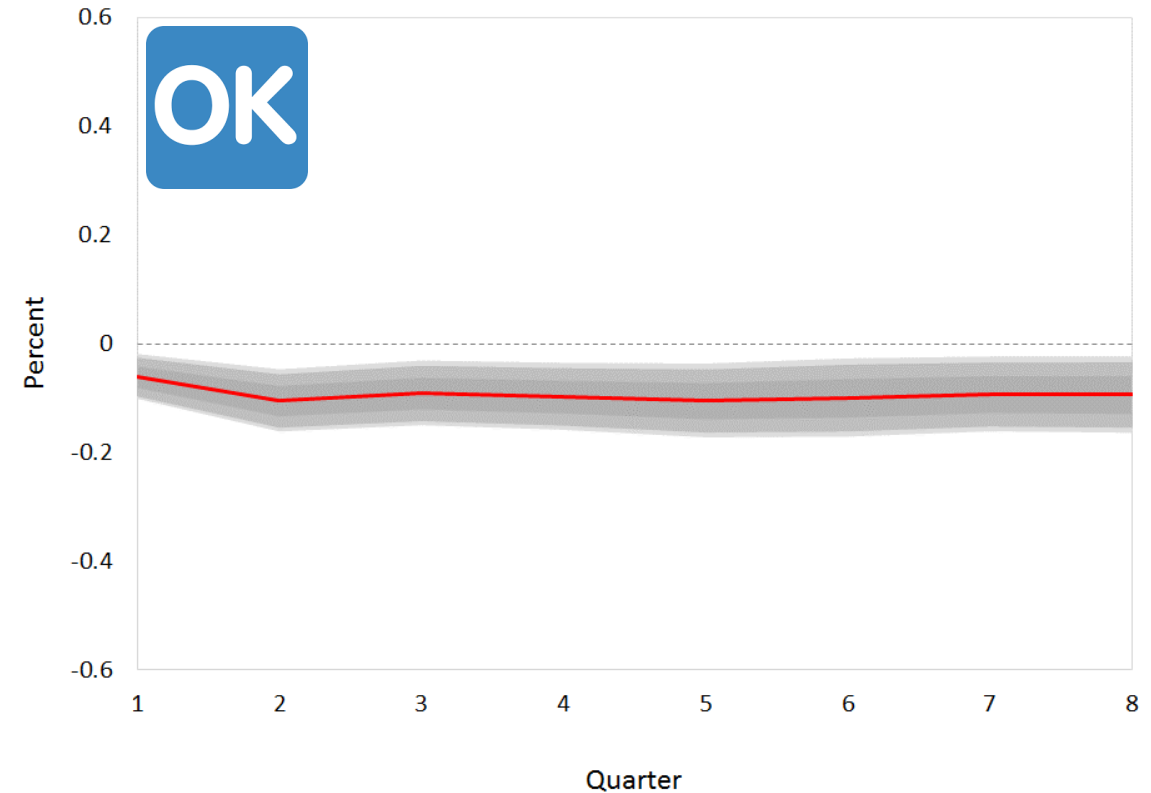# Panel VAR

- $\Delta Y_{i,t} = \alpha_i + A(l)\Delta Y_{i,t-1} + \mu_{i,t},$

  where ΔY includes ΔRGDP, inflation, ΔECRR^{all}, and ΔIR^{all}.

ΔECRR^{all} → ΔGDP

ΔIR^{all} → ΔGDP

Jordà's "local projections"

- $$\Delta y_{i,t+h} \;=\; \alpha_{i,h} + \beta_h \Delta ECRR_{i,t}^{all} + \delta_h \Delta IR_{i,t}^{all} + \sum_{l=1}^{4}\left(\psi_{l,h}\Delta ECRR_{i,t-l}^{all} + \theta_{l,h}\Delta IR_{i,t-l}^{all}\right) +$$

$$+\sum_{l=1}^{4}\left(\lambda_{l,h}\Delta y_{i,t-l} + \phi_{l,h}\pi_{i,t-l}\right) + \sum_{l=0}^{h-1}\left(\omega_{lh}\Delta ECRR_{i,t+h-l}^{all} + \nu_{lh}\Delta IR_{i,t+h-l}^{all}\right) + \mu_{i,t,h},$$

$\Delta ECRR^{all} \rightarrow \Delta GDP$ 　　　　　　 $\Delta IR^{all} \rightarrow \Delta GDP$
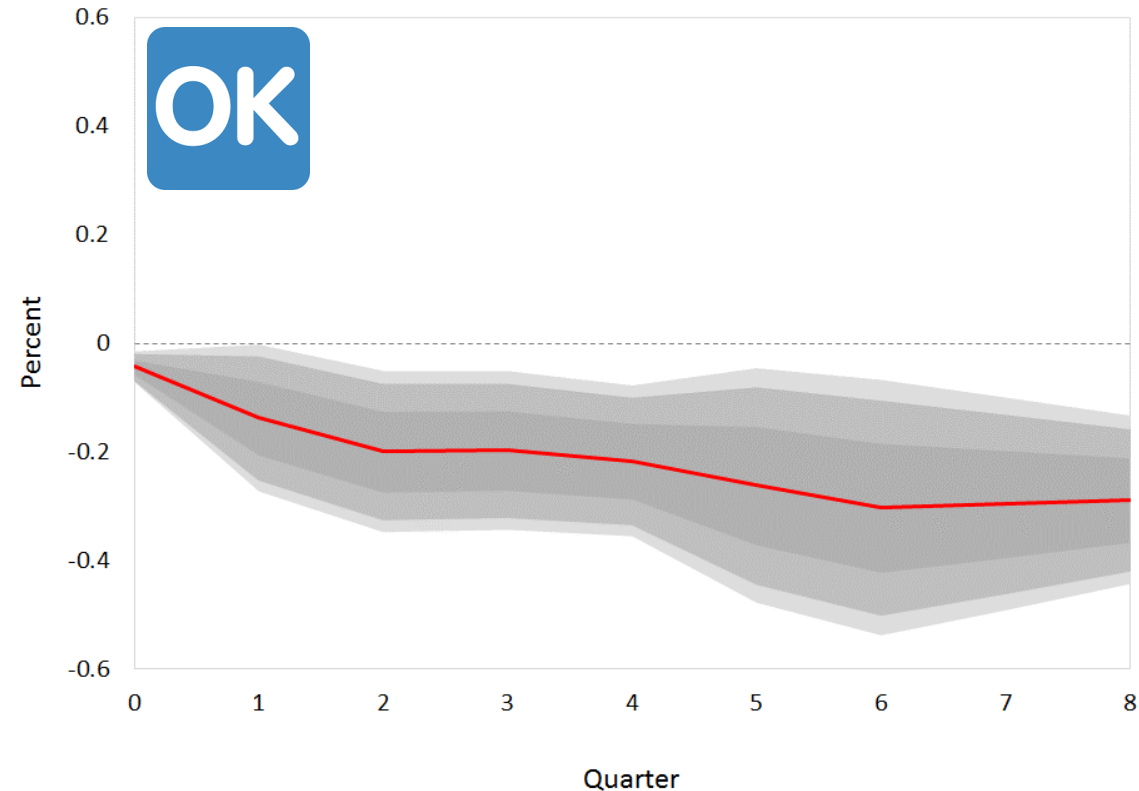
$$\Delta y_{i,t+h} = \alpha_{i,h} + \beta_h \Delta ECRR_{i,t}^{all} + \delta_h \Delta IR_{i,t}^{all} + \sum_{l=1}^{4} \left(\psi_{l,h} \Delta ECRR_{i,t-l}^{all} + \theta_{l,h} \Delta IR_{i,t-l}^{all} \right) +$$

$$+ \sum_{l=1}^{4} \left(\lambda_{l,h} \Delta y_{i,t-l} + \phi_{l,h} \pi_{i,t-l} \right) + \sum_{l=0}^{h-1} \left(\omega_{lh} \Delta ECRR_{i,t+h-l}^{all} + \nu_{lh} \Delta IR_{i,t+h-l}^{all} \right) + \mu_{i,t,h},$$

ΔECRR^{all} → ΔGDP
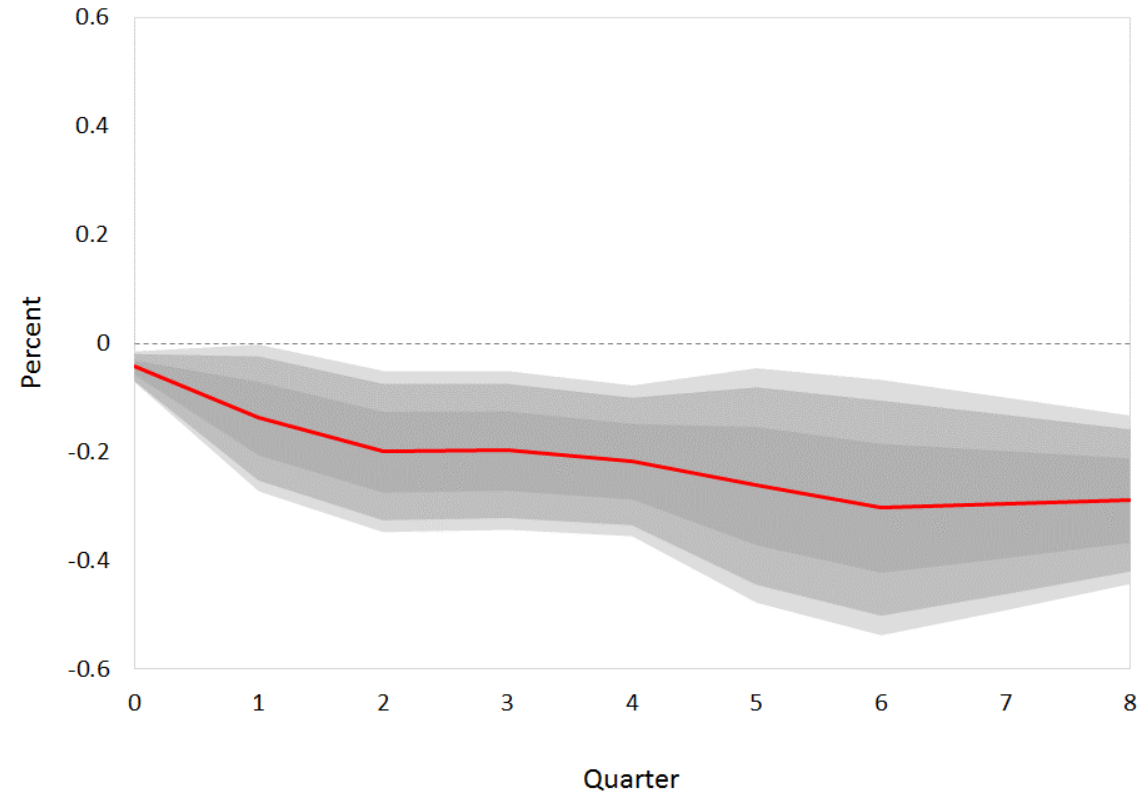
ΔIR^{all} → ΔGDP

Jordà's "local projections"

- $$\Delta y_{i,t+h} = \alpha_{i,h} + \beta_h \Delta ECRR_{i,t}^{all} + \delta_h \Delta IR_{i,t}^{all} + \sum_{l=1}^{4} \left(\psi_{l,h} \Delta ECRR_{i,t-l}^{all} + \theta_{l,h} \Delta IR_{i,t-l}^{all} \right) +$$

$$+ \sum_{l=1}^{4} \left(\lambda_{l,h} \Delta y_{i,t-l} + \phi_{l,h} \pi_{i,t-l} \right) + \sum_{l=0}^{h-1} \left(\omega_{lh} \Delta ECRR_{i,t+h-l}^{all} + \nu_{lh} \Delta IR_{i,t+h-l}^{all} \right) + \mu_{i,t,h},$$

ΔECRR^{all} → ΔGDP

ΔIR^{all} → ΔGDP

Road map

1. Motivation and sneak peek of our findings

2. Reserve requirement data

3. Evidence from traditional identification strategy

4. **New measure of reserve requirement shock**

5. Evidence from new identification strategy

6. Final thoughts

Narrative-based identification à la Romer and Romer (2010)

- Identify the motivation for each change in legal reserve requirement:

  - <u>Endogenous:</u> taken to offset current or projected developments that would cause output growth to differ from trend.

    E.g. for Argentina: (i) increase in RR in 1993 (during the Convertibility Plan euphoria) and (ii) series of decreases in RR in 1995 (right after the Tequila crisis).

  - <u>Exogenous:</u> not taken to offset factors pushing growth away from normal includes financial liberalization, microprudential purposes (improving financial intermediation and solvency), and liquidity regulation (easy pressure on inflation and exchange rate).

- Sources: IMF reports including Staff Reports and Recent Economic Developments, as well as central banks' documents including working papers and monetary and financial stability reports, among others.

Applying the criteria

	total	exogenous	endogenous
Argentina (1990:1-2018:1)	49	29	20
Brazil (1994:3-2018:2)	31	22	9
Uruguay (1990:1-2018:2)	13	11	2
Total	93	62	31

	financial liberalization	liquidity regulation	micro-prudential
Argentina (1990:1-2018:1)	11	7	11
Brazil (1994:3-2018:2)	3	12	7
Uruguay (1990:1-2018:2)	0	1	10
Total	14	20	28

Applying the criteria

	total	exogenous	endogenous
Argentina (1990:1-2018:1)	49	29	20
Brazil (1994:3-2018:2)	31	22	9
Uruguay (1990:1-2018:2)	13	11	2
Total	93	62	31
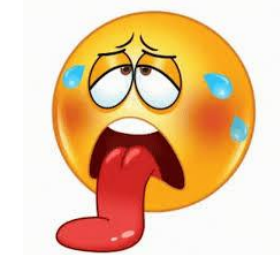
	financial liberalization	liquidity regulation	micro-prudential
Argentina (1990:1-2018:1)	11	7	11
Brazil (1994:3-2018:2)	3	12	7
Uruguay (1990:1-2018:2)	0	1	10
Total	14	20	28

Road map

1. Motivation and sneak peek of our findings

2. Reserve requirement data

3. Evidence from traditional identification strategy

4. **New measures of central bank interest rate shock**

5. Evidence from new identification strategy

6. Final thoughts

∆IRˣᵒᵍ calculated à la Romer and Romer (2004)

- For each country:

$$\triangle IR_t = \theta_0 + \theta_1 IR_{t-1} + \theta_2 IR_{t-2} + \sum_{k=-2}^{4} \left(\omega_k \pi_{t+k} + \delta_k D\pi_{t+k} + \beta_k \triangle y_{t+k} + \gamma_k D\triangle y_{t+k} \right) + \mu_t,$$

where $DX_{t+k} = X_{t+k} - X_{t+k-2}$ for variable X.

In the spirit of Romer and Romer (2004), for each country, the change in the policy rate is regressed on two lags of inflation, GDP growth, the policy rate, and on (4 quarters) forecasted values for inflation, the growth rate as well as changes in lags and in forecasted values of these variables.

- Sources: World Economic Outlook (WEO) historical forecast data. This dataset contains 2-years of historical data and 6-years of forecast data.

∆IR^{exog} calculated à la Romer and Romer (2004)

- For each country:

$$\triangle IR_t = \theta_0 + \theta_1 IR_{t-1} + \theta_2 IR_{t-2} + \sum_{k=-2}^{4} \left(\omega_k \pi_{t+k} + \delta_k D\pi_{t+k} + \beta_k \triangle y_{t+k} + \gamma_k D\triangle y_{t+k} \right) + \mu_t,$$

$$\triangle IR^{exog}$$

where $DX_{t+k} = X_{t+k} - X_{t+k-2}$ for variable X.

In the spirit of Romer and Romer (2004), for each country, the change in the policy rate is regressed on two lags of inflation, GDP growth, the policy rate, and on (4 quarters) forecasted values for inflation, the growth rate as well as changes in lags and in forecasted values of these variables.

- Sources: World Economic Outlook (WEO) historical forecast data. This dataset contains 2-years of historical data and 6-years of forecast data.
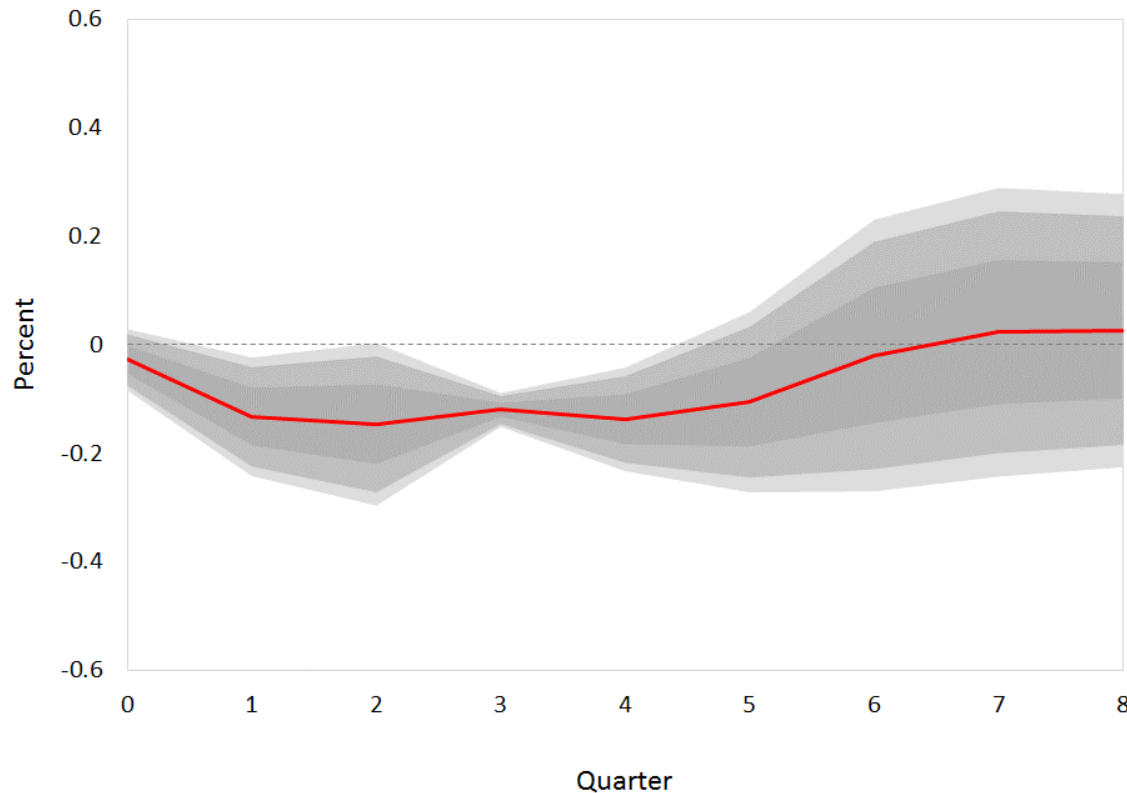
Road map

1. Motivation and sneak peek of our findings

2. Reserve requirement data

3. Evidence from traditional identification strategy

4. New measures of reserve requirement and interest shock

5. **Evidence from new identification strategy**
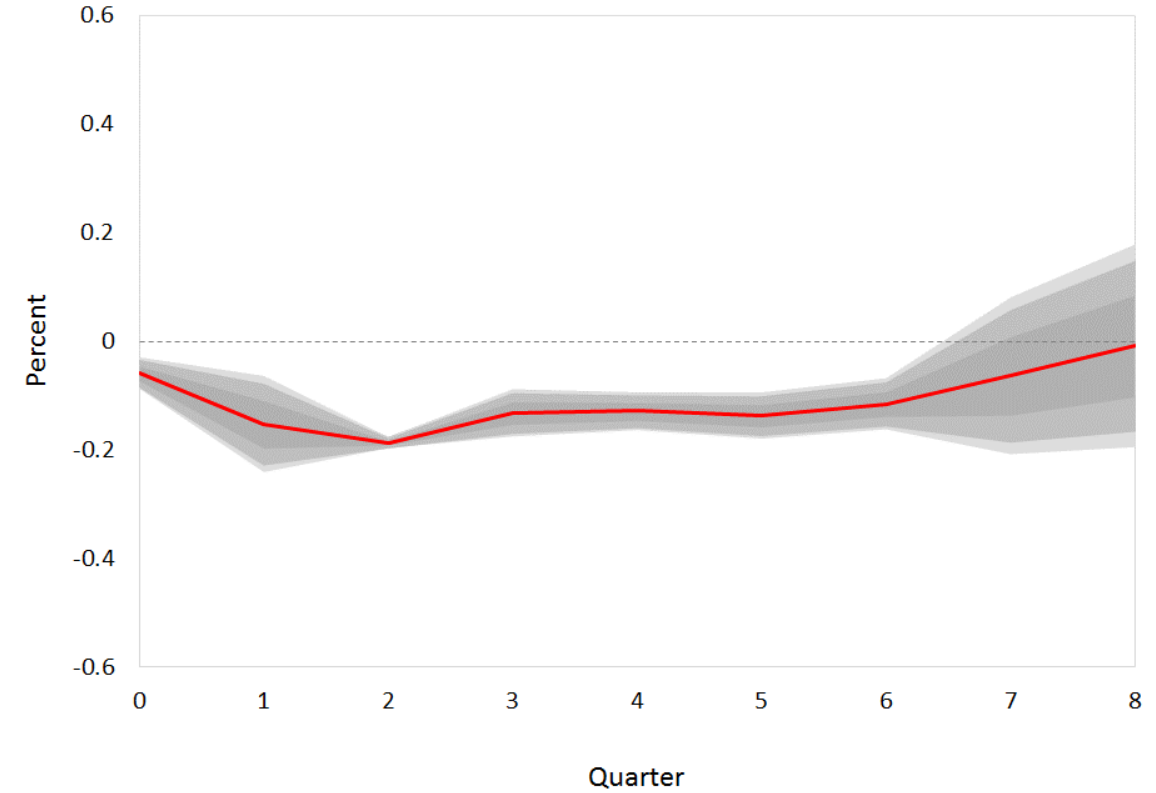
6. Final thoughts

Using $\Delta ECRR^{exog}$ and ΔIR^{exog}

- $$\Delta y_{i,t+h} \;=\; \alpha_{i,h} + \beta_h \Delta ECRR_{i,t}^{exog} + \delta_h \Delta IR_{i,t}^{exog} + \sum_{l=1}^{4} \left(\psi_{l,h} \Delta ECRR_{i,t-l}^{all} + \theta_{l,h} \Delta IR_{i,t-l}^{all} \right) +$$

$$+ \sum_{l=1}^{4} \left(\lambda_{l,h} \Delta y_{i,t-l} + \phi_{l,h} \pi_{i,t-l} \right) + \sum_{l=0}^{h-1} \left(\omega_{lh} \Delta ECRR_{i,t+h-l}^{exog} + \nu_{lh} \Delta IR_{i,t+h-l}^{exog} \right) + \mu_{i,t,h},$$

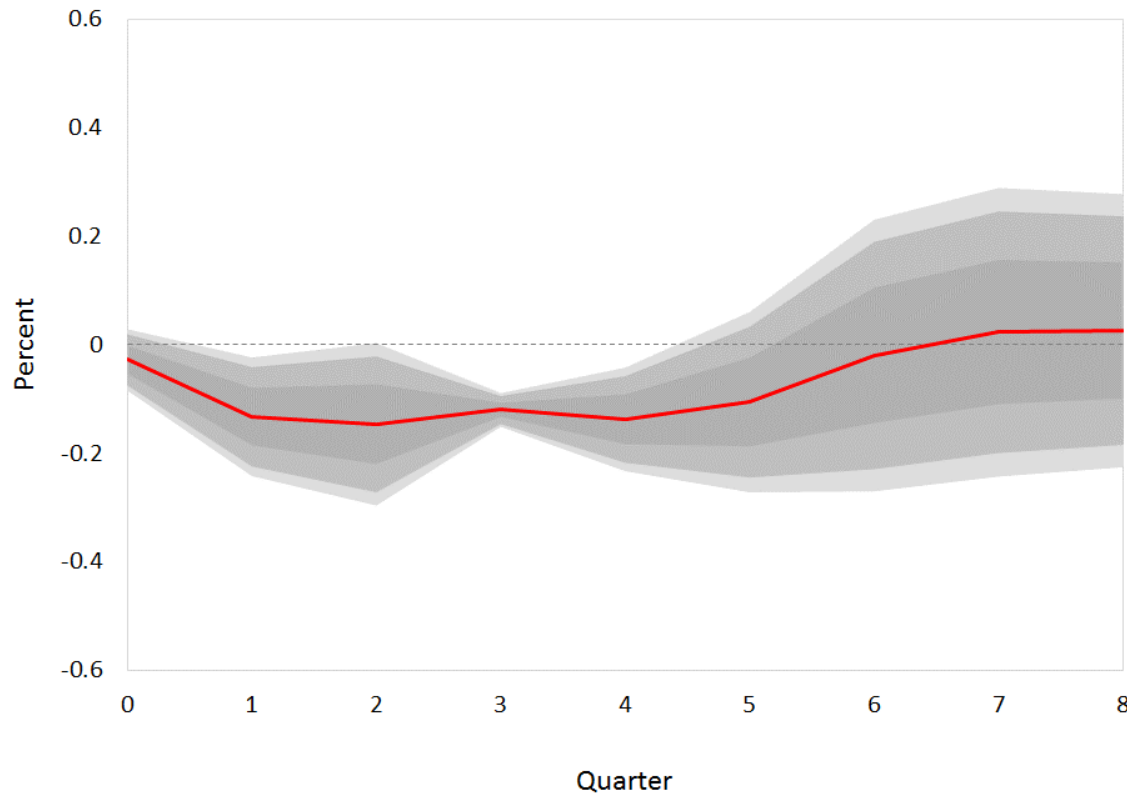### $\Delta ECRR^{exog} \to \Delta GDP$

$\Delta IR^{exog} \to \Delta GDP$

Using $\Delta\text{ECRR}^{\text{exog}}$ and $\Delta\text{IR}^{\text{exog}}$

$$\Delta y_{i,t+h} \quad = \quad \alpha_{i,h} + \beta_h \Delta ECRR_{i,t}^{exog} + \delta_h \Delta IR_{i,t}^{exog} + \sum_{l=1}^{4} \left(\psi_{l,h} \Delta ECRR_{i,t-l}^{all} + \theta_{l,h} \Delta IR_{i,t-l}^{all} \right) +$$

$$+ \sum_{l=1}^{4} \left(\lambda_{l,h} \Delta y_{i,t-l} + \phi_{l,h} \pi_{i,t-l} \right) + \sum_{l=0}^{h-1} \left(\omega_{lh} \Delta ECRR_{i,t+h-l}^{exog} + \nu_{lh} \Delta IR_{i,t+h-l}^{exog} \right) + \mu_{i,t,h},$$

$\Delta\text{ECRR}^{\text{exog}} \rightarrow \Delta\text{GDP}$ $\Delta\text{IR}^{\text{exog}} \rightarrow \Delta\text{GDP}$
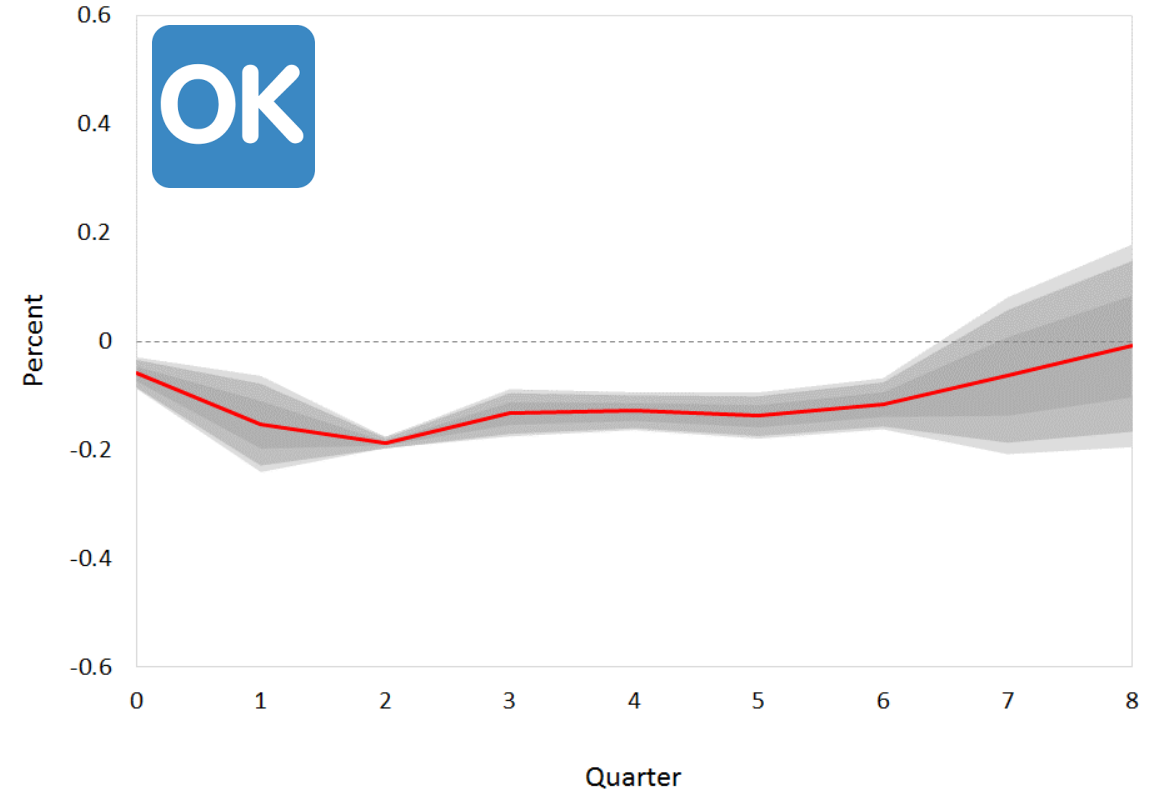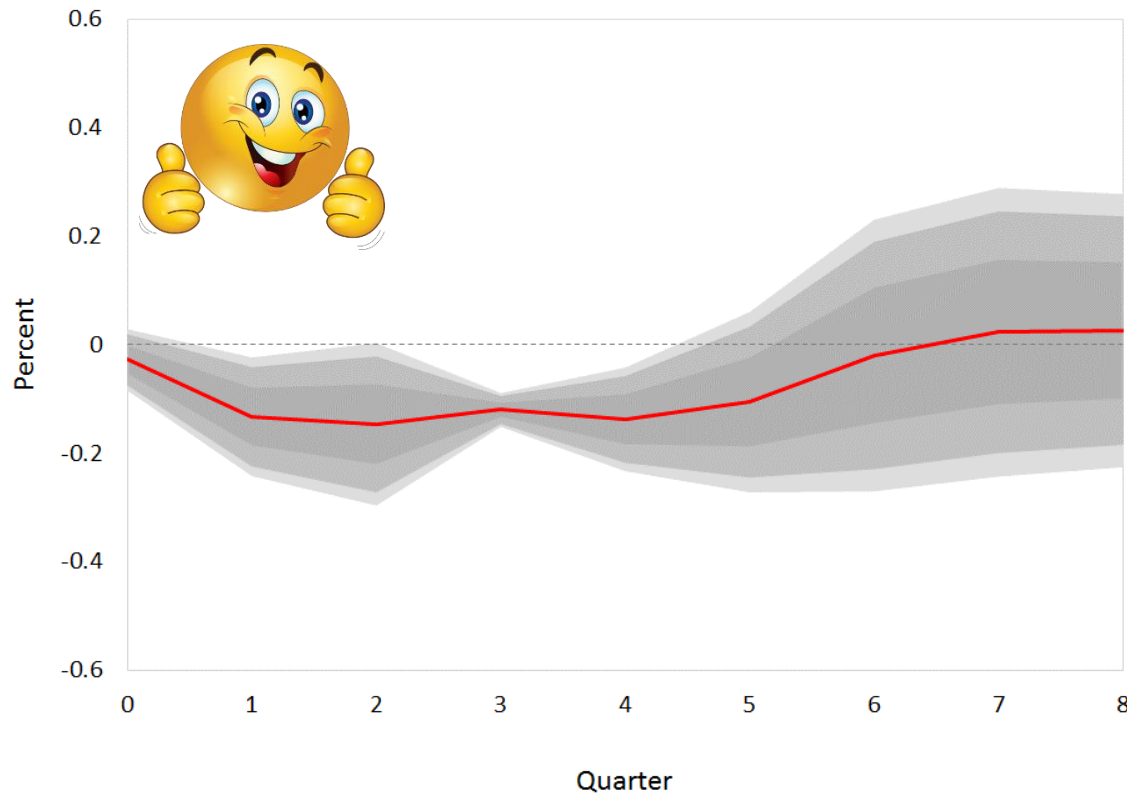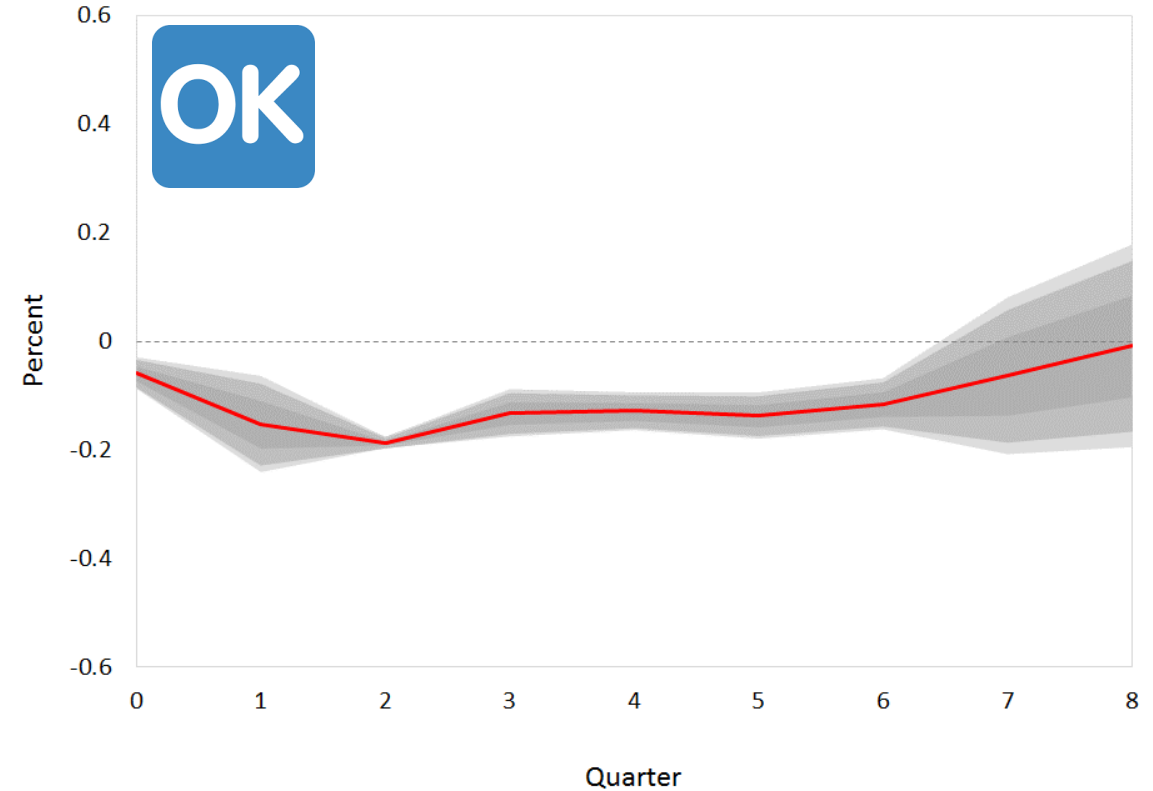
- $$\Delta y_{i,t+h} = \alpha_{i,h} + \beta_h \Delta ECRR_{i,t}^{exog} + \delta_h \Delta IR_{i,t}^{exog} + \sum_{l=1}^{4} \left(\psi_{l,h} \Delta ECRR_{i,t-l}^{all} + \theta_{l,h} \Delta IR_{i,t-l}^{all} \right) +$$

$$+ \sum_{l=1}^{4} \left(\lambda_{l,h} \Delta y_{i,t-l} + \phi_{l,h} \pi_{i,t-l} \right) + \sum_{l=0}^{h-1} \left(\omega_{lh} \Delta ECRR_{i,t+h-l}^{exog} + \nu_{lh} \Delta IR_{i,t+h-l}^{exog} \right) + \mu_{i,t,h},$$
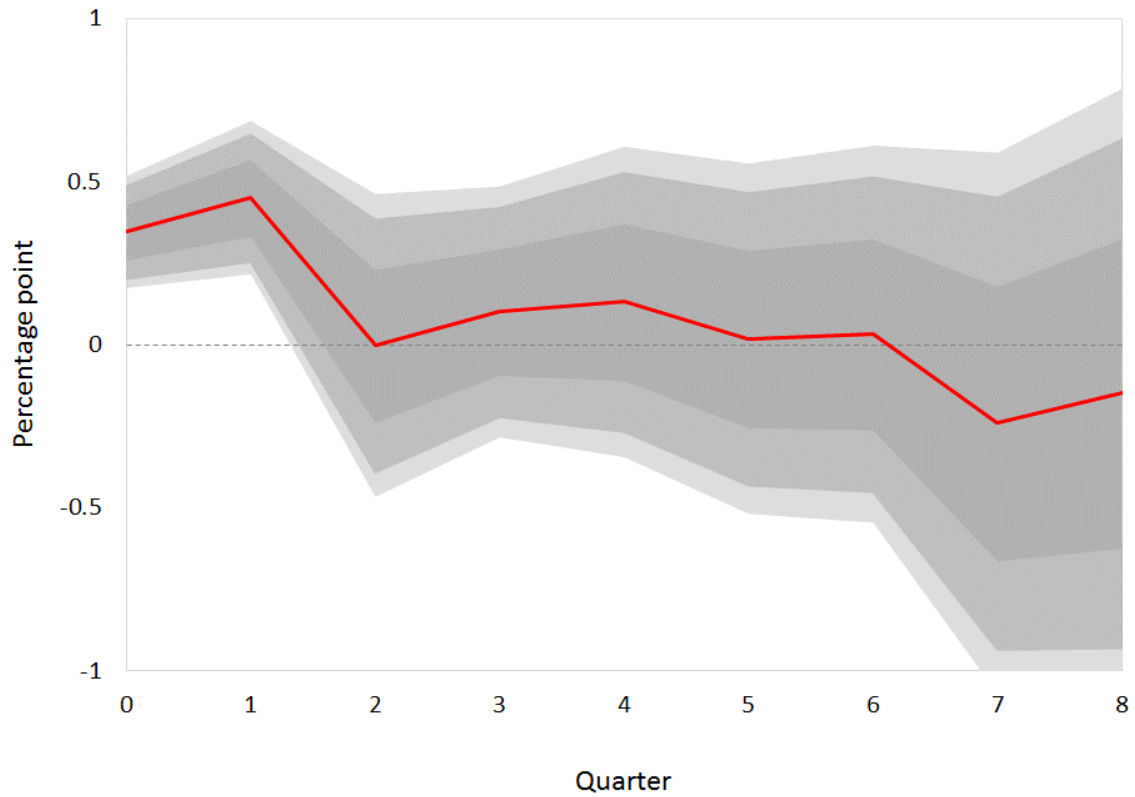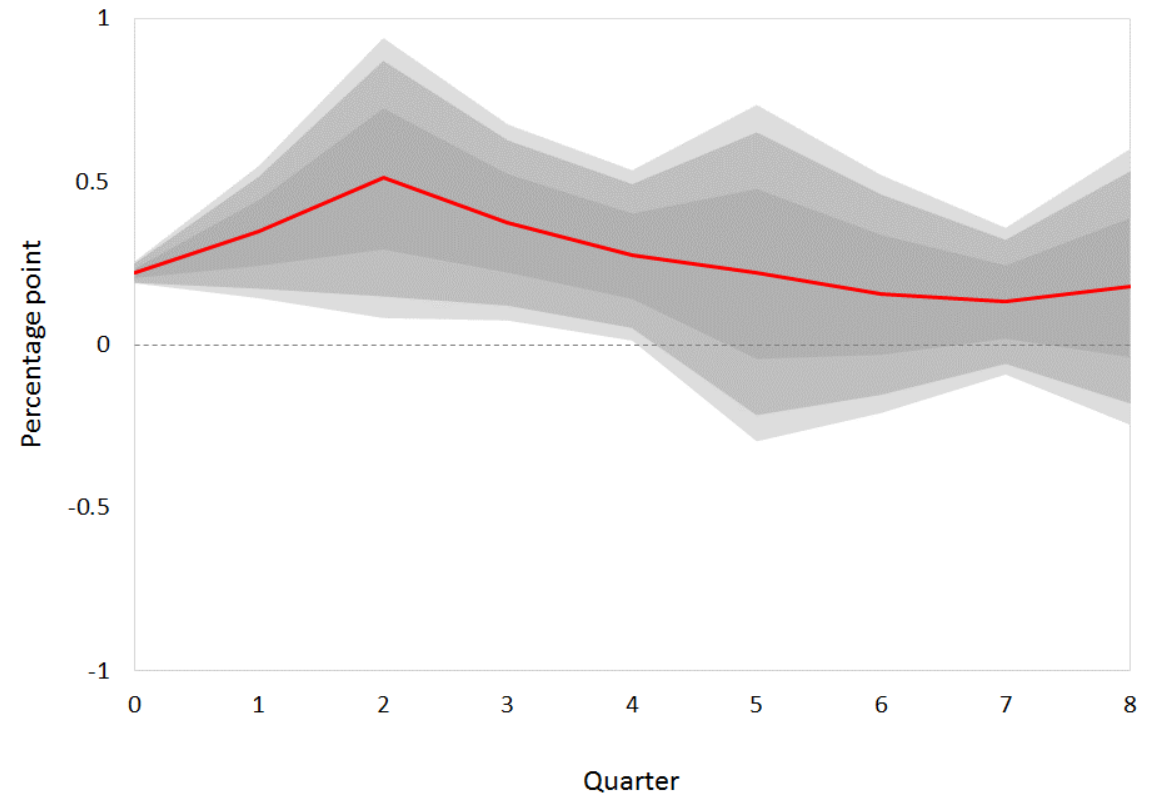
ΔECRR^exog → ΔGDP

ΔIR^exog → ΔGDP

Mechanisms

$\Delta ECRR^{exog} \rightarrow \Delta i^{spread}$
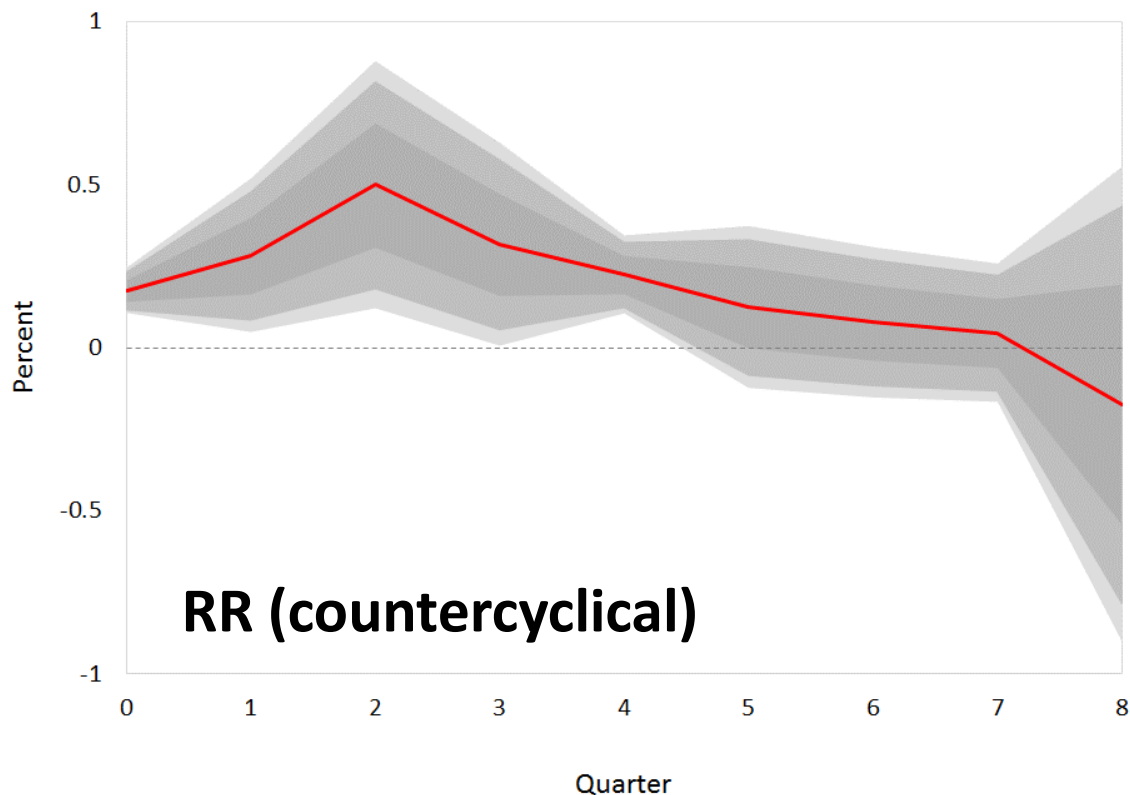
$\Delta IR^{exog} \rightarrow \Delta i^{spread}$
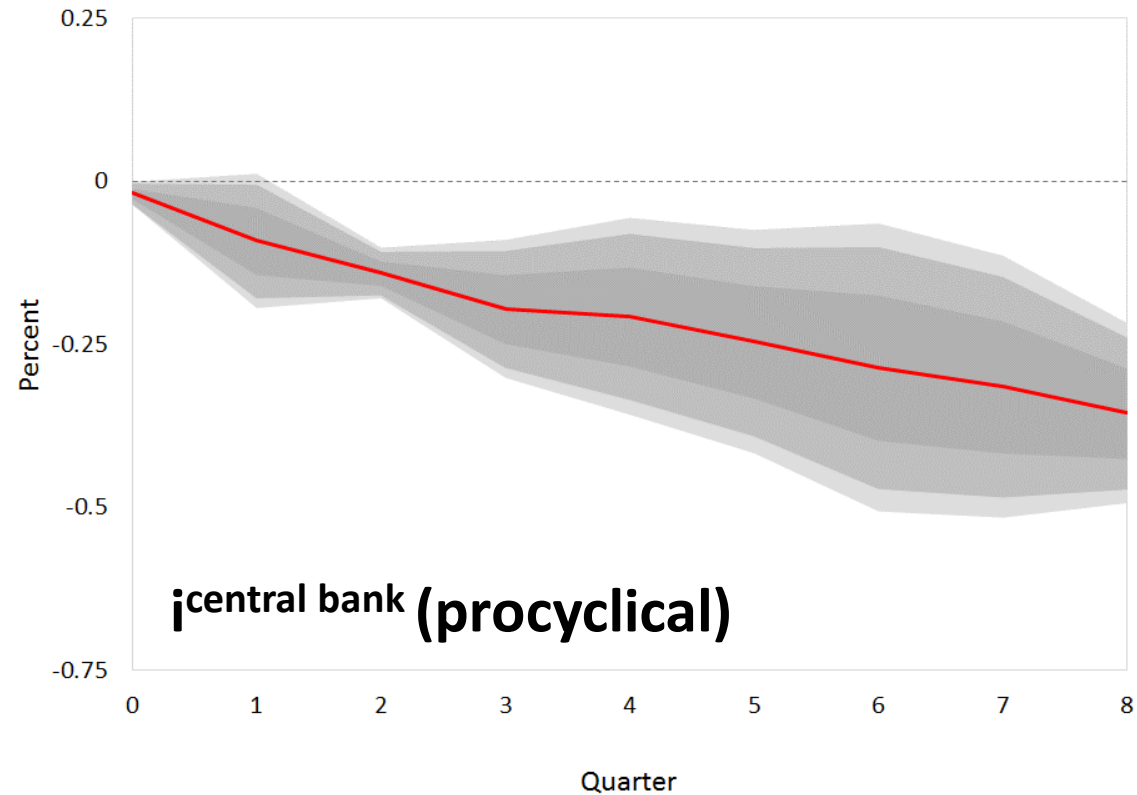
Biases due to misidentification

$$\Delta y_{i,t+h} = \alpha_{i,h} + \beta_h \Delta ECRR_{i,t}^{endog} + \delta_h \Delta IR_{i,t}^{endog} + \sum_{l=1}^{4} \left(\psi_{l,h} \Delta ECRR_{i,t-l}^{all} + \theta_{l,h} \Delta IR_{i,t-l}^{all} \right) +$$

$$+ \sum_{l=1}^{4} \left(\lambda_{l,h} \Delta y_{i,t-l} + \phi_{l,h} \pi_{i,t-l} \right) + \sum_{l=0}^{h-1} \left(\omega_{lh} \Delta ECRR_{i,t+h-l}^{endog} + \nu_{lh} \Delta IR_{i,t+h-l}^{endog} \right) + \mu_{i,t,h},$$

ΔECRR^{endog} → ΔGDP   ΔIR^{endog} → ΔGDP

RR (countercyclical)   i$^{central\ bank}$ (procyclical)

Road map

1. Motivation and sneak peek of our findings

2. Reserve requirement data

3. Evidence from traditional identification strategy

4. New measures of reserve requirement and interest shock

5. Evidence from new identification strategy

6. **Final thoughts**

- Novel evidence on the true macroeconomic effects of macroprudential policy on the macroeconomy.

- Contribution focusing on measurement and identification.

- Main findings:

  - $\Delta GDP/\Delta RR \geq 0$ when *<u>NOT</u>* property identified!

  - $\Delta GDP/\Delta RR < 0$ when property identified.

The macroeconomic effects of macroprudential policy: Evidence from a narrative approach

Diego Rojas

World Bank and UMBC

Carlos Vegh

Johns Hopkins University and NBER

Guillermo Vuletin

World Bank

Thank you!

Paper and other materials available at: **www.guillermovuletin.com**