The long-run effects of monetary policy

Òscar Jordà [⋆] Sanjay R. Singh [§] Alan M. Taylor [‡]

Economic Fluctuations & Growth Program Meeting
July 2023

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How long do the effects of monetary interventions last?

Methods

data: historical panel, 115 years x 17

identification: trilemma of international macroeconomics

method: local projections instrumental variables (LP-IV)

This paper

Outline of the key empirical findings

1. large persistent effects of monetary shocks
   - twelve years later, real GDP lower relative to pre-shock trend
   - labor returns to pre-trend level
   - capital and TFP persistently lower
2. sign asymmetry
   - persistence with tightening shocks, not with easing shocks
3. US & UK monetary shocks
   - Extend replication of 3 published papers to 8-year horizons

Empirical analysis

Data

Annual 1900–2015 (excluding world wars) for 17 advanced economies

Data requirement: long span of data for outcomes/controls and the IV

Jordà, Schularick & Taylor (2017)
www.macrohistory.net/data/
Interest rates, output, inflation, investment, house & stock prices, consumption ...

Bergeaud, Cette & Lecat (2016)
www.longtermproductivity.com
hours worked, number of employees, capital stock (machines and buildings)...

17 advanced economies in our sample:
Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, U.K., and U.S.

The trilemma instrument. Jordà, Schularick and Taylor (2020, JME)

peg + open to capital → correlated interest rates

3 subpopulations: bases (b), pegs, floats

$k_{i,t}$ index $\in [0,1]$ Quinn, Schindler, and Toyoda (2011), 1 is open

$z^j_{i,t} = D^j_{i,t}\, k_{i,t}\, \Delta \widehat{R}_{b(i,t),t}$ (base "pre-cleaned" using $x_{b(i,t),t}$ controls) $j = P, F$

$j = P$ if peg in t and $t-1$

- *intervention:* $\Delta R_{i,t}$ short-rate proxy, 3-mo govt. bill
- *instrument:* $z_{i,t}$ trilemma IV
- *outcomes:* home output and its components (at $t, t+1, ..., t+H$)

summary stats | exchange regime switches | base rate changes

Home—base country links by era

Base country interest rate	Pre-WW1	Interwar	Bretton Woods	Post-BW
UK (Gold standard/BW base)	All countries		Sterling bloc: AUS*	
UK/USA/France composite (Gold standard base)		All countries		
USA (BW/Post-BW base)			All other countries	Dollar bloc: AUS, CAN, CHE, JPN, NOR
Germany (EMS/ERM/Eurozone base)				All other countries

* we treat AUS as moving to a dollar peg in 1967

The instrument is relevant

For identification need correlation of rates, not equality: *do not* need UIP.

First Stage: $\Delta R_{i,t} = \kappa_i + z^P_{i,t}\lambda_P + z^F_{i,t}\lambda_F + x_{i,t}g + \eta_{i,t}$

	All years	PostWW2
λ_{Pegs}	0.59***	0.61***
t-statistic	[9.47]	[9.02]
λ_{Floats}	0.27***	0.26***
t-statistic	[3.30]	[2.77]

coefficients $\approx$ Obstfeld, Shambaugh & Taylor (2005), not 0/1: dirty pegs and floats

What are the controls?

implementation details on choice of x:

- log real GDP; log real C; log real I
- log CPI
- short-term (3m) + long-term (5y) govt. rates
- log real stock prices; log real house prices
- credit to GDP
- log real global GDP: common global shocks

lags:	2
transformations:	log differences $\times$ 100 (except interest rates and credit to GDP ratio)
sample:	1900–2015, 17 advanced economies, annual frequency

Panel local projections with *external* instruments: LP-IV

assumption that instrument is valid, conditional on controls x (saturate)

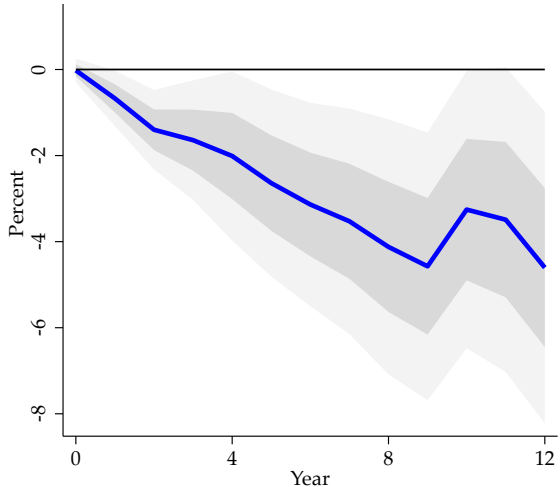
$$y_{i,t+h} - y_{i,t-1} = \alpha_{i,h} + x_{i,t}\gamma_h + \widehat{\Delta R}_{i,t}\beta_h + \nu_{i,t+h} \qquad \text{(second stage LP)}$$

β_h: cumulative IRF of variable y at horizon h relative to horizon -1 in response to an instrumented interest rate change.

Note: results robust with using one instrument $z^P_{i,t}$.

Empirics

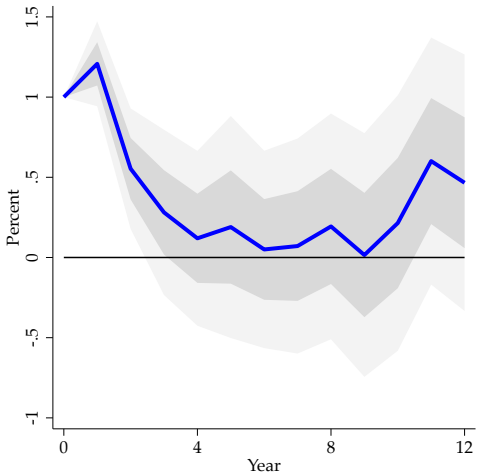
baseline result: real GDP — the long shadow



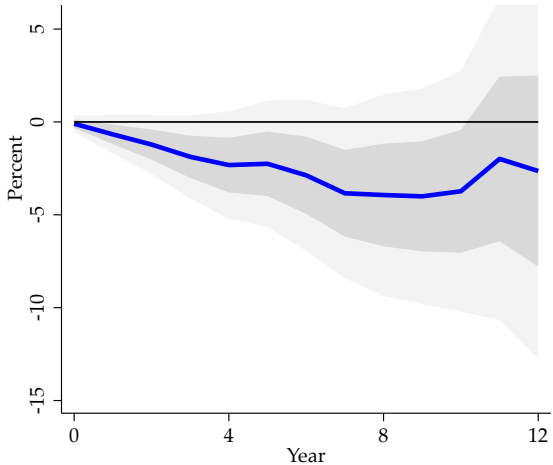
† confidence bands: 68% and 95% Driscoll & Kraay (1998) standard errors, sample: 1900–2015

short term nominal interest rate and CPI

(a) Short term nominal rate



(b) CPI



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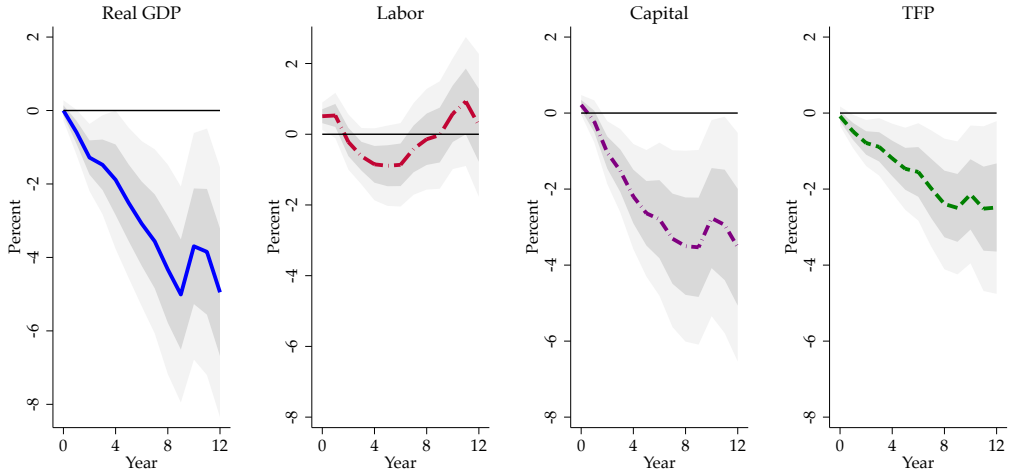
Solow decomposition & Asymmetry

Inspecting the mechanism – LPs for the Solow decomposition



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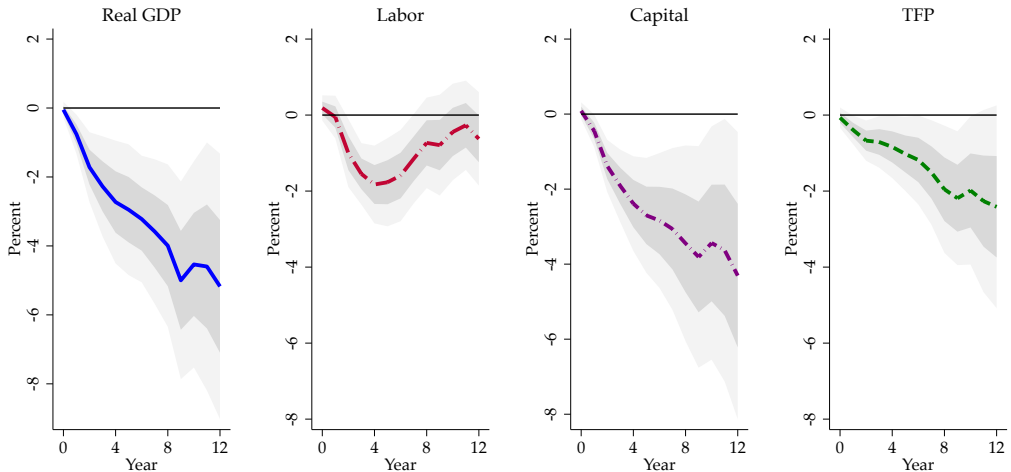
Asymmetric responses, contractionary shocks



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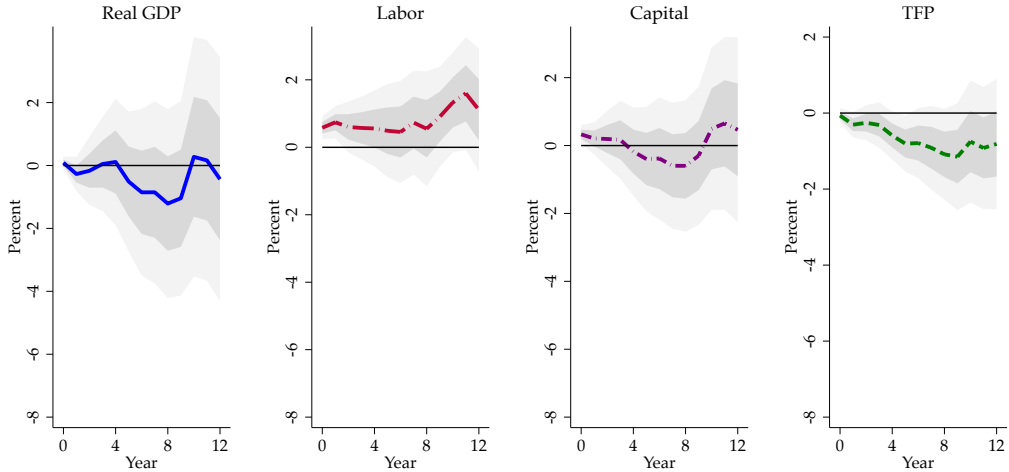
Asymmetric responses, expansionary shocks



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Robustness

1. Absence of Pre-trends
2. Drop one country at a time
3. Dropping 5-year windows at a time
4. Post-WW2 sample
5. Exclusion restriction: NK-open economy based spillover correction
6. Exclusion restriction: Open-economy controls
7. Structural Breaks in TFP growth

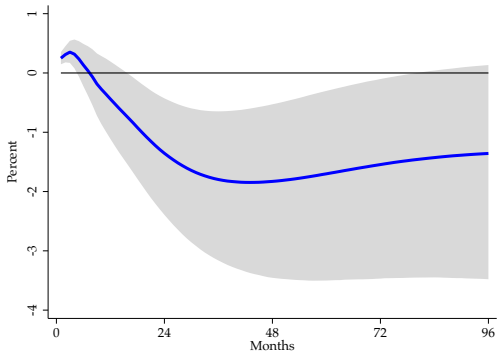
Robustness

Other Monetary Shocks

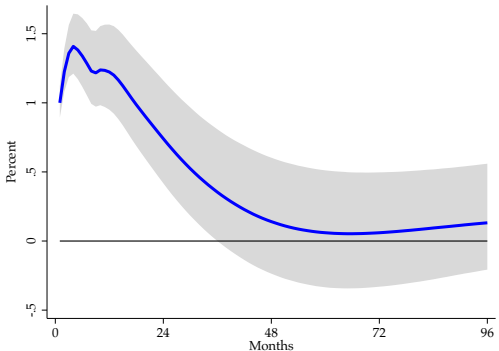
US Economy: Brunnermeier, Palia, Sastry, and Sims (2021, AER)

Extend replication code of published studies to 8-year horizon

(a) Industrial Production



(b) Fed Funds Rate



Shaded areas denote 90% posterior coverage bands in panels (a) and (b). Sample 1973:1–2015:6

USUK

Conclusion: Pushing on a long string?

long-run money neutrality may not hold

- a monetary tightening shock:
  - causes output to decline over a long period of time
  - because it causes the capital stock and TFP to decline

evidence based on

- small-open economy NK model to formalize identification
- LP-IV estimation using universe of available historical data
- various robustness exercises and alternative identification schemes

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additional slides

Summary statistics

average peg: 21 years (note: gold + Bretton Woods)
Obstfeld and Rogoff (1995): 5yrs (developing countries)

pegs are more open than floats

average degree of capital openness: $\bar{k}$

all years		postWW2	
pegs ($q = 1$)	floats ($q = 0$)	pegs ($q = 1$)	floats ($q = 0$)
0.87	0.70	0.76	0.74
(0.21)	(0.31)	(0.24)	(0.30)

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how often do countries switch exchange rate regime?

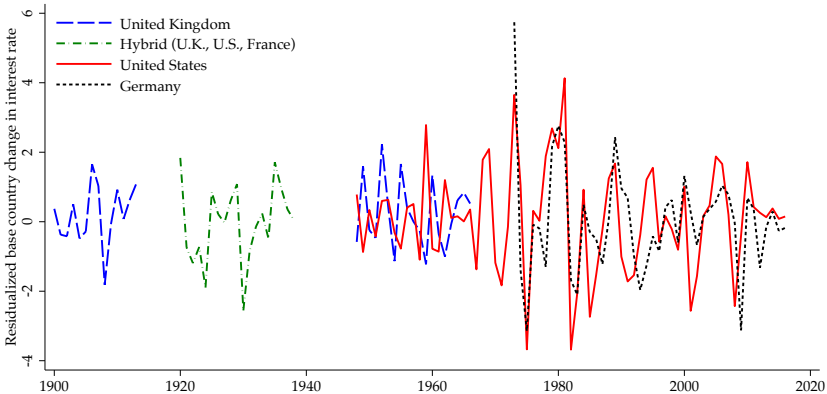
excluding wars

	1870–2013		1870–1939		1948–2015	
	Frequency	%	Frequency	%	Frequency	%
float to peg	19	2	6	3	13	2
no change	954	96	191	93	763	97
peg to float	19	2	8	4	11	1
Total	992	100	205	100	787	100

Back

IV construction

Residualized component $\Delta\widehat{R}_{b(i,t),t}$ of base country interest rates



$\Delta\widehat{R}_{b(i,t),t} = (\Delta R_{b(i,t),t} - \Delta\tilde{R}_{b(i,t),t})$ where $b(i,t)$ denotes the base for country i at time t and the final term is the predicted interest rate from a cleaning regression.

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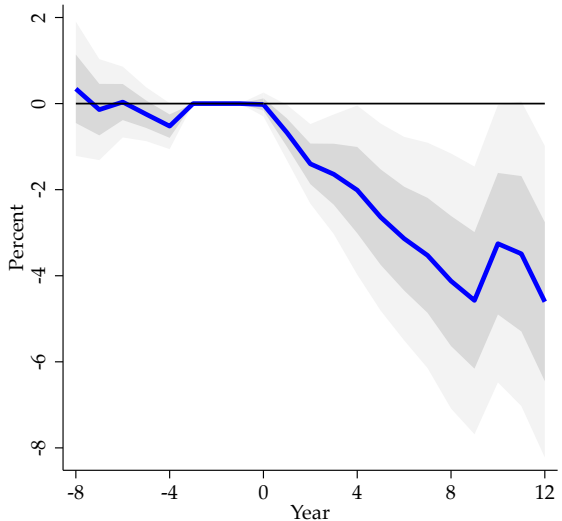
Robustness

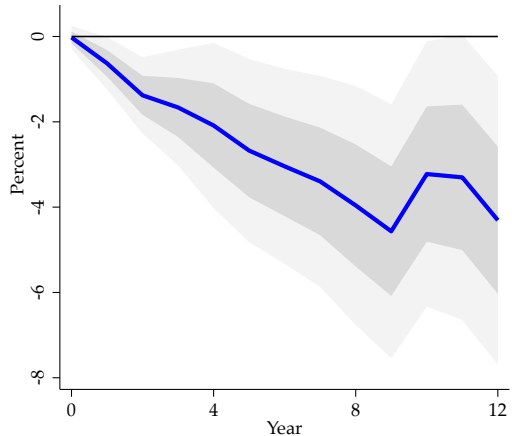
Robustness with pre-trends: IRF of Real GDP



† confidence bands: 68% and 95% Driscoll & Kraay (1998) standard errors, sample: 1900–2015

open economy variables: exclusion restriction

control for (i) base country GDP, (ii) global GDP, (iii) own current account and (iv) exchange rate wrt USD



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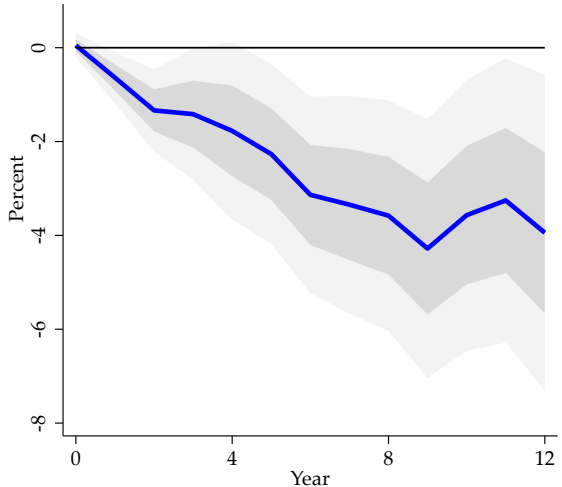
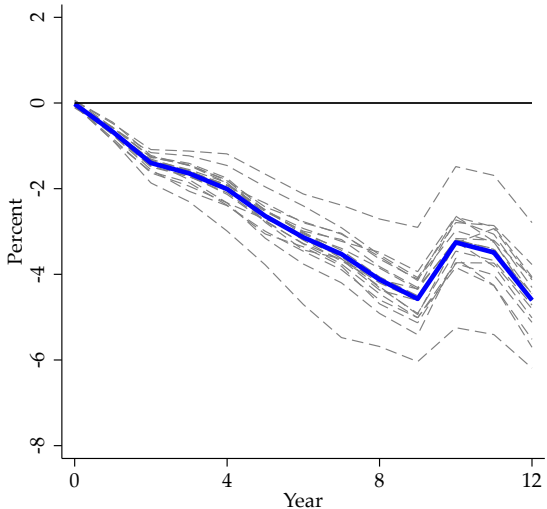
Post-WW2 sample: IRF of Real GDP

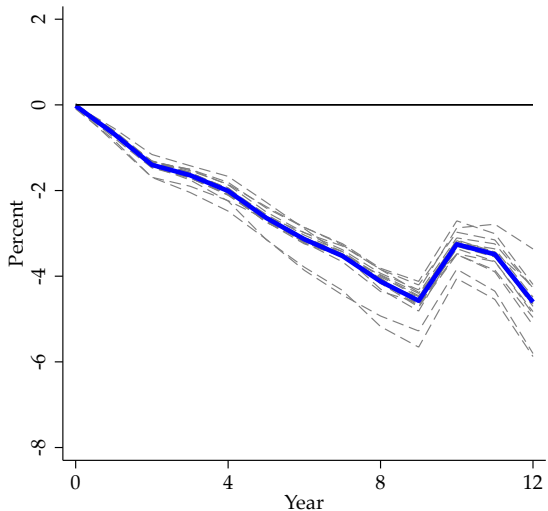


† confidence bands: 68% and 95% Driscoll & Kraay (1998) standard errors, sample: 1948–2015

Dropping successive 5-year windows one at a time : IRF of Real GDP



Dropping each country one at a time: IRF of Real GDP



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Spillover: exclusion restriction violation

If the instrument $z_{i,t}$ affects the outcome through other channels θ

$$y_{i,t+h} - y_{i,t} = \alpha_{i,h} + x_{i,t}\gamma_h + \widehat{\Delta R}_{i,t}\beta_h + z_{i,t}\theta + \nu_{i,t+h}$$

- e.g. a recession in base reduces demand for home exports

Spillover correction:

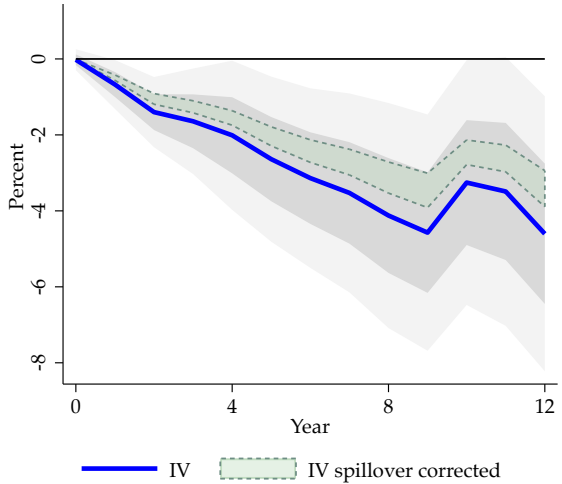
Employ a **control function approach**, by using the model to get a bound:

$$\theta = \underbrace{\text{share of exported tradables in home output}}_{\text{calibrate: } \Phi \in [0,\ 0.3]} \times \underbrace{\text{responsiveness of exported tradable demand to base interest rate}}_{\text{assumption: upper bound } = \beta_h}$$

$\rightarrow$ Estimate an augmented LP :

$$y_{i,t+h} - y_{i,t} = \alpha_{i,h} + +x_{i,t}\gamma_h + \left(\widehat{\Delta R}_{i,t} + \Phi z_{i,t}\right)\beta_h + \nu_{i,t+h}$$

Model-based spillover correction



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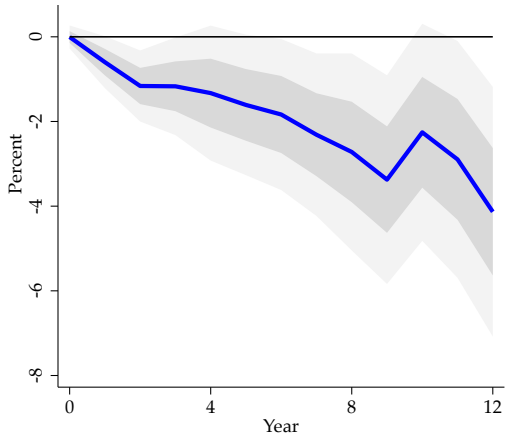
Structural breaks in TFP growth: IRF of real GDP:

Fernald, 2007, 2014; Gordon 2016

Allow intercept to be regime-dependent based on Bai & Perron (1998)



† confidence bands: 68% and 95% Driscoll & Kraay (1998) standard errors, sample: 1900–2015

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Other Monetary Shocks: US Economy

Extend replication code of published studies to 8-year horizon

1. Miranda-Agrippino and Ricco (2021 AEJ Macro, 2023 JME)
   - high-frequency surprises around FOMC announcements + Greenbook forecasts
   - monthly Bayesian proxy-VAR(12)
   - Sample 1979:1– 2014:12
2. Brunnermeier, Palia, Sastry, and Sims (2021, AER)
   - identification by heteroskedasticity (Rigobon 2003)
   - ten-variable monthly Bayesian SVAR(10) model
   - Sample 1973:1–2015:6

Other Monetary Shocks: UK Economy

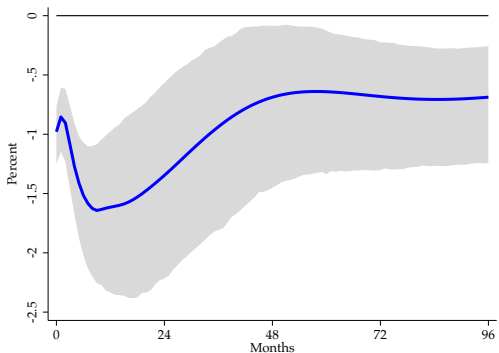
Extend replication code of published studies to 8-year horizon

1. Cesa-Bianchi, Thwaites, and Vicondoa (2020, EER)
   - series of monetary policy surprises for the UK using intra-day three-month Sterling futures data
   - monthly proxy SVAR(4)
   - Sample 1992:1 – 2015:1

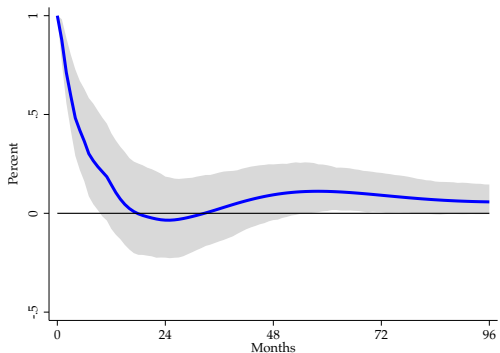
Miranda-Agrippino and Ricco (2021, AEJ Macro)

Extend replication code of published studies to 8-year horizon

(a) Industrial Production



(b) One-year T-bond



Shaded areas denote 90% posterior coverage bands in panels (a) and (b).

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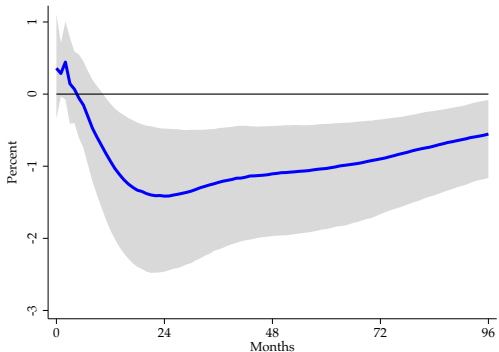
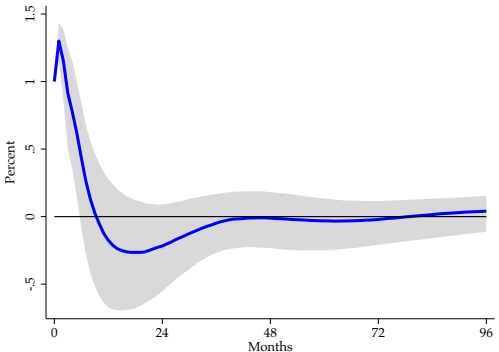
Cesa-Bianchi, Thwaites, and Vicondoa (2020, EER)

Extend replication code of published studies to 8-year horizon

(a) Monthly estimate of GDP



(b) One-year Gilt Rate



Shaded areas denote 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

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