The Systematic Origins of Monetary Policy Shocks

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Motivation

- Large literature studies empirical monetary policy (MP) shocks
  (1) Effectiveness of MP (e.g., Romer/Romer 04, Miranda-Agrippinio/Ricco 21)
  (2) MP counterfactuals (e.g., McKay/Wolf 23, Barnichon/Mesters 23)
  (3) Estimate DSGE models (e.g., Christiano/Eichenbaum/Evans 05)
- Requires well-identified shocks
  - unpredictable
  - orthogonal to other macro shocks

Motivation

- A monetary policy rule: $$i_t = \alpha + \underbrace{(\phi + \tilde{\phi}_t)'}_{\substack{\text{systematic MP} \\ \text{(slope)}}} \underbrace{x_t}_{\substack{\text{e.g., inflation,} \\ \text{output, ...}}} + \underbrace{w_t^m}_{\substack{\text{MP shock} \\ \text{(intercept)}}}$$

- Conventional empirical strategies to identify w_t^m implicitly assume time-constant $\tilde{\phi}_t = 0$
  - linear Taylor rule regressions (e.g., Romer/Romer 04)
  - linear SVAR with zero restrictions, sign restrictions, or external instruments

    (e.g., Christiano/Eichenbaum/Evans 99, Uhlig 05, Gertler/Karadi 15)
  - high-frequency identification (e.g., Nakamura/Steinsson 18)

- Does time-varying ϕ_t interfere with the identification of empirical MP shocks?

What we do

- **Theory**: applying conventional identification strategies in an environment with time-varying systematic MP yields empirical MP shocks that ...
  - are contaminated by other macro shocks
  - are predictable by time-variation in systematic MP
  - lead to biased IRF estimates

What we do

- **Theory**: applying conventional identification strategies in an environment with time-varying systematic MP yields empirical MP shocks that ...
  - are contaminated by other macro shocks
  - are predictable by time-variation in systematic MP
  - lead to biased IRF estimates

- **Empirics**: demonstrate contamination and bias in empirical MP shocks for the U.S.
  - Measure systematic MP via FOMC's Hawk-Dove balance (Istrefi 19, Hack/Istrefi/Meier 23)
  - MP shocks by Romer/Romer (04), Aruoba/Drechsel (22) and Miranda-Agrippino/Ricco (21) predictable by variation in systematic MP
  - Orthogonalized new MP shocks lead to stronger, quicker inflation & GDP responses

Related literature

- **Conventional strategies to identify effects of MP shocks** Romer/Romer (89,04), Uhlig (05), Bernanke/Blinder (92), Christiano/Eichenbaum/Evans (99), Grkaynak/Sack/Swanson (05), Barakchian/Crowe (13), Gertler/Karadi (15), Antoln-Daz/Rubio-Ramrez (18), Champagne/Sekkel (18), Arias/Caldara/Rubio-Ramrez (19), Jarocinski/Karadi (20), Miranda-Agrippinio/Ricco (21), Bauer/Swanson (23,23), Aruoba/Drechsel (24), ...

  NEW: characterize misidentification under time-varying systematic MP & propose solution

- **Models with time-varying systematic MP as latent variable** Owyang/Ramey (04), Primicieri (05), Boivin (06), Sims/Zha (06), Coibion/Gorodnichenko (11), Coibion (12), Bauer/Pflueger/Sunderam (24), ...

  NEW: leverage measured time variation in systematic MP

Theoretical analysis

Monetary policy shocks

Monetary policy rule

$$i_t \;=\; \alpha + \underbrace{(\phi + \tilde{\phi}_t)'}_{\text{systematic MP}}\; x_t \;+\; \underbrace{w_t^m}_{\text{MP shock}}$$

$i_t, w_t \in \mathbb{R}; \quad \phi, \tilde{\phi}_t, x_t \in \mathbb{R}^{n\times 1}$

Assumption: $\mathbb{E}[\tilde{\phi}_t w_t^m] = 0$

Normalization: $\mathbb{E}[\tilde{\phi}_t] = \mathbb{E}[x_t] = \mathbb{E}[w_t^m] = \mathbb{E}[i_t] = 0$

Conventional identification strategies

- Taylor rule regressions as in Romer/Romer (04)
- Linear, monetary SVAR models as in Christiano et al., (99), Uhlig (05), Antolin-Diaz/Rubio-Ramirez (18), Gertler/Karadi (15), ...

$$i_t \;=\; b'\, x_t \;+\; e_t^m$$

- High-frequency monetary policy surprises (e.g., Nakamura/Steinsson, 18)

Proposition 1 (Contamination)

Given an estimate $\hat{b}$, the estimated empirical MP shock $\hat{e}_t^m$ satisfies

$$\hat{e}_t^m = i_t - \hat{b}' x_t = w_t^m + \left(\omega_t^{\hat{b}} + \omega_t^{\tilde{\phi}}\right),$$

with the two wedges given by

$$\omega_t^{\hat{b}} = (\phi - \hat{b})' x_t, \quad \text{and} \quad \omega_t^{\tilde{\phi}} = \tilde{\phi}_t' x_t - \mathbb{E}[\tilde{\phi}_t' x_t].$$

- $\omega_t^{\hat{b}}$: contamination through misidentification of ϕ OLS bias
- $\omega_t^{\tilde{\phi}}$: contamination through time-varying systematic MP

- $\hat{e}_t^m$ not orthogonal to (present or past) macro shocks that influence x_t (and $\tilde{\phi}_t$)
- Testable prediction: $\tilde{\phi}_t' x_t$ explains (some) variation in $\hat{e}_t^m$

High-frequency identification → similar problems

- High-frequency monetary policy surprise

$$\hat{e}_t^m = \mathbb{E}_{t+\Delta}[i_t] - \mathbb{E}_{t-\Delta}[i_t]$$
$$= w_t^m + \phi' \underbrace{\left(\mathbb{E}_{t+\Delta}[x_t] - \mathbb{E}_{t-\Delta}[x_t]\right)}_{\text{update about } x_t} + \underbrace{\left(\mathbb{E}_{t+\Delta}[\tilde{\phi}_t' x_t] - \mathbb{E}_{t-\Delta}[\tilde{\phi}_t' x_t]\right)}_{\text{update about } \tilde{\phi}_t' x_t}$$

- Absent updating about x_t

$$\hat{e}_t^m = w_t^m + \left(\mathbb{E}_{t+\Delta}[\tilde{\phi}_t] - \mathbb{E}_{t-\Delta}[\tilde{\phi}_t]\right)' x_t$$

- If (perceived) $\tilde{\phi}_t$ changes in event window, then $\hat{e}_t^m$ contaminated
  - Special case: constant updating → regress $\hat{e}_t^m$ on x_t (Bauer/Swanson 23)

Systematic origins of monetary policy shocks

- Empirical MP shocks capture time variation in systematic MP

  $\hookrightarrow$ consistent with common views about the empirical shocks

  - Ramey (2016, Handbook of Macroeconomics): *We do not have many good economic theories for what a structural monetary policy shock should be. Other than "random coin flipping," the most frequently discussed source of monetary policy shocks is shifts in central bank preferences, caused by changing weights on inflation vs unemployment in the loss function or by a change in the political power of individuals on the FOMC.*

  - Christiano et al. (1999, Handbook of Macroeconomics): An empirical monetary policy shock *[..] reflects exogenous shocks to the preferences of the monetary authority, perhaps due to stochastic shifts in the relative weight given to unemployment and inflation. These shifts could reflect shocks to the preferences of the members of the Federal Open Market Committee (FOMC) [..].*

- Can we use such empirical shocks to identify the causal effects of MP (shocks)?

Impulse responses bias (an example)

- Local projection to estimate output response:

$$y_{t+h} = c^h + d^h \hat{e}_t^m + u_{t+h}^h, \quad h = 0, ..., H$$

- Consider simple MP rule $x_t = \pi_t$, then:

$$\hat{e}_t^m = w_t^m + \left(\omega_t^{\hat{b}} + \omega_t^{\tilde{\phi}}\right), \qquad \omega_t^{\hat{b}} = (\phi - \hat{b})\pi_t, \qquad \omega_t^{\tilde{\phi}} = \tilde{\phi}_t\pi_t - \mathbb{E}[\tilde{\phi}_t\pi_t]$$

- OLS estimate $\hat{d}^h$ will generally be biased
  - y_t and $\hat{e}_t^m$ depend on present/past macro shocks
  - y_t and $\hat{e}_t^m$ depend on interactions of present/past macro shocks and $\tilde{\phi}_t$

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- OLS estimate $\hat{d}^h$ will generally be biased
  - y_t and $\hat{e}_t^m$ depend on present/past macro shocks
  - y_t and $\hat{e}_t^m$ depend on interactions of present/past macro shocks and $\tilde{\phi}_t$
- Sufficient conditions for zero bias
  - fully exogenous MP: $\tilde{\phi}_t\pi_t$ exogenous and $\hat{b} = \phi$
  - time-invariant systematic MP: $\tilde{\phi}_t = 0$ and $\hat{b} = \phi$
- In the paper: formal example (NK model) & general characterization of IRF bias

Empirical evidence on MP shock contamination

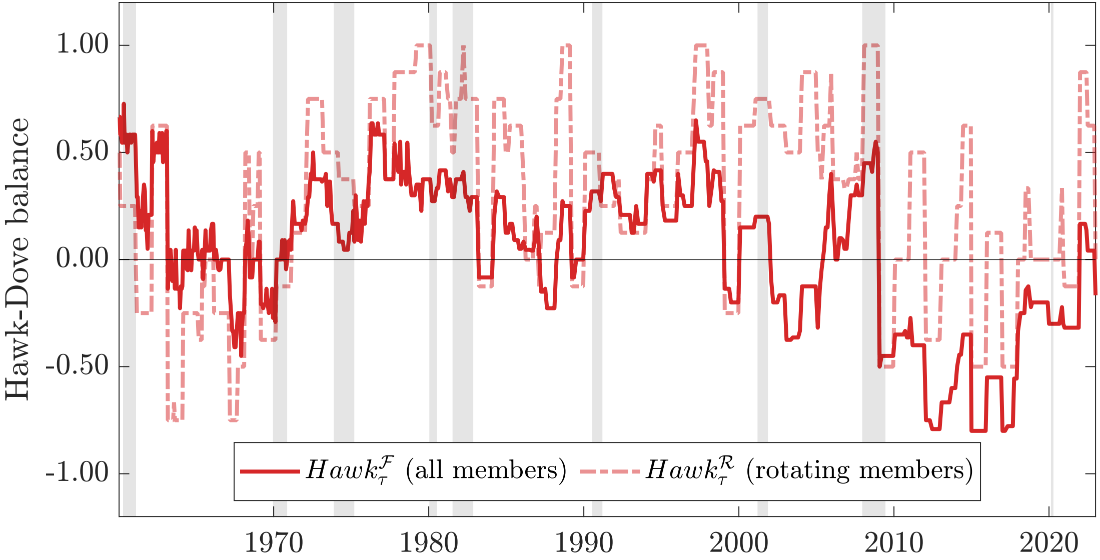
Measurement of systematic monetary policy

- Istrefi (19): newspaper-based classification of FOMC members into hawks and doves
- Hawk-Dove balance for full FOMC ($\mathcal{B} = \mathcal{F}$) or rotation panel ($\mathcal{B} = \mathcal{R}$) Examples FOMC Stats

$$\tilde{\phi}_t \sim \mathit{Hawk}_\tau^{\mathcal{B}} = \frac{1}{|\mathcal{B}_\tau|} \sum_{i \in \mathcal{B}_\tau} \mathit{Hawk}_{i\tau}, \qquad \mathit{Hawk}_{i\tau} \in \begin{cases} +1 & \textit{Hawk} \\ +\frac{1}{2} & \textit{Swinging hawk} \\ 0 & \textit{Preference unknown} \\ -\frac{1}{2} & \textit{Swinging dove} \\ -1 & \textit{Dove} \end{cases}$$

  - Avoid specification of a particular policy rule, rule inputs, and policy instruments
  - Consistent with dissents, preferred rates, forecasts (Istrefi 19), related to early life experience/education (Bordo/Istrefi 23)
  - A hawkish FOMC: responds to higher inflation with more aggressive hikes (Bordo/Istrefi 23; Hack/Istrefi/Meier 23); responds more aggressively to expansionary government spending shocks (Hack/Istrefi/Meier 23). Validation

FOMC Hawk-Dove balance



Empirical analysis

– Predictability of empirical MP shocks–

Predictability of Romer/Romer (04) shocks

- RR identification of empirical MP shock

$$i_\tau = a + b' x_\tau + e^{rr}_\tau, \qquad \tau = \text{FOMC meeting},$$

where x_τ includes Greenbook forecasts and revisions for GDP, inflation, unemployment

- Test theoretical prediction that systematic MP (partly) explains RR shock

$$\begin{aligned} \hat{e}^{rr}_\tau = & \beta_0 + \beta_1' \, x_{\tau-p} Hawk^{\mathcal{B}}_{\tau-p} + \beta_2' \, x_{\tau-p} \Delta Hawk^{\mathcal{B}}_{\tau-p} \\ & + \beta_3' \, Hawk^{\mathcal{B}}_{\tau-p} + \beta_4' \, \Delta Hawk^{\mathcal{B}}_{\tau-p} + \beta_5' \, x_{\tau-p} + u_\tau \end{aligned}$$

  - Lags $p = 0, 1, 2$
  - $Hawk^{\mathcal{F}}_\tau$ vs $Hawk^{\mathcal{R}}_\tau$
  - Different samples

	$Hawk_\tau^{\mathcal{F}}$			$Hawk_\tau^{\mathcal{R}}$		
Sample	69-07	69-96	83-07	69-07	69-96	83-07
(a) Contemporaneous FOMC meeting (p=0)						
R^2	0.098	0.134	0.426	0.165	0.216	0.462
p-value	0.189	0.243	0.000	0.012	0.000	0.000
T	353	265	200	353	265	200
(b) One FOMC meeting lag (p=1)						
R^2	0.333	0.431	0.452	**0.432**	**0.543**	**0.441**
p-value	0.003	0.001	0.000	0.000	0.000	0.000
T	349	261	200	349	261	200
(c) Two FOMC meetings lag (p=2)						
R^2	0.241	0.310	0.369	0.278	0.359	0.423
p-value	0.000	0.000	0.000	0.000	0.000	0.000
T	347	259	200	347	259	200

Take-aways

- High predictive power across specifications, highest for $p = 1$ and rotation panel
- Quantitatively key regressors: $x_{\tau-1} Hawk_{\tau-1}^{\mathcal{R}}$ and $x_{\tau-1} \Delta Hawk_{\tau-1}^{\mathcal{R}}$ details
- Lasso: 4 regressors yield $R^2 = 0.15$ for 69-07 sample details

Predictability of other MP shocks

Aruoba/Drechsel (22)

- AD, Refined RR shock, adding sentiment indicators about the Fed staff's assessment of the economy
- R^2 between 0.26 and 0.36 for the 83-07 sample. go

Miranda-Agrippino/Ricco (21)

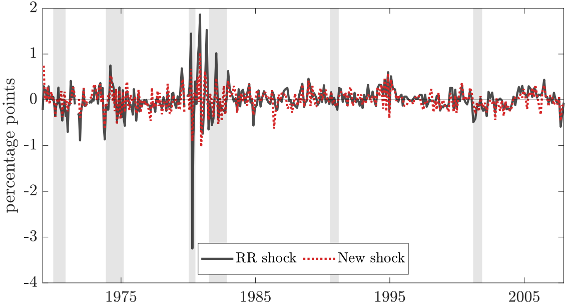
- MAR, Proxy VAR with high-frequency MP surprises as an external instrument.
- R^2 between 0.24 and 0.53 for the 80-14 sample. go

Empirical analysis

– New MP shocks –

New shock e_τ^{new}: orthogonal to systematic MP

$$i_\tau = \beta_0 + \beta_1' x_\tau + \beta_2' x_{\tau-1} + \beta_3' \, x_{\tau-1} Hawk_{\tau-1}^{\mathcal{R}} + \beta_4' \, x_{\tau-1} \Delta Hawk_{\tau-1}^{\mathcal{R}} + \beta_5' \, Hawk_{\tau-1}^{\mathcal{R}} + \beta_6' \, \Delta Hawk_{\tau-1}^{\mathcal{R}} + e_\tau^{new}$$



Some statistics

- R^2(new shock regression) $= 0.67$
  R^2(regression w/o Hawk) $= 0.44$
  R^2(RR shock regression) $= 0.27$
- $Corr(\hat{e}_\tau^{new}, \; \hat{e}_\tau^{rr}) = 0.67$
- $Corr(sign(\hat{e}_\tau^{new}), \; sign(\hat{e}_\tau^{rr})) = 0.42$
- $Std(\hat{e}_\tau^{new}) = 0.23 < Std(\hat{e}_\tau^{rr}) = 0.34$

Impulse responses to new shock vs conventional MP shocks

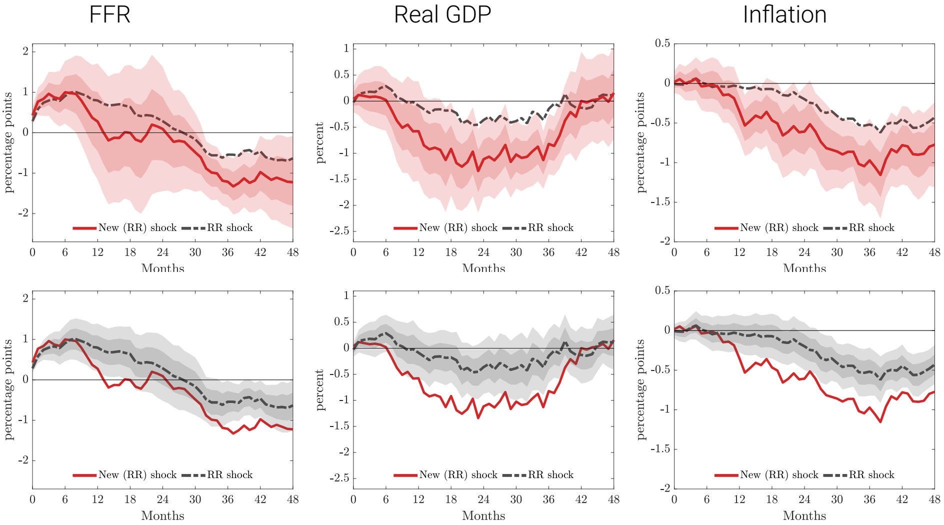
- Estimate impulse responses via monthly local projections

$$y_{t+h} - y_{t-1} = \alpha^h_{yk} + \boxed{\beta^h_{yk}}\ \hat{e}^k_t + \Gamma_{yk} Z_t + v^h_{yk,t+h}$$

  - y_{t+h}: federal funds rate, log real GDP, or inflation rate (GDP deflator)
  - $\hat{e}^k_t$: conventional MP shock or new orthogonalized MP shock
  - Z_t: 12 lags of federal funds rate, inflation, log real GDP, linear time trend

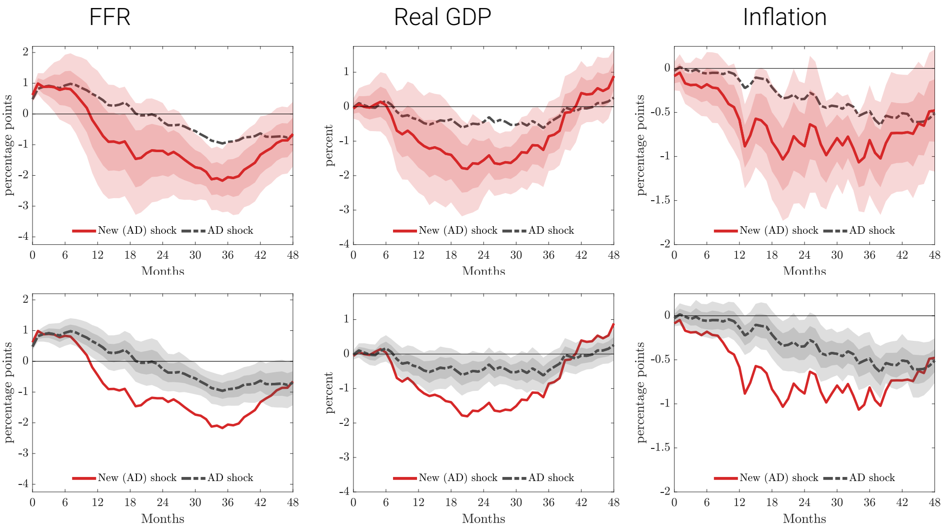
  - Focus on sample 83–07 ← well-known to be "problematic" (e.g., Ramey 16)

New shock: MP transmission quicker, stronger, and more significant



Shaded areas indicate 68% and 95% confidence bands using HAC standard errors.

New shock II: MP transmission quicker, stronger, and more significant

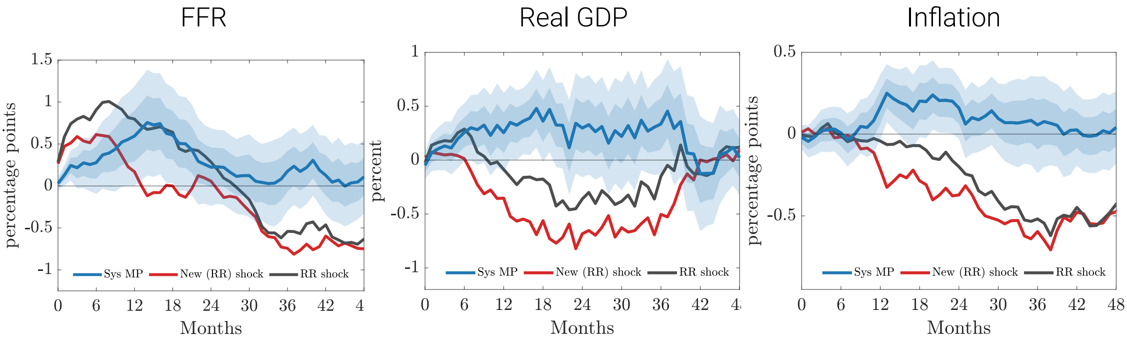


Shaded areas indicate 68% and 95% confidence bands using HAC standard errors.

Decomposing the RR shock

Estimate IRFs using the same monthly LPs as previously specified

$$IRF(\hat{e}_t^{rr*}) = \omega^s IRF(\hat{s}_t) + \omega^{new} IRF(\hat{e}_t^{new}), \qquad \hat{s}_t = \hat{e}_t^{rr*} - \hat{e}_t^{new}$$



Shaded areas indicate 68% and 95% confidence bands using HAC standard errors.

Additional results and sensitivity

- Additional outcomes variables go
- Additional control variables go
- Timing restriction (recursive) go
- IP and CPI (instead of GDP and GDP deflator) go
- Estimate shocks on late sample go
- Estimate responses on full sample go
- New shock controling only for $x_{\tau-1}$ (placebo) go
- New MAR shock go

Conclusion

- In theory, the presence of time-varying systematic MP poses a challenge for conventional strategies used to identify MP shocks
- Our evidence highlights the theoretical challenge is of high quantitative relevance
- New MP shocks that control for this issue show that MP transmission is quicker, stronger, and more significant

Appendix slides

Sources of endogeneity

- Suppose we estimate $i_t = b'\tilde{x}_t + e_t^m$ via OLS
- Under the appropriate stationarity and ergodicity assumptions

$$\hat{b} \xrightarrow{p} \phi + \underbrace{\mathbb{E}\left[x_t x_t'\right]^{-1} \mathbb{E}\left[x_t w_t^m\right]}_{\substack{\text{well-known endogeneity bias} \\ \text{due to MP shocks}}} + \underbrace{\mathbb{E}\left[x_t x_t'\right]^{-1} \mathbb{E}\left[x_t x_t' \tilde{\phi}_t\right]}_{\substack{\text{novel endogeneity bias} \\ \text{due to systematic MP}}}$$

- Carvalho/Nechio/Tristao (21) argue that bias due to MP shocks is small as monetary policy shocks explain little variance of macro outcomes
- But argument does not apply to bias due to systematic MP, especially when $\tilde{\phi}_t$ is endogenous, i.e., if its time variation is driven by unobserved macro shocks

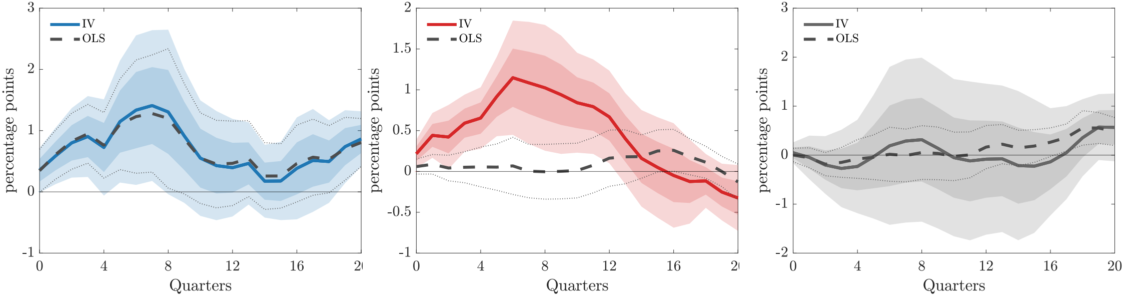
back

Validation 1 (Hack/Istrefi/Meier 23)

Do Hawks/Doves respond differently to forecasts of inflation and output gap?

$$FFR_{\tau+h} = \alpha^h + \beta_\pi^h \hat{\pi}_\tau + \beta_y^h \hat{y}_\tau + \gamma_\pi^h \hat{\pi}_\tau (Hawk_\tau^{\mathcal{F}} - \overline{Hawk}^{\mathcal{F}}) + \gamma_y^h \hat{y}_\tau (Hawk_\tau^{\mathcal{F}} - \overline{Hawk}^{\mathcal{F}})$$
$$+ \delta^h (Hawk_\tau^{\mathcal{F}} - \overline{Hawk}^{\mathcal{F}}) + \zeta^h Z_{\tau-1} + v_{\tau+h}^h$$

Average response to $\hat{\pi}$ (β_π^h) | Differential response to $\hat{\pi}$ (γ_π^h) | Response to $Hawk_t^{\mathcal{F}}$ (δ^h)



IV estimates based on $Hawk_t^{\mathcal{R}}$. Shaded areas indicate 68% and 95% confidence bands using HAC standard errors.

Back

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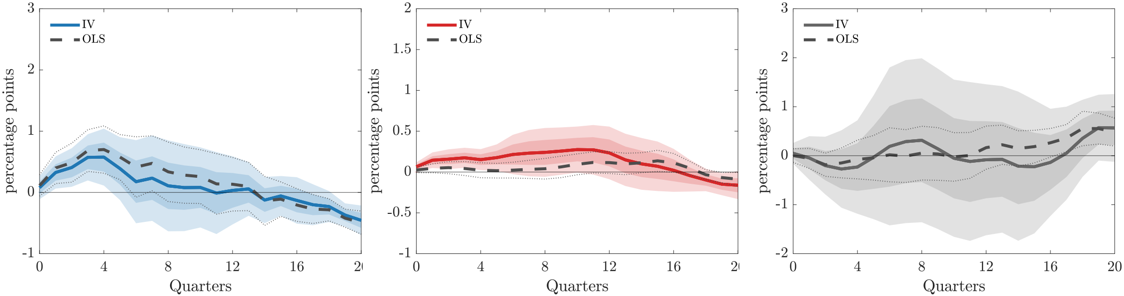
Do Hawks/Doves respond differently to forecasts of inflation and output gap?

$$
\begin{aligned}
FFR_{\tau+h} =&\alpha^h + \beta_\pi^h \hat{\pi}_\tau + \beta_y^h \hat{y}_\tau + \gamma_\pi^h \hat{\pi}_\tau (Hawk_\tau^{\mathcal{F}} - \overline{Hawk}^{\mathcal{F}}) + \gamma_y^h \hat{y}_\tau (Hawk_\tau^{\mathcal{F}} - \overline{Hawk}^{\mathcal{F}}) \\
&+ \delta^h (Hawk_\tau^{\mathcal{F}} - \overline{Hawk}^{\mathcal{F}}) + \zeta^h Z_{\tau-1} + v_{\tau+h}^h
\end{aligned}
$$

Average response to $\hat{y}$ (β_y^h) | Differential response to $\hat{y}$ (γ_y^h) | Response to $Hawk_t^{\mathcal{F}}$ (δ^h)



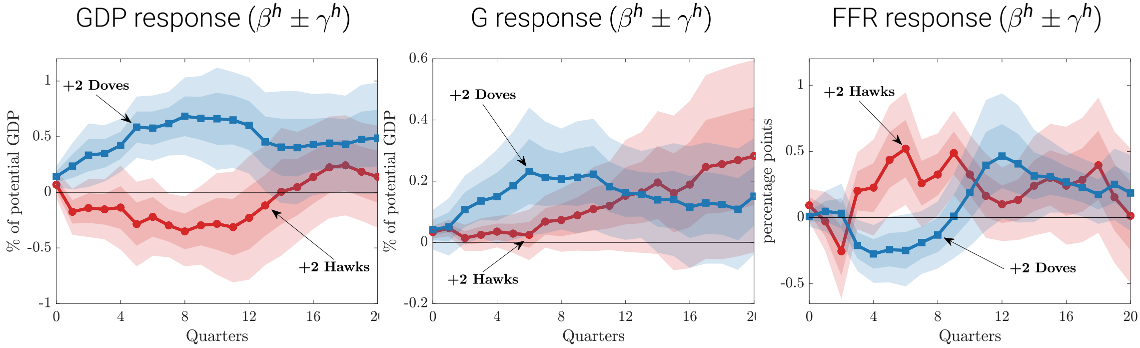
IV estimates based on $Hawk_t^{\mathcal{R}}$. Shaded areas indicate 68% and 95% confidence bands using HAC standard errors.

Back

Validation 2 (Hack/Istrefi/Meier 23)

Do Hawks/Doves shape the propagation of spending shocks (ε_t^s)?

$$x_{t+h} = \alpha^h + \beta^h \varepsilon_t^s + \gamma^h \varepsilon_t^s (Hawk_t^{\mathcal{F}} - \overline{Hawk}^{\mathcal{F}}) + \delta^h (Hawk_t^{\mathcal{F}} - \overline{Hawk}^{\mathcal{F}}) + \zeta^h Z_{t-1} + v_{t+h}^h$$



IV estimates based on $Hawk_t^{\mathcal{R}}$. Shaded areas indicate 68% and 95% confidence bands using HAC standard errors.

Decomposing the RR shock

- Rewrite the shock regression

$$\overbrace{i_\tau - \hat{\beta}_0 - \hat{\beta}_1' x_\tau - \hat{\beta}_2' x_{\tau-1}}^{\hat{e}_\tau^{rr*} \text{ (RR shock*)}}$$
$$= \underbrace{\hat{\beta}_3'\, x_{\tau-1} Hawk^{\mathcal{R}}_{\tau-1} + \hat{\beta}_4'\, x_{\tau-1} \Delta Hawk^{\mathcal{R}}_{\tau-1} + \hat{\beta}_5'\, Hawk^{\mathcal{R}}_{\tau-1} + \hat{\beta}_6'\, \Delta Hawk^{\mathcal{R}}_{\tau-1}}_{\hat{s}_\tau \text{ (systematic MP } \tilde{\phi}_t' x_t)} + \underbrace{\hat{e}_\tau^{new}}_{\text{(new shock)}}$$

- Decompose estimated impulse responses to RR shock* (for some outcome z_{t+h})

$$IRF(\hat{e}_t^{rr*}) = \omega^s IRF(\hat{s}_t) + \omega^{new} IRF(\hat{e}_t^{new})$$

$$\omega^s = \frac{\sum_t (\hat{s}_t)^2}{\sum_t (\hat{e}_t^{rr*})^2}, \qquad \omega^\phi = \frac{\sum_t (\hat{e}_t^{new})^2}{\sum_t (\hat{e}_t^{rr*})^2}$$

Interpretation

- Consider stylized NK model with $\boldsymbol{z}_t = \boldsymbol{x}_t = \pi_t$ and exogenous $\tilde{\phi}_t$

$$\begin{aligned}
\pi_t =& \beta \mathbb{E}_t[\pi_{t+1}] + \kappa y_t - w_t^a \\
y_t =& \mathbb{E}_t[y_{t+1}] - \left(i_t - \mathbb{E}_t[\pi_{t+1}]\right) \\
i_t =& (\phi + \tilde{\phi}_t)\pi_t + w_t^m \\
& w_t^a, w_t^m, \tilde{\phi}_t \ \ \textit{iid} \text{ and mutually independent}
\end{aligned}$$

$$\pi_t = \alpha + \underbrace{\delta^m}_{\delta_z^0} w_t^m + \underbrace{\delta^a w_t^a + \gamma^m \left(w_t^m \tilde{\phi}_t - \mathbb{E}[w_t^m \tilde{\phi}_t]\right) + \gamma^a \left(w_t^a \tilde{\phi}_t - \mathbb{E}[w_t^a \tilde{\phi}_t]\right) + \delta^\phi \tilde{\phi}_t}_{\tilde{v}_{z,t}^0}$$

- IRF bias under (optimistic) assumption $\hat{b} = \phi$

$$\textit{bias} = \mathbb{E}\left[(\hat{e}_t^m)^2\right]^{-1} \left(-\delta_z^0 \mathbb{E}\left[\tilde{\phi}_t' x_t w_t^m\right] + \mathbb{E}\left[\tilde{\phi}_t' x_t \tilde{v}_{z,t}^0\right] - \delta_z^0 \mathbb{E}\left[(\tilde{\phi}_t' x_t - \mathbb{E}[\tilde{\phi}_t' x_t])^2\right]\right)$$

Interpretation

- Through the lens of the NK model

$$\mathbb{E}[\tilde{\phi}_t' x_t w_t^m] = \gamma^m \mathbb{E}[(w_t^m)^2]\mathbb{E}[(\tilde{\phi}_t)^2]$$
$$\mathbb{E}[\tilde{\phi}_t' x_t \tilde{v}_{z,t}^0] = 2\delta^m \gamma^m \mathbb{E}[(w_t^m)^2]\mathbb{E}[(\tilde{\phi}_t)^2] + 2\delta^a \gamma^a \mathbb{E}[(w_t^a)^2]\mathbb{E}[(\tilde{\phi}_t)^2]$$

- Bias reflects the shock propagation through $\tilde{\phi}_t$

Impulse responses

Goal: identify causal effect of $\boldsymbol{i_t}$ ($\rightarrow w_t^m$) on some outcome $\boldsymbol{z_{t+h}}$

General DGP for z_t

$$z_{t+h} = \gamma_z^h + \delta_z^h \, w_t^m + \tilde{v}_{z,t+h}^h$$

Causal effect of $\boldsymbol{w_t^m}$ on $\boldsymbol{z_{t+h}}$ given by δ_z^h

Assumption: $E[\tilde{v}_{z,t+h}^h] = \mathbb{E}[w_t^m \tilde{v}_{z,t+h}^h] = 0$

DGP nests NK model with time-varying $\tilde{\phi}_t$

Local projection

$$z_{t+h} = c_z^h + d_z^h \, \hat{e}_t^m + u_{z,t+h}^h$$

Can we recover the causal effect: $\hat{d}_z^h \xrightarrow{p} \delta_z^h$

?

Proposition 2 (IRF bias)

As $T \to \infty$, the OLS estimate $\hat{d}_z^h$ of the local projection satisfies

$$\hat{d}_z^h \xrightarrow{p} \delta_z^h + \left(\vartheta_z^{\hat{b}} + \vartheta_z^{\tilde{\phi}} + \vartheta_z^a\right)$$

where the three bias terms are given by

$$\begin{aligned}
\vartheta_z^{\hat{b}} &= \mathbb{E}\left[(\hat{e}_t^m)^2\right]^{-1} (\phi - \hat{b})' \left(\delta_z^h \mathbb{E}\left[x_t w_t^m\right] + \mathbb{E}\left[x_t \tilde{v}_{z,t+h}^h\right]\right), \\
\vartheta_z^{\tilde{\phi}} &= \mathbb{E}\left[(\hat{e}_t^m)^2\right]^{-1} \left(\delta_z^h \mathbb{E}\left[\tilde{\phi}_t' x_t w_t^m\right] + \mathbb{E}\left[\tilde{\phi}_t' x_t \tilde{v}_{z,t+h}^h\right]\right), \\
\vartheta_z^a &= \mathbb{E}\left[(\hat{e}_t^m)^2\right]^{-1} \delta_z^h \left(\mathbb{E}\left[(w_t^m)^2\right] - \mathbb{E}\left[(\hat{e}_t^m)^2\right]\right).
\end{aligned}$$

- $\vartheta_z^{\hat{b}}$ captures wedge between $\hat{b}$ and ϕ
- $\vartheta_z^{\tilde{\phi}}$ captures endogeneity bias due to $\tilde{\phi}_t$
- ϑ_z^a captures attenuation bias

(In)sufficient conditions for no bias

- IRF bias under (optimistic) assumption $\hat{b} = \phi$

$$bias = \mathbb{E}\left[(\hat{e}_t^m)^2\right]^{-1}\left(-\delta_z^h \mathbb{E}\left[\tilde{\phi}_t' x_t w_t^m\right] + \mathbb{E}\left[\tilde{\phi}_t' x_t \tilde{v}_{z,t+h}^h\right] - \delta_z^h \mathbb{E}\left[(\tilde{\phi}_t' x_t - \mathbb{E}[\tilde{\phi}_t' x_t])^2\right]\right)$$

- Insufficient conditions for $bias = 0$
  - $\tilde{\phi}_t$ has no impact on x_t and z_t ($\gamma = \delta = 0$) $\rightarrow$ attenuation bias remains
  - Exogeneity (or predeterminedness) of x_t
  - Exogeneity (or predeterminedness) of $\tilde{\phi}_t$
- Sufficient conditions for $bias = 0$ (assuming $\hat{b} = \phi$)
  - Exogeneity of $\tilde{\phi}_t' x_t$ (orthogonal to w_t^a, w_t^m) $\rightarrow$ fully exogenous MP
  - Time-invariant systematic MP $\tilde{\phi}_t = 0$
  - Time-invariant $x_t = 0$ $\rightarrow$ fully exogenous MP
  - Knife-edge parametric assumptions

Examples of Hawk/Dove perceptions and categorization

Hawk:

"[Volcker] leans toward tight-money policies and high interest rates to retard inflation"

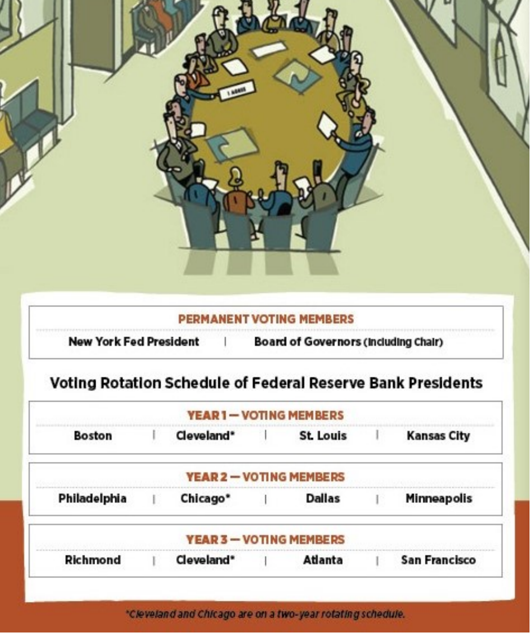
New York Times, 2 May 1975

Dove:

"Bernanke is widely seen as a deflation fighter and not an inflation warrior. So for better or worse he is perceived as more dovish than Greenspan."

Dow Jones Capital Markets Report, 19 October 2005

Back



Federal Open Market Committee (FOMC)

- 12 FOMC members decide Fed's monetary policy
  Board of Governors: 7, FRB presidents: 5
- Members/policy preferences change
  induces time-variation in who decides MP
- Voting rights rotate mechanically for FRB presidents
  induces plausibly exogenous variation

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FOMC Statistics

Group	Fed chair	Board of Governors	FRB presidents
Number of members	1	6	5
Appointment procedure	Congress / POTUS		Regional FRB Board of Directors[1]
Legal term length	4y	14y	5y
Average term length	10y	7y	11y[2]

[1] Details depend on regional FRB and time (if the laws change). E.g. the NY president used to be selected by the Board of Directors (BoD) but since 2010 only by a subset of the BoD.

[2] The average term length of the NY Fed president is 9 years.

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	Interactions			Levels		
Sample	69-07	69-96	83-07	69-07	69-96	83-07
	(a) $Hawk^{\mathcal{R}}_{\tau-1} \times x_{\tau-1}$			(b) $Hawk^{\mathcal{R}}_{\tau-1}$ & $\Delta Hawk^{\mathcal{R}}_{\tau-1}$		
R^2	0.112	0.138	0.117	0.006	0.010	0.002
p-value	0.087	0.058	0.034	0.370	0.330	0.826
	(c) $\Delta Hawk^{\mathcal{R}}_{\tau-1} \times x_{\tau-1}$			(d) $x_{\tau-1}$		
R^2	0.248	0.289	0.065	0.090	0.133	0.255
p-value	0.000	0.000	0.000	0.031	0.005	0.000
	(e) All interactions			(f) All level terms		
R^2	0.341	0.399	0.193	0.096	0.151	0.255
p-value	0.000	0.000	0.000	0.039	0.001	0.000
T	350	262	200	350	262	200

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	(1)	(2)	(3)	(4)	(5)
$\Delta Hawk^{\mathcal{R}}_{\tau-1} \times y_{\tau-1,2}$	-0.195	-0.148	-0.138	-0.107	-0.082
	(0.300)	(0.368)	(0.346)	(0.301)	(0.367)
$\Delta Hawk^{\mathcal{R}}_{\tau-1} \times \Delta\pi_{\tau-1,-1}$		0.149	0.111	0.233	0.224
		(0.137)	(0.244)	(0.047)	(0.054)
$\Delta Hawk^{\mathcal{R}}_{\tau-1} \times \pi_{\tau-1,1}$			0.133	0.076	-0.226
			(0.262)	(0.338)	(0.400)
$\Delta Hawk^{\mathcal{R}}_{\tau-1} \times \Delta\pi_{\tau-1,1}$				0.222	0.273
				(0.032)	(0.026)
$\Delta Hawk^{\mathcal{R}}_{\tau-1} \times \pi_{\tau-1,2}$					0.325
					(0.267)
Constant	0.007	0.002	0.003	0.007	0.006
	(0.713)	(0.917)	(0.864)	(0.678)	(0.715)
T	350	350	350	350	350
R^2	0.046	0.067	0.086	0.145	0.154

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Aruoba/Drechsel (24) shock

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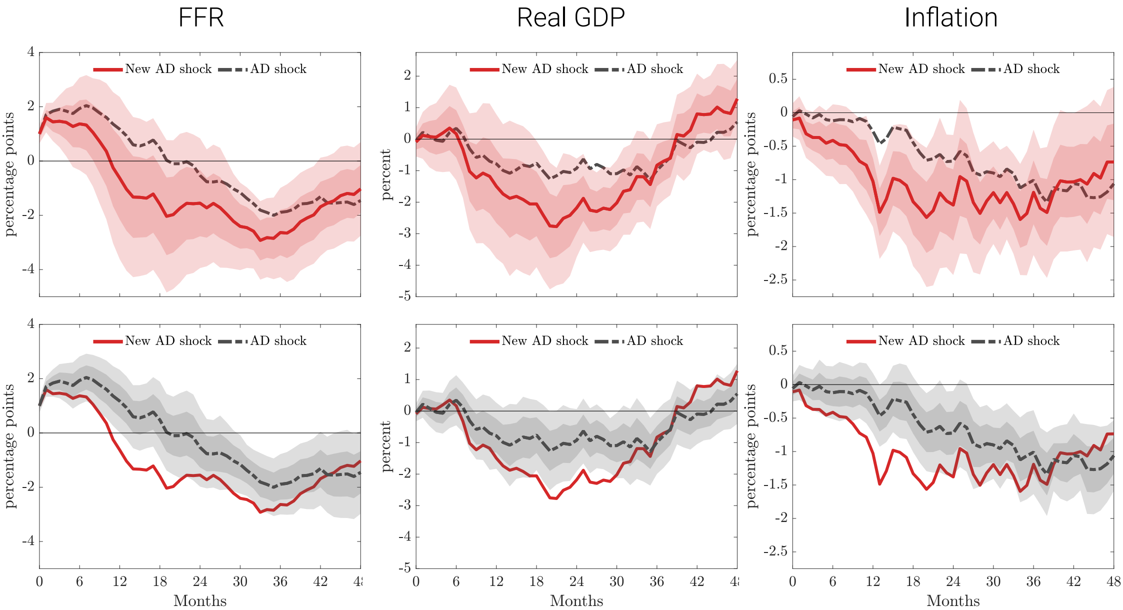
Table: Explaining AD shocks by systematic monetary policy

	$Hawk_\tau^{\mathcal{F}}$		$Hawk_\tau^{\mathcal{R}}$	
Sample	83-07	83-96	83-07	83-96
(a) Contemp. FOMC meeting (p=0)				
R^2	0.315	0.649	0.328	0.616
p-value	0.000	0.000	0.000	0.000
T	192	104	192	104
(b) One FOMC meeting lag (p=1)				
R^2	0.291	0.600	0.263	0.629
p-value	0.000	0.000	0.000	0.000
T	192	104	192	104
(c) Two FOMC meetings lag (p=2)				
R^2	0.330	0.515	0.362	0.668
p-value	0.000	0.000	0.000	0.000
T	192	104	192	104

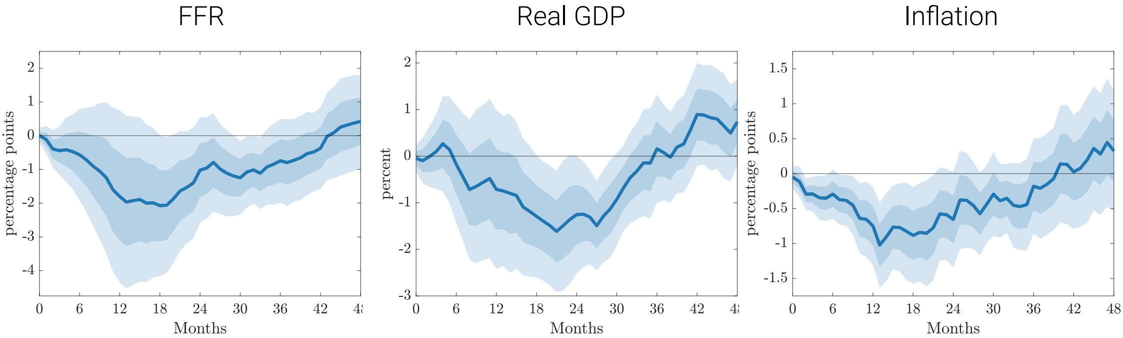
Aruoba/Drechsel (24) shock

back



Aruoba/Drechsel (24) shock: new AD “minus” AD shock

back



Additional outcomes

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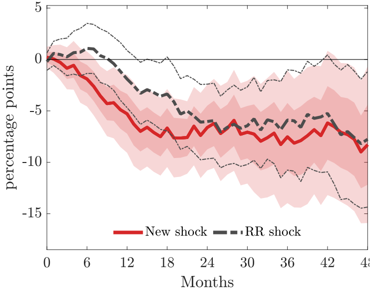
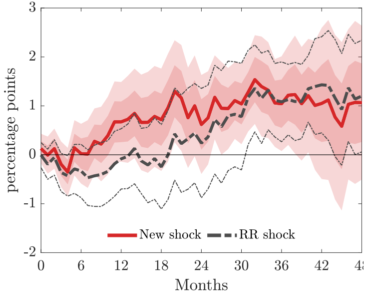
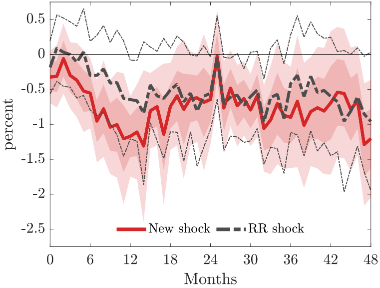
Capacity utilization



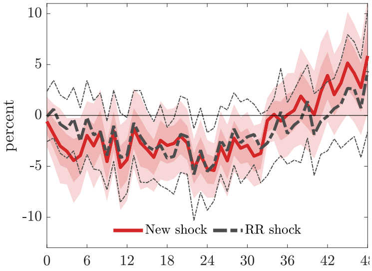
Unemployment rate



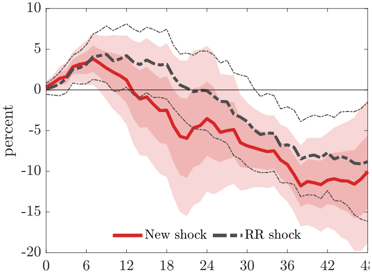
Manuf. hours



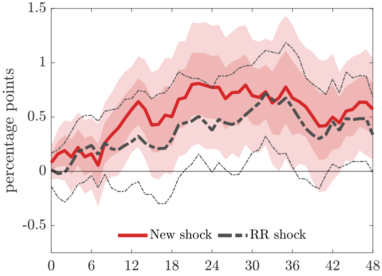
Consumption



Inventories



Credit spread



Additional outcomes: new “minus” RR shock

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Control for 12 lags of S&P 500 and EBP

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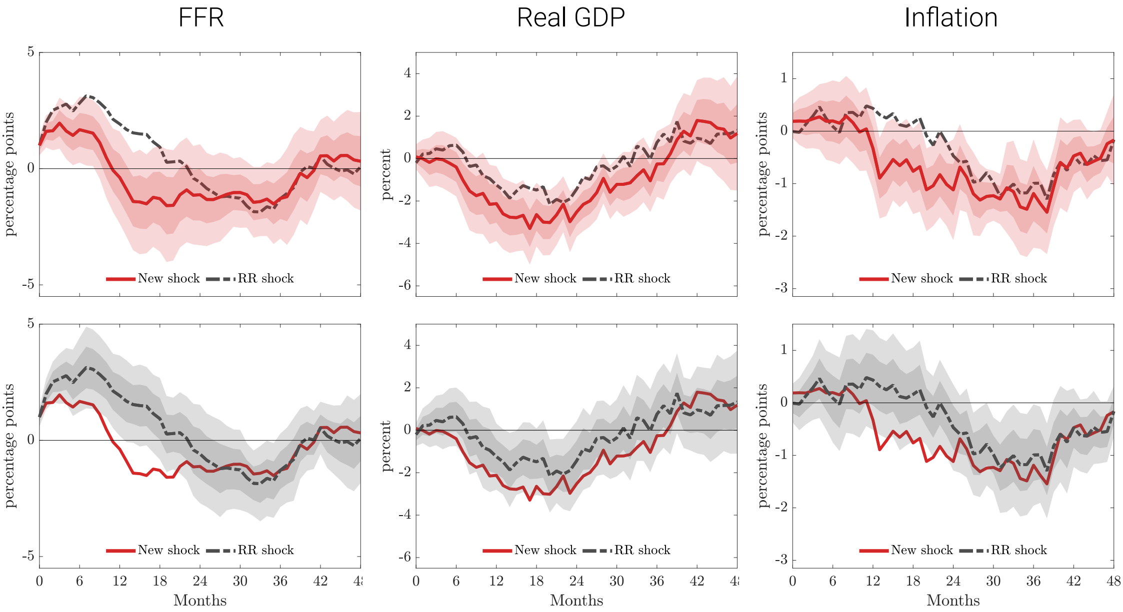
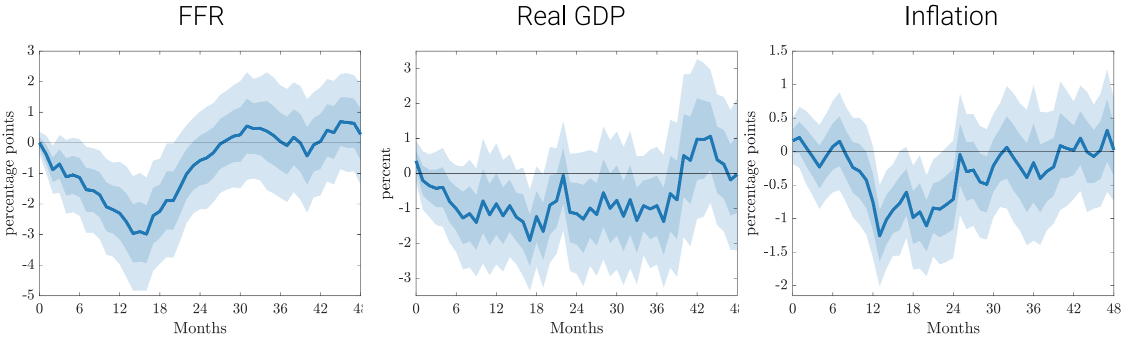
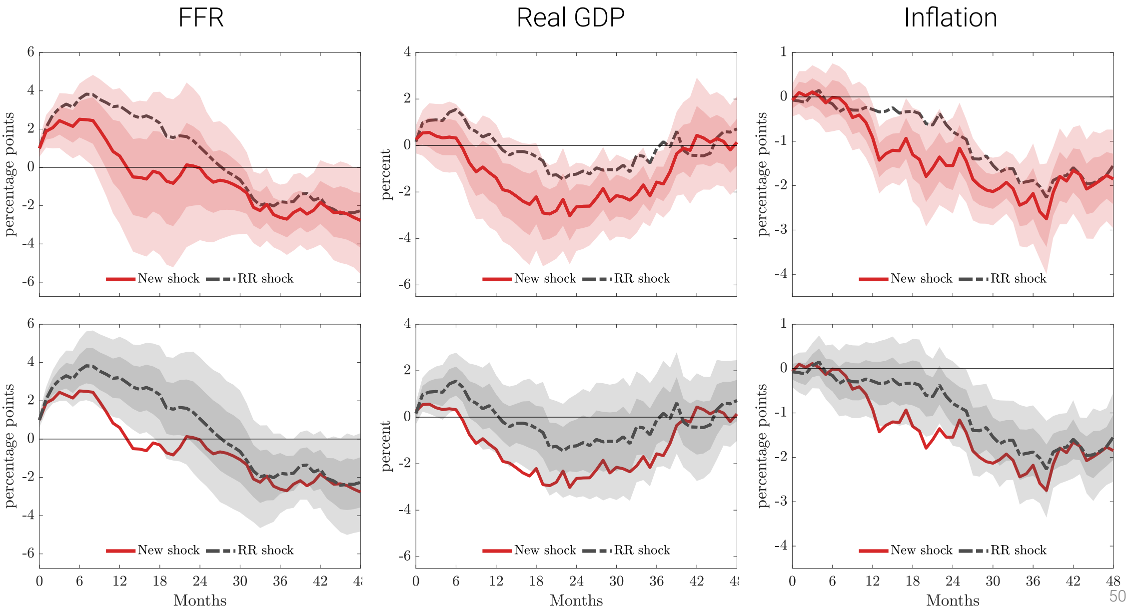


Control for 12 lags of S&P 500 and EBP : new “minus” RR shock

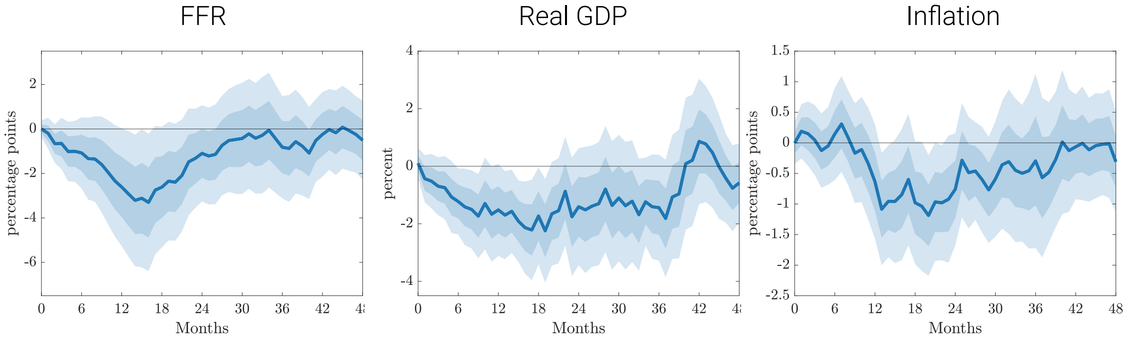
back



Control for 12 lags of shock under consideration

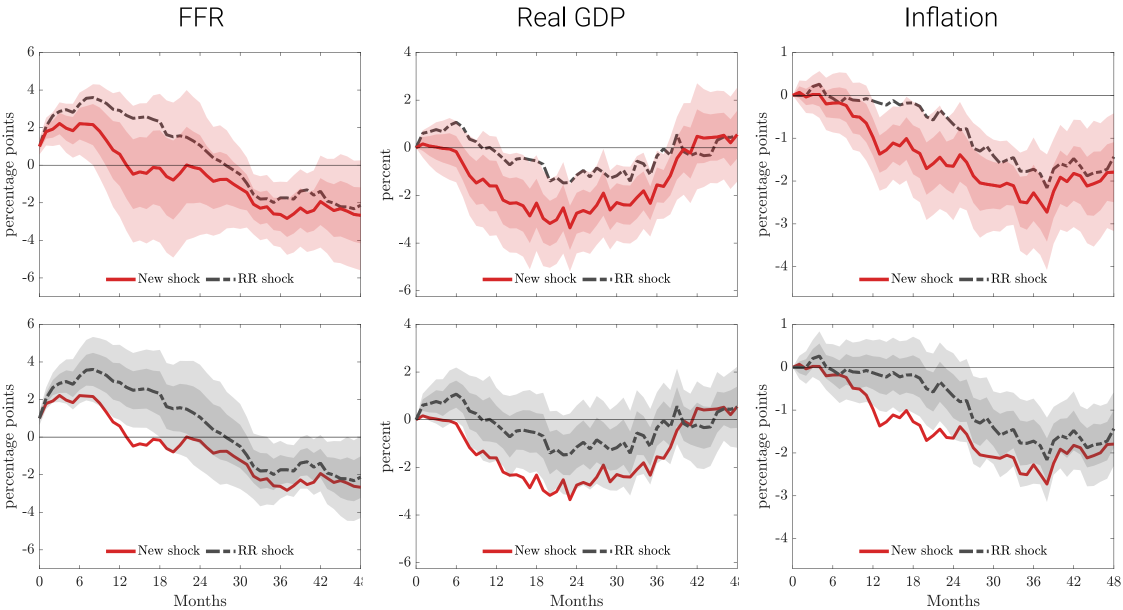


Control for 12 lags of shock under consideration: new “minus” RR shock back



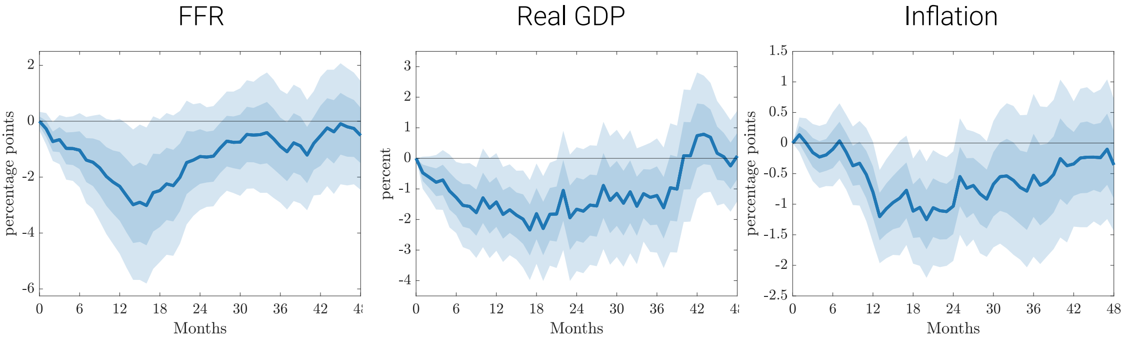
Recursiveness assumption

back



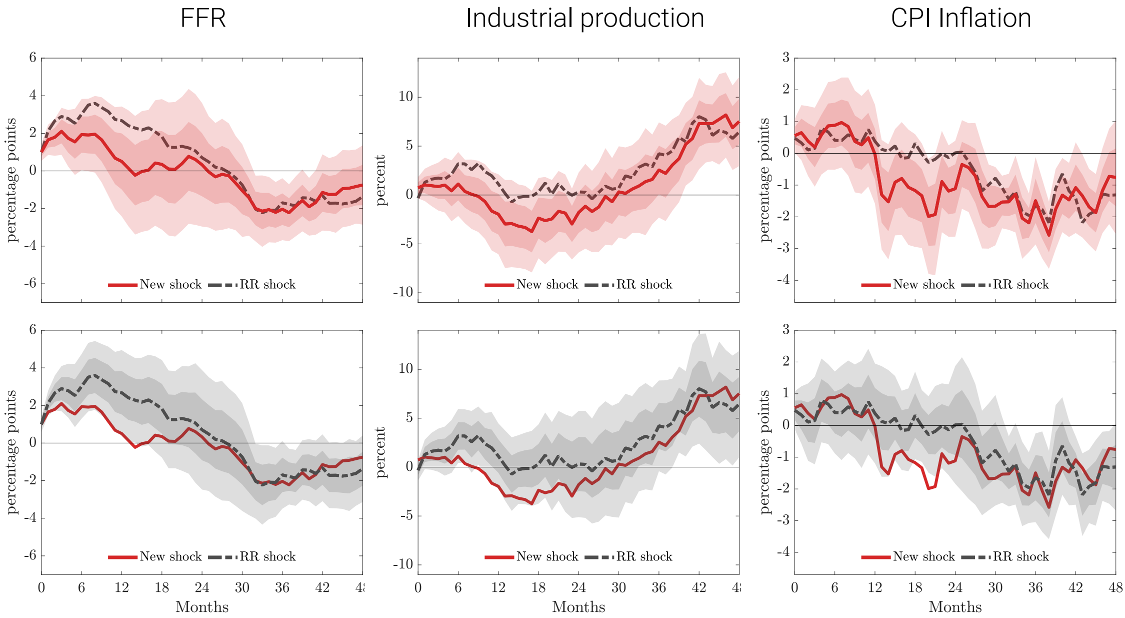
Recursivness assumption: new “minus” RR shock

back



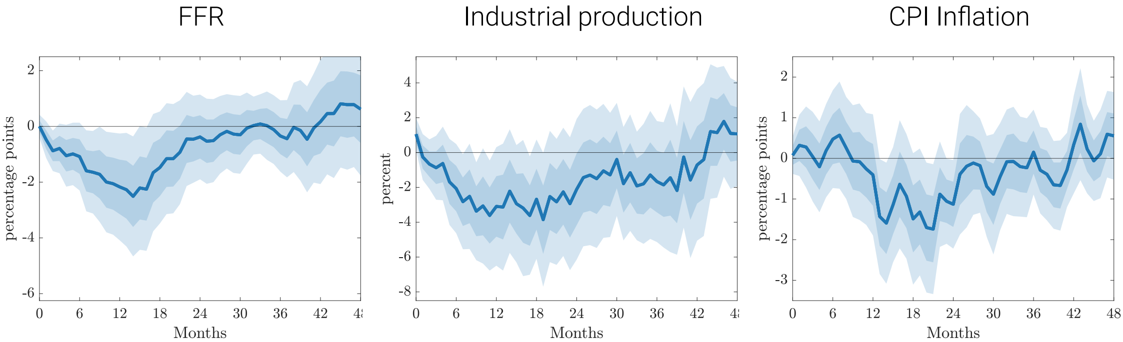
Alternative outcomes

back



Alternative outcomes: new “minus” RR shock

back



Alternative outcomes and 12 lags of S&P 500 and EBP

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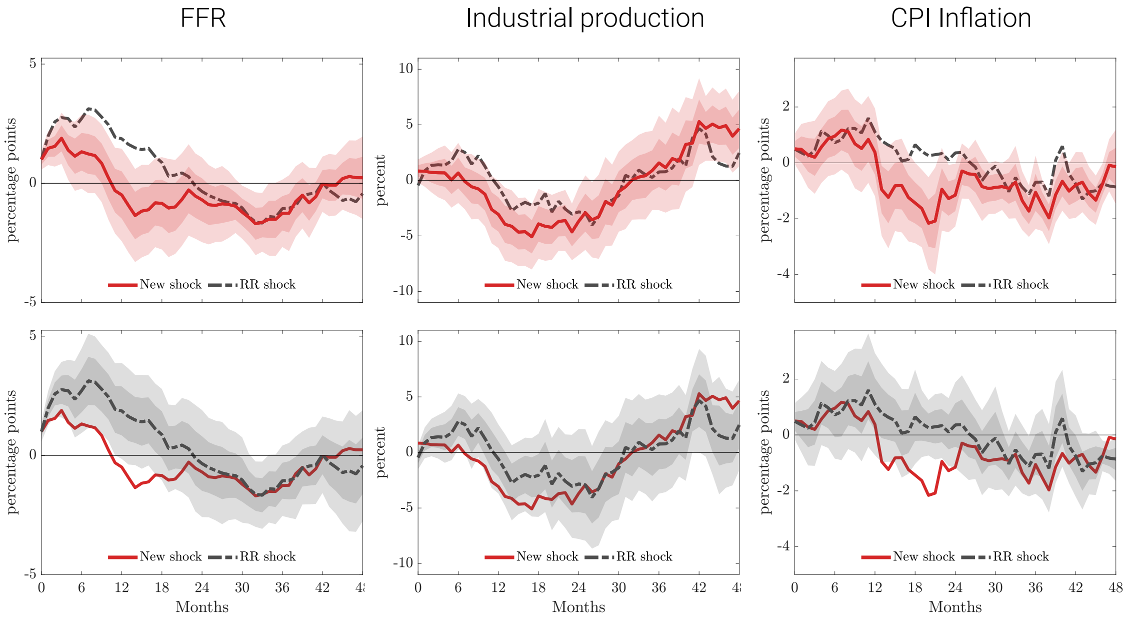

Alternative outcomes and 12 lags of S&P 500 and EBP: new "minus" RR shock

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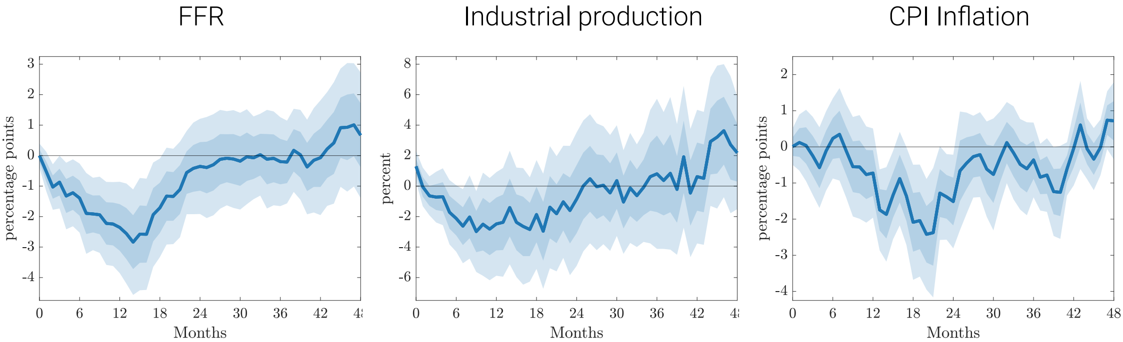
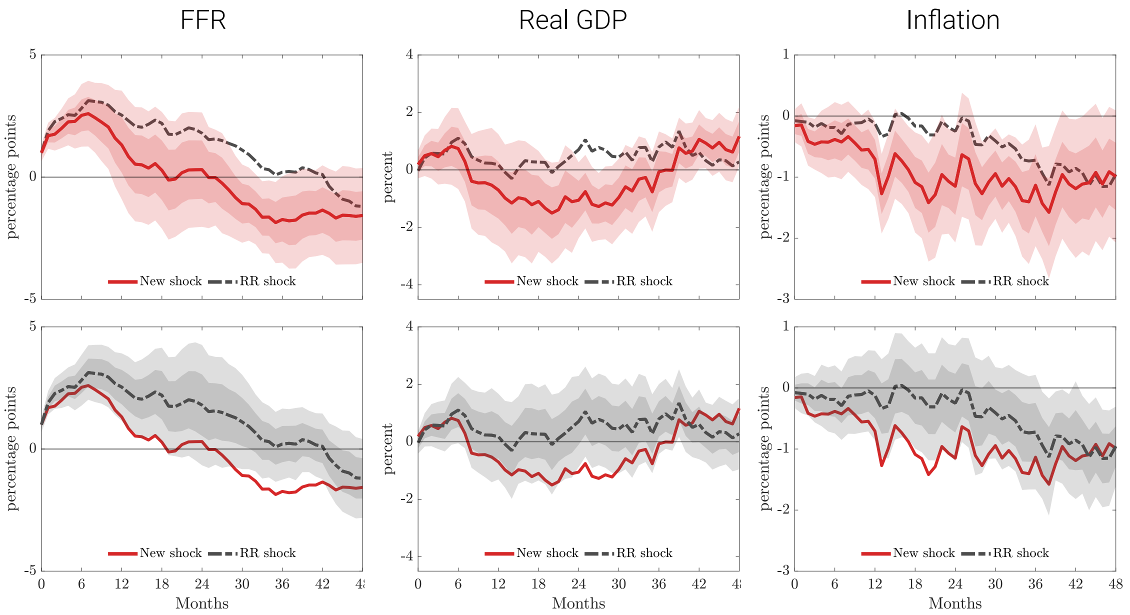


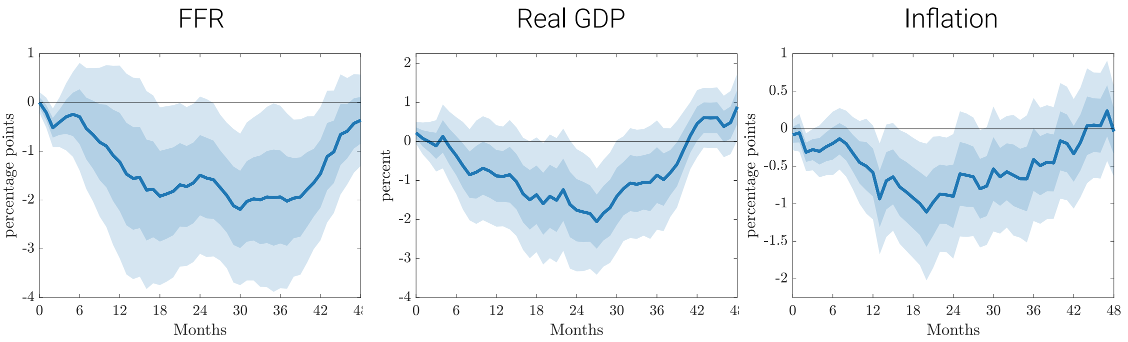
Estimate shocks for 1983–2007

back



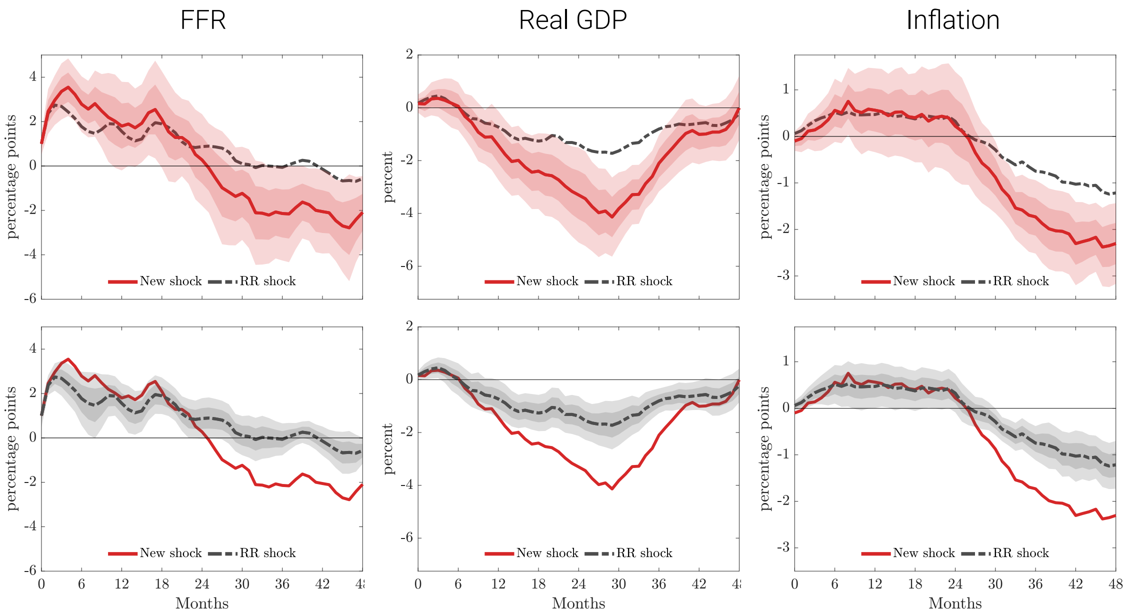
Estimate shocks for 1983–2007: new "minus" RR shock

back



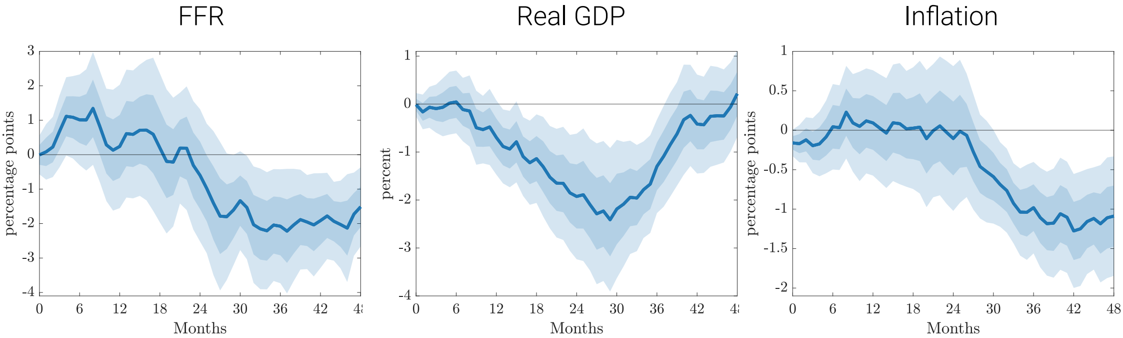
Estimate responses for 1969–2007

back

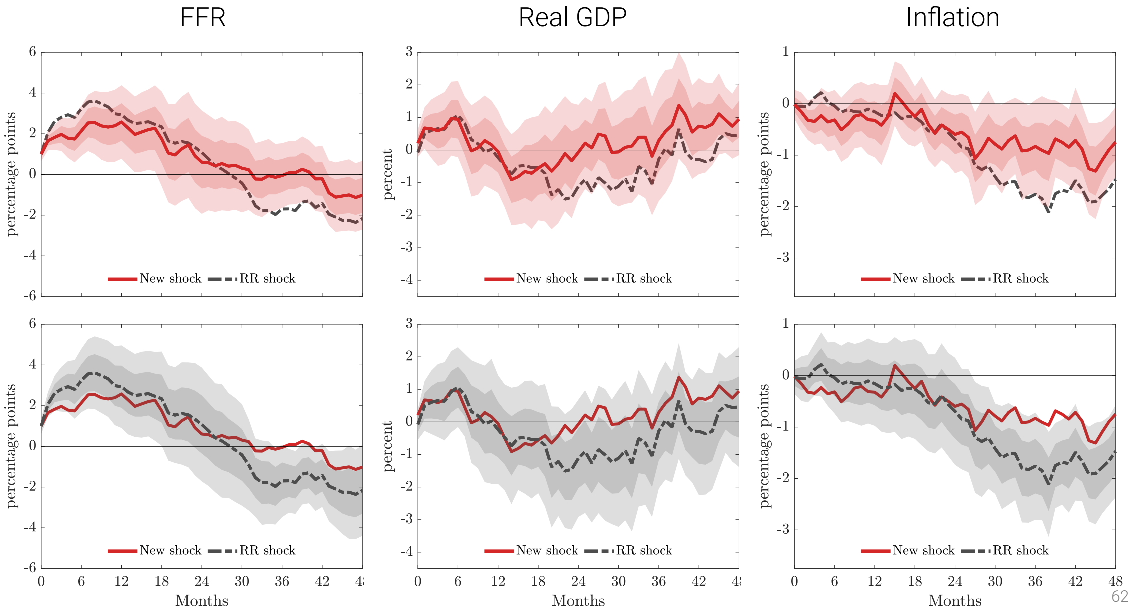


Estimate responses for 1969–2007: new “minus” RR shock

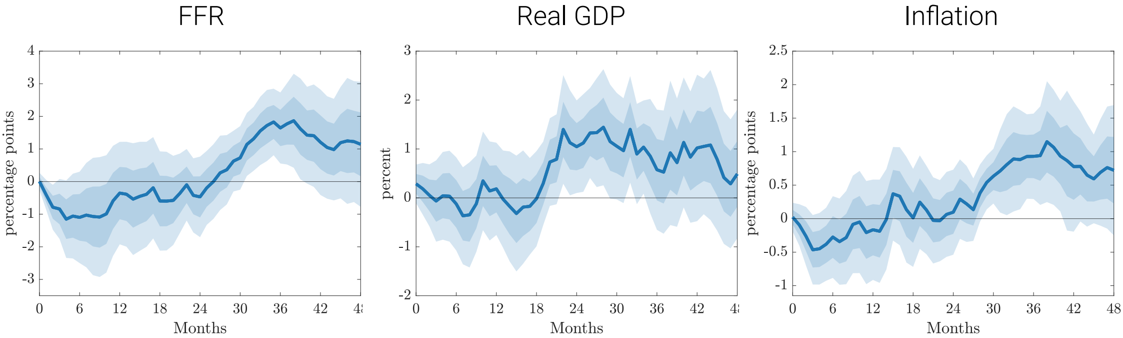
back



Placebo: new shock with only ($x_{\mathcal{T}}$, $x_{\mathcal{T}-1}$) as regressors

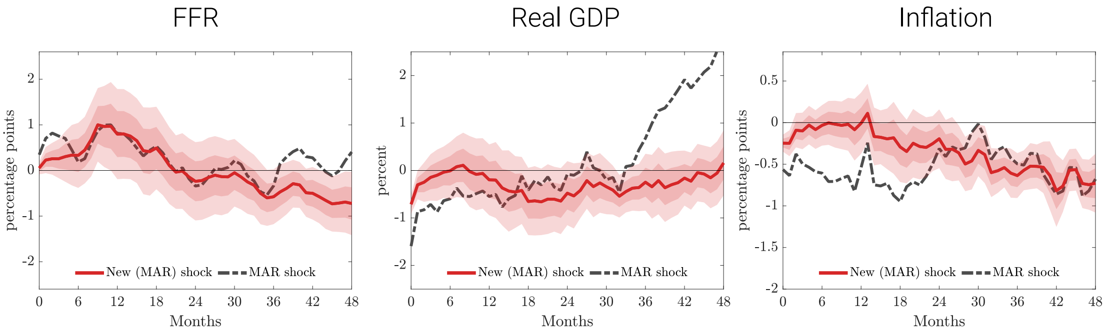


Placebo: new shock with only $(\boldsymbol{x}_\tau,\ \boldsymbol{x}_{\tau-1})$ as regressors: new "minus" RR shock back



MAR shocks

back



Shaded areas indicate 68% and 95% confidence bands using HAC standard errors.