The Systematic Component of Monetary Policy in SVARs: An Agnostic Identification Procedure*

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*The views expressed here are the authors' and not necessarily those of the Federal Reserve Bank of Atlanta or the Board of Governors of the Federal Reserve System.

Introduction

- Consensus view:
  - Contractionary monetary policy shocks negatively affect output
- Consensus based on SVAR analysis:
  - **Bernanke and Blinder (1992)**, **CEE (1996)**, **Leeper, Sims and Zha (1996)**, **Bernanke and Mihov (1998)**, ...
- Cornerstone behind New Keynesian DSGE models
- DSGE models estimated by matching IRFs to a MP Shock:
  - **Rotemberg and Woodford (1997)**
  - **Christiano, Eichenbaum and Evans (2005)**
  - **Altig, Christiano, Eichenbaum and Linde (2011)**
  - **Christiano, Eichenbaum and Trabandt (2015)**

Uhlig's (2005) Critique

- **Uhlig's (2005)** agnostic procedure challenges the consensus
- MP shock identified with sign restrictions on IRFs
- No restriction on the response of output to MP shock
- Main finding: MP Shocks do not negatively affect output!
  - "One can suspect that an important ingredient has so far been left out in my agnostic identification approach"
    – **Uhlig (2005)**

The Systematic Component of MP

- We follow the tradition in *What Does Monetary Policy Do?*
  - "Even the harsher critics of monetary authorities would not maintain that policy decisions are unrelated to the economy" – **Leeper, Sims, and Zha (1996)**
- We discipline the systematic component of MP:
  - Identification based on sign and zero restrictions
  - No restriction on the response of output to MP shock
- Our results:
  - Output drops following a contractionary MP shock
  - Robust across different MP specifications

Reduced Form VAR Estimation Details

- Consider a six-variables and twelve lags at monthly frequency
  1. Real GDP (y_t)
  2. GDP deflator (p_t)
  3. Commodity price index ($p_{c,t}$)
  4. Total reserves (tr_t)
  5. Nonborrowed reserves (nbr_t)
  6. Federal funds rate (r_t)
- Sample period: January 1965-December 2003
- Bayesian + Normal-Inverse Wishart prior as **Uhlig (2005)**

Identification: The Monetary Policy Equation

- Specifying a MP shock is equivalent to specifying MP equation

$$\mathsf{r}_t = \psi_{\mathsf{y}}\mathsf{y}_t + \psi_{\mathsf{p}}\mathsf{p}_t + \psi_{\mathsf{p}_c}\mathsf{p}_{c,t} + \psi_{\mathsf{nbr}}\mathsf{nbr}_t + \psi_{\mathsf{tr}}\mathsf{tr}_t + \sigma\varepsilon_{\mathsf{MP},t}$$

- FFR is the policy instrument: $\psi_{\mathsf{nbr}} = \psi_{\mathsf{tr}} = 0$

$$\mathsf{r}_t = \psi_{\mathsf{y}}\mathsf{y}_t + \psi_{\mathsf{p}}\mathsf{p}_t + \psi_{\mathsf{p}_c}\mathsf{p}_{c,t} + \sigma\varepsilon_{\mathsf{MP},t}$$

- FFR reacts to output: $\psi_{\mathsf{y}} > 0$
- FFR reacts to domestic prices: $\psi_{\mathsf{p}} > 0$
- Normalization of the MP equation: $\sigma > 0$

Baseline Identification

Restrictions

Monetary Policy Instrument:

The federal funds rate is the monetary policy instrument and it only reacts contemporaneously to output and prices (i.e. $\psi_{tr} = \psi_{nbr} = 0$*)*

Systematic Monetary Policy:

The contemporaneous reaction of the federal funds rate to output and the GDP deflator is positive (i.e. $\psi_y, \psi_p > 0$ *while* ψ_{p_c} *remains unrestricted)*

Normalization:

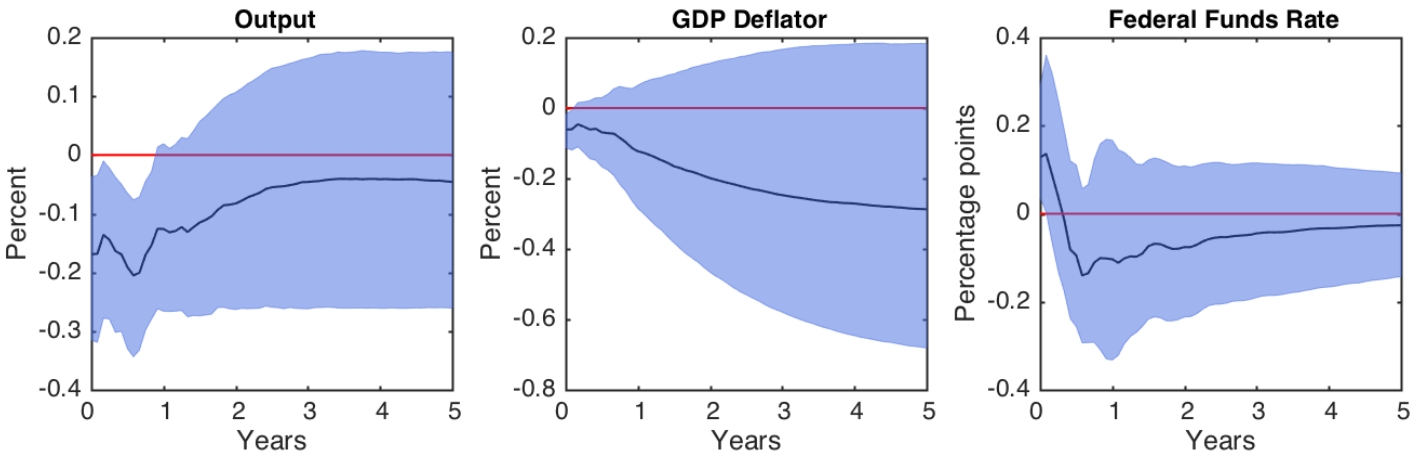
We normalize the monetary policy equation by imposing $\sigma > 0$*, and we normalize the IRFs by imposing that the federal funds rate increases on impact in response to a monetary policy shock*

The Role of the Prior

- Identification comes only from stated restrictions
  - **Arias, Rubio-Ramirez, and Waggoner (2016)**
- Agnostic procedure $\Leftrightarrow$ agnostic prior
- Not agnostic prior $\Rightarrow$ identification = prior + restrictions
- Why is this important?
  - Because the differences in results are only due to identification

Baseline Identification

IRFs to a MP Shock



Relationship with Existing Literature

- **Uhlig (2005)**. Why?
  - Neither of us restricts the response of output
  - Both of us set and partially identify the model
  - Both of us use agnostic priors
  - We obtain different IRFs for output
- **CEE (1996)**. Why?
  - Motivates our MP instrument restriction
  - Questionable exclusion restrictions

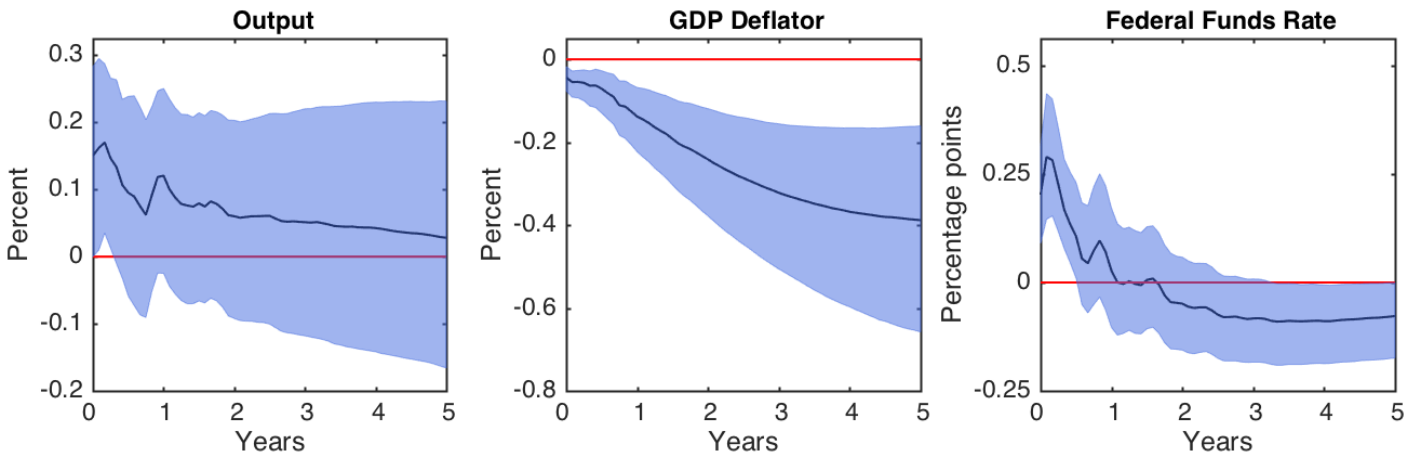
Uhlig (2005): Agnostic Identification Procedure

Uhlig's (2005) Restrictions:

A monetary policy shock leads to a negative response of the GDP deflator, commodity prices, and nonborrowed reserves, and to a positive response of the federal funds rate, all at horizons $t = 0, \ldots, 5$

Uhlig (2005)

IRFs to a MP Shock



Systematic MP in Uhlig (2005)

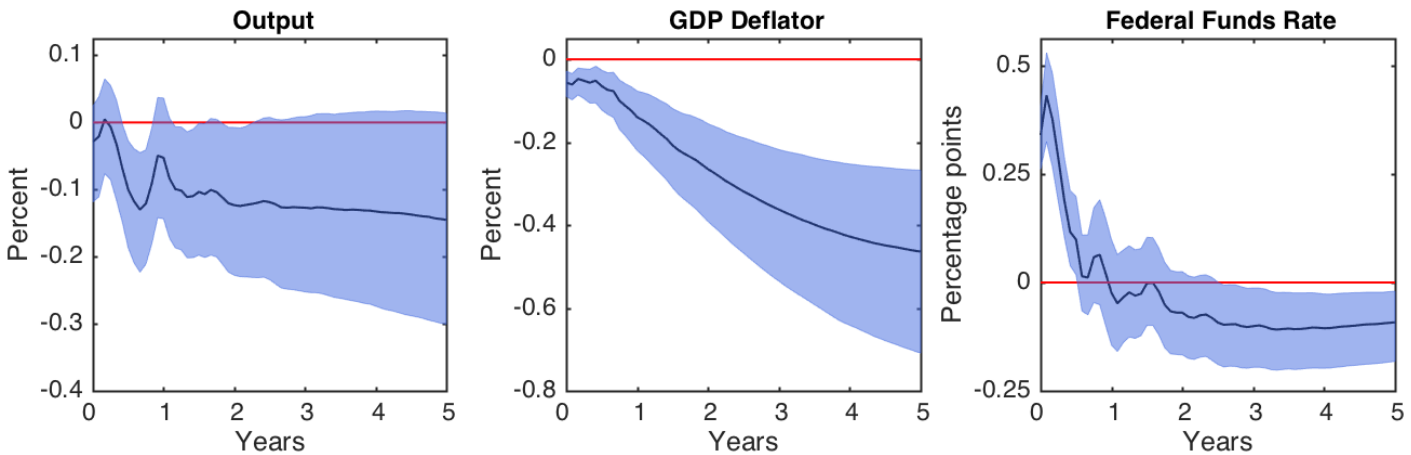
- Contemporaneous coefficients in the MP equation

	ψ_y	ψ_p	ψ_{p_c}
Uhlig's (2005) Restrictions	-0.43 $(-2.54,0.82)$	2.25 $(0.11,7.21)$	0.11 $(0.00,0.37)$
Baseline Restrictions	1.22 $(0.34,3.11)$	3.52 $(0.98,9.88)$	-0.02 $(-0.41,0.32)$

- MP instrument and systematic monetary policy are violated
- Even after imposing MP instrument
  - About 90% of draws violate systematic monetary policy

Uhlig (2005) + Baseline Identification

IRF to a MP Shock



Robustness

- Commodity Prices
  - Baseline Restrictions + $\psi_{p_c} = 0$
- Lagged Federal Funds Rate
  - Baseline Restrictions + $\psi_r > 0$
- Long-run Coefficients on Output and Prices (ℓ_y and ℓ_p)
  - Baseline Restrictions + $\ell_y > 0$ and $\ell_p > 0$
- Monetary Policy Equation in First Differences

$$r_t = \psi_y \Delta y_t + \psi_p \Delta p_t + \psi_{p_c} \Delta p_{c,t} + \psi_{tr} \Delta tr_t + \psi_{nbr} \Delta nbr_t + \sigma \varepsilon_{1,t}$$

  - Baseline Restrictions in FD

Money Rules

- Systematic components that focus on the relationship between the fed funds rate, output, and prices are not the only ones
- Focus on the relationship between interest rates and money:
  - **Leeper, Sims, and Zha (1996)**
  - **Leeper and Zha (2003)**
  - **Sims and Zha (2006)**
- In particular, we look at money rules

Identification: The Monetary Policy Equation

- Specifying a MP shock is equivalent to specifying MP equation

$$\mathsf{r}_t = \psi_{\mathsf{y}}\mathsf{y}_t + \psi_{\mathsf{p}}\mathsf{p}_t + \psi_{\mathsf{p}_c}\mathsf{p}_{c,t} + \psi_{\mathsf{m}}\mathsf{m}_t + \sigma\varepsilon_{\mathsf{MP},t}$$

- FFR is the policy instrument and only reacts contemporaneously to commodity prices and money (i.e. $\psi_{\mathsf{y}} = \psi_{\mathsf{p}} = 0$)

$$\mathsf{r}_t = \psi_{\mathsf{p}_c}\mathsf{p}_{c,t} + \psi_{\mathsf{m}}\mathsf{m}_t + \sigma\varepsilon_{\mathsf{MP},t}$$

- The contemporaneous reaction of the FFR to money is positive (i.e. $\psi_{\mathsf{m}} > 0$)

- Normalization of the MP equation: $\sigma > 0$

Alternative Identification

Restrictions

Monetary Policy Instrument:

The federal funds rate is the monetary policy instrument and it only reacts contemporaneously to commodity prices and money (i.e. $\psi_y = \psi_p = 0$*)*

Systematic Monetary Policy:

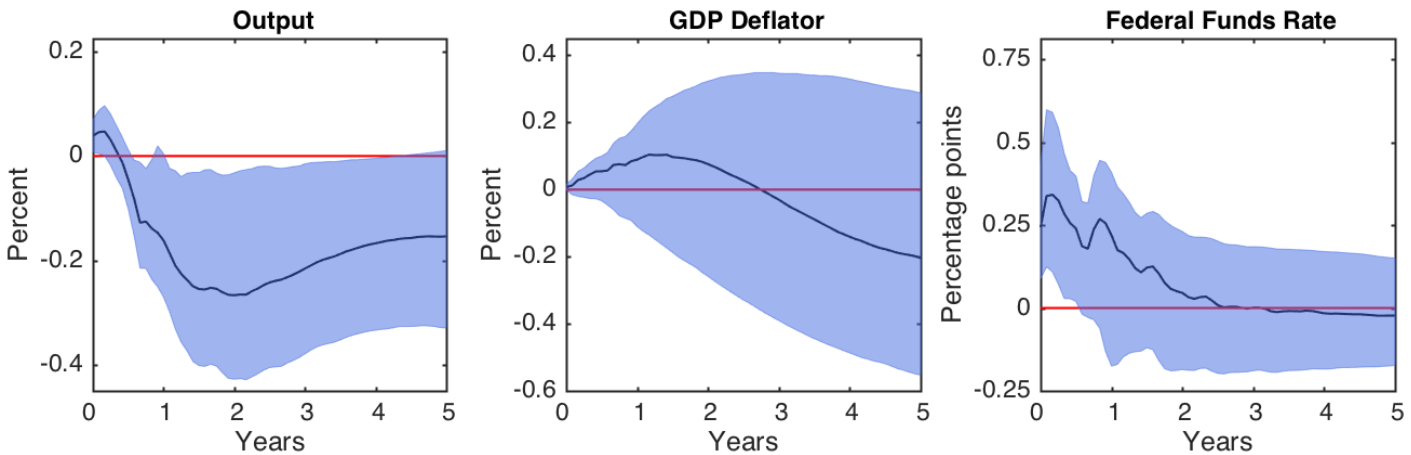
The contemporaneous reaction of the federal funds rate to money is positive. (i.e. $\psi_m > 0$*)*

Normalization:

We normalize the monetary policy equation by imposing $\sigma > 0$*, and we normalize the IRFs by imposing that the federal funds rate increases on impact in response to a monetary policy shock*

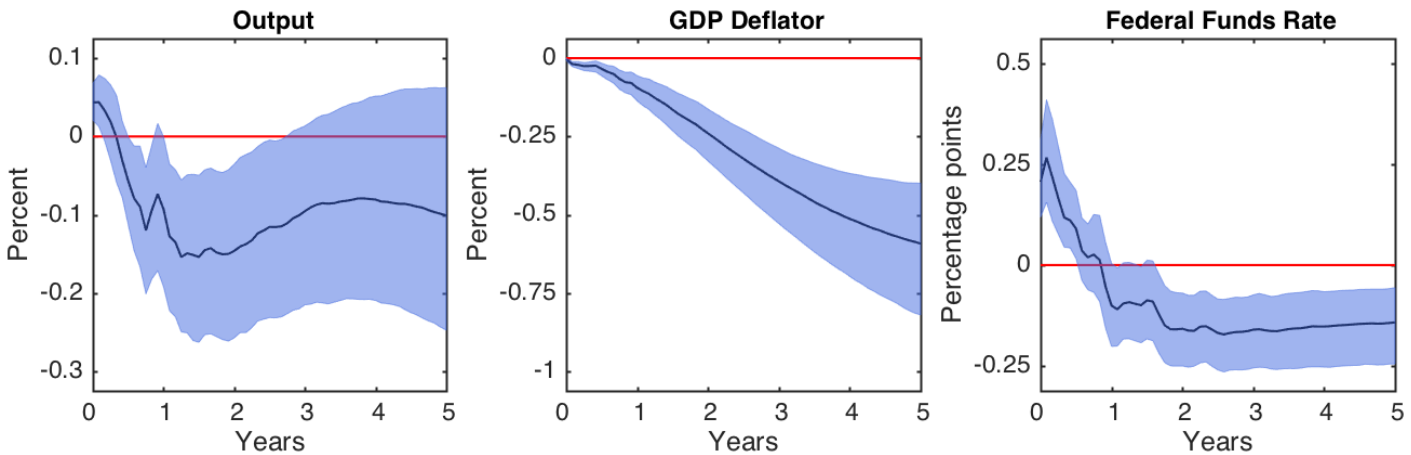
MP Instrument + Systematic MP

IRFs to a Monetary Policy Shock



Uhlig (2005) + Alternative Identification

IRFs to a Monetary Policy Shock

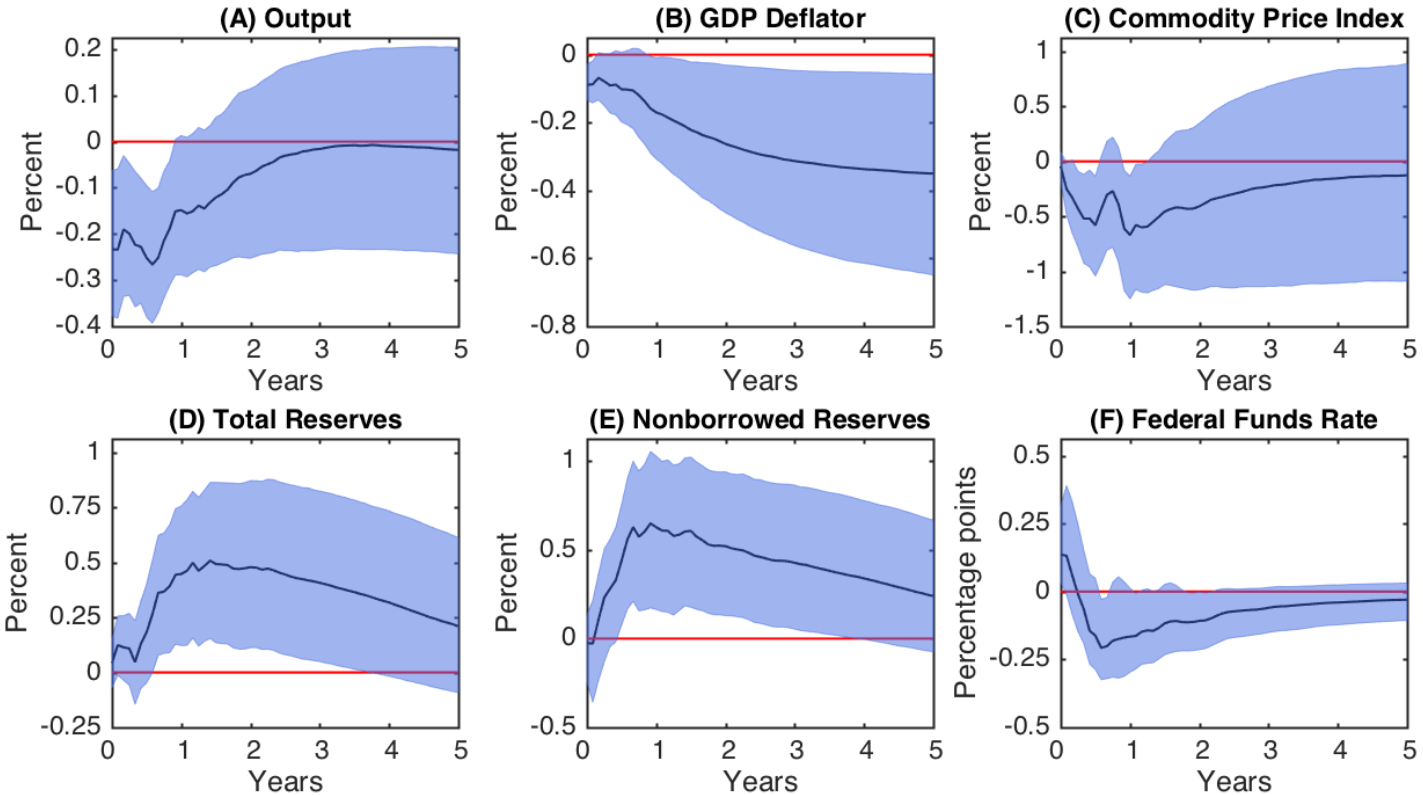


Conclusion

- The consensus was that MP shocks are contractionary
- **Uhlig (2005)** challenged this consensus
- We propose to set identify monetary policy shocks disciplining the systematic component of monetary policy
  - We find monetary policy shocks are indeed contractionary
  - Systematic component of monetary policy implied by Uhlig (2005) violates our restrictions
- Results are robust to alternative restrictions on the systematic component consistent with the literature

IRFs to a Monetary Policy Shock

Baseline Restrictions + $\psi_{p_c} = 0$



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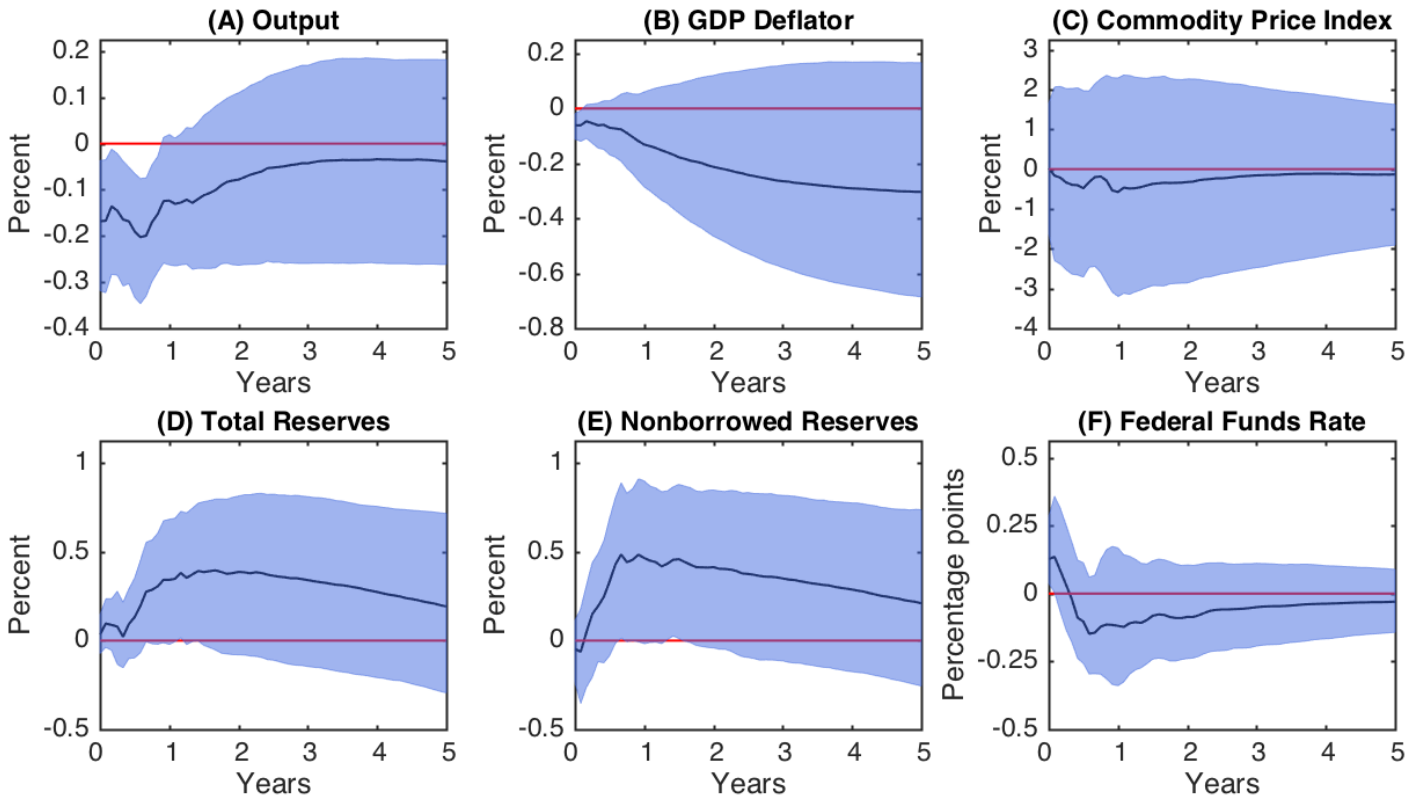
IRFs to a Monetary Policy Shock

Baseline Restrictions + $\psi_r > 0$



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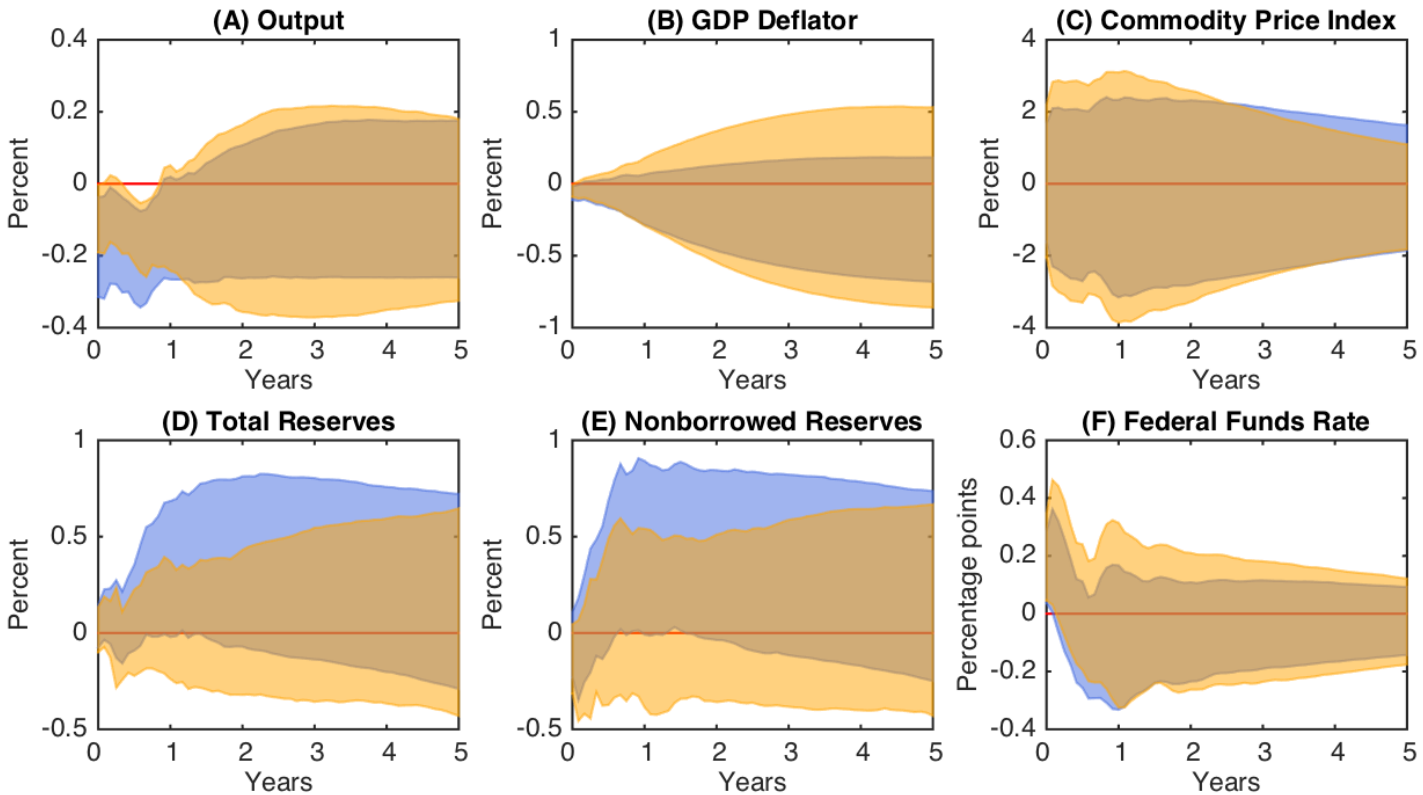
IRFs to a Monetary Policy Shock

Baseline Restrictions + $\ell_y > 0$ and $\ell_p > 0$



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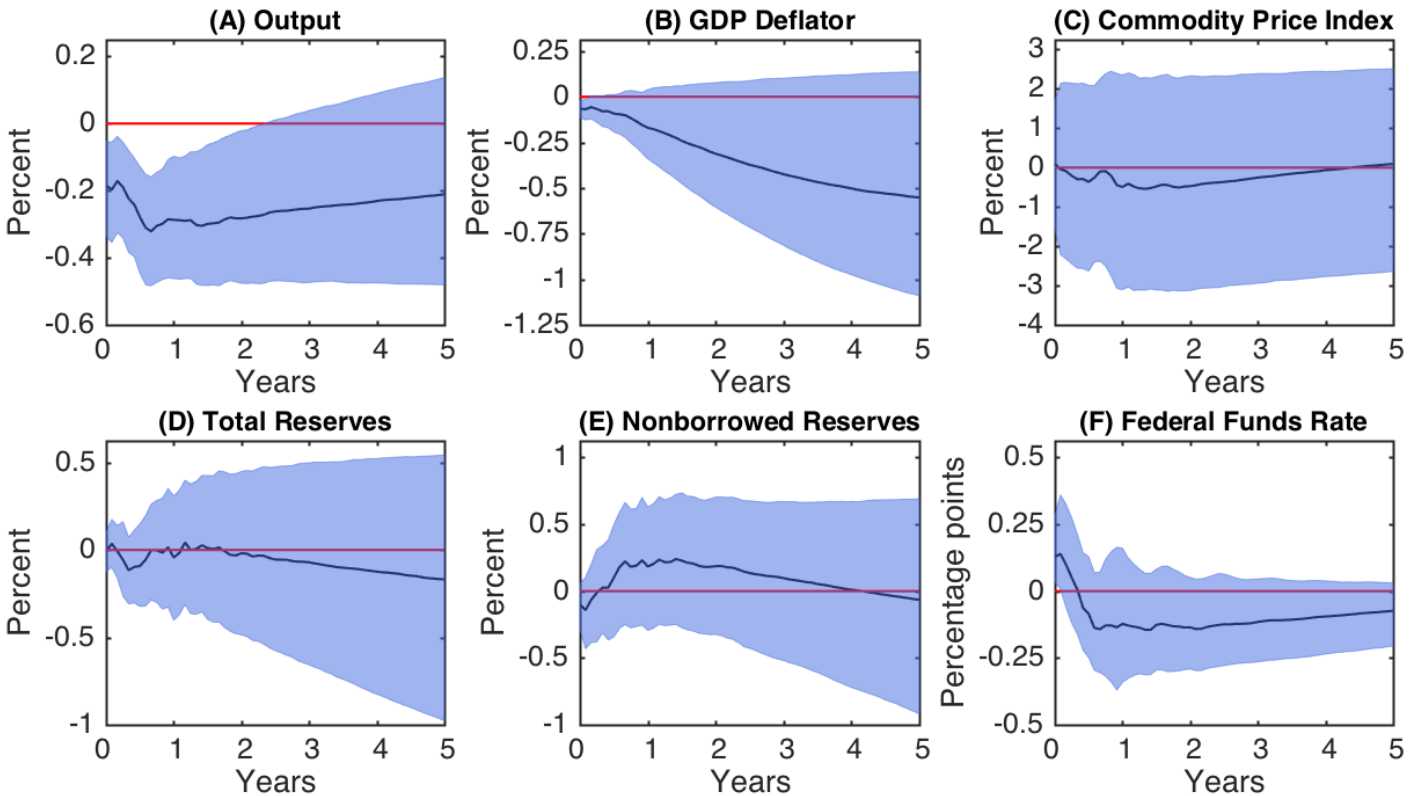
IRFs to a Monetary Policy Shock

Baseline Restrictions in FD



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Systematic Component of Monetary Policy in CEE (1996)

- Probability of violating restrictions on the systematic component of monetary policy

	$P(\psi_y < 0)$	$P(\psi_p < 0)$	$P(\psi_y < 0 \cup \psi_p < 0)$
CEE (1996)	0.00	0.10	0.10

Table: Probability of Violating Zero and Sign Restrictions