Forward Guidance Matters:
Disentangling Monetary Policy Shocks

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What is Forward Guidance?

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- ▶ According to Campbell et al. (2012), it can take two forms
  - ▶ Odyssean: FOMC commits to a future path of interest rates
  - ▶ Delphic: FOMC provides information about their view of the future

Examples

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- January 2012: "the Committee ... currently anticipates that economic conditions ... are likely to warrant **exceptionally low levels for the federal funds rate at least through late 2014**."

Research Questions

Central Question
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Subquestion
Is forward guidance effective?

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    - ▶ *"When I was at the Federal Reserve, I occasionally observed
      that monetary policy is 98 percent talk and only 2 percent
      action."* Ben S. Bernanke, March 30, 2015.

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What are the dynamic responses of macroeconomic and financial variables to forward guidance shocks?

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Is forward guidance effective?

- ▶ Why is it relevant?

    - ▶ *"When I was at the Federal Reserve, I occasionally observed that monetary policy is 98 percent talk and only 2 percent action."* Ben S. Bernanke, March 30, 2015.

    - ▶ If changes in policy rates are anticipated and this is not taken into account, we cannot properly recover the conventional monetary policy shocks

Some Background

▶ Selected Literature: Forward Guidance in VARs

  ▶ ... mixed with conventional monetary policy: Jarocinski and Karadi (2018), Andrade and Ferroni (2018) and Debortoli, Gali and Gambetti (2019)

  ▶ ... isolated from conventional monetary policy:

    ▶ Surveys: D'Amico and King (2015)
    ▶ Futures: Gertler and Karadi (2015), Bundick and Smith (2017) and Lakdawala (2019)
    ▶ Text-mining: Hansen and McMahon (2016)

This Paper

- ▶ Combines sign restrictions with two sources of extraneous information
    - ▶ narrative evidence
        - ▶ Convenient since forward guidance is itself a narrative policy tool
    - ▶ high-frequency data
- ▶ ... to disentangle conventional monetary policy shocks and forward guidance shocks

This Paper

- Combines sign restrictions with two sources of extraneous information
  - narrative evidence
    - Convenient since forward guidance is itself a narrative policy tool
  - high-frequency data
- ... to disentangle conventional monetary policy shocks and forward guidance shocks
- Contribution
  - In terms of identification, it combines different strategies to refine inference
  - Economic contribution: using this identification strategy, finds that forward guidance does matter for macroeconomic outcomes

Outline

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Econometric Framework

The point of departure for the analysis is a VAR model of the form:

$$\begin{pmatrix} m_t \\ y_t \end{pmatrix} = c + \sum_{p=1}^{P} \beta^p \begin{pmatrix} m_{t-p} \\ y_{t-p} \end{pmatrix} + A_0 \varepsilon_t \qquad (1)$$

where m_t is a vector of N_m high-frequency surprises. y_t is a vector of N_y monthly macroeconomic and financial variables.

ε_t are the structural shocks and A_0 is a decomposition of the covariance matrix.

Data and Estimation

- Monthly VAR for the US with 7 variables
  - 2 high-frequency variables: [target factor; path factor] ▸ GSS
  - 5 low-frequency variables: [(log) IP; (log) CPI; EBP; fed funds; 2-y gov. bond rate]
- Sample period: 1993-2017 (220 meetings)
- 5 lags (AIC)
- Flat prior

Outline

Sign Restrictions

Finding A_0

$$\begin{pmatrix} m_t \\ y_t \end{pmatrix} = c + \sum_{p=1}^{P} \beta^p \begin{pmatrix} m_{t-p} \\ y_{t-p} \end{pmatrix} + A_0 \varepsilon_t \qquad (2)$$

▶ As in Rubio-Ramirez et al. (2010) find A_0 by
  ▶ calculating $\tilde{A}_0$, an arbitrary matrix square root of Σ, Chol
  ▶ multiplying it with a rotation matrix Q

then check if the impulse responses using this candidate satisfy the sign restrictions

Sign restrictions on responses at horizon 0 to 5[2]

	MP shock	FG shock
target factor	+	
path factor		+
IP		
CPI	-	-
EBP	+	+
fed funds	+	0
2-year rate		+

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[2]The zero restriction and the sign restrictions on the target and path factors are imposed only on impact.

Narrative Sign Restrictions: AR, 2018

▶ Idea is to impose on top of the traditional sign restrictions, restrictions on the sign of the structural shocks and the historical decomposition of the data based on narrative information (Antolin-Diaz and Rubio-Ramirez, 2018).

$$\varepsilon_{j,t}(\Theta) < 0$$

$$|H_{i,j,t}(\Theta, \varepsilon_t(\Theta))| > \sum_{j' \neq j} |H_{i,j',t}(\Theta, \varepsilon_t(\Theta))|$$

▶ If restrictions are not satisfied, the draw is discarded. Otherwise, keep the draw, and re-weight.

▶ NSR: function depends on the structural shocks; it truncates the support of the likelihood function. Then **Importance Sampling** is required.

Narrative Restrictions: Others

- ▶ Ludvigson et al. (2020)

$$\varepsilon_{j,t}(\Theta) < \bar{k}$$

- ▶ Ben Zeev (2018)

- ▶ Giacomini et al. (2021)
  - ▶ Use posterior bounds of Giacomini and Kitagawa (2018)
  - ▶ Skip importance sampling

Narrative Sign Restrictions: Events for Monetary Policy

- ► Antolin-Diaz and Rubio-Ramirez (2018)
  - ► Narrative Sign Restriction 8. The monetary policy shock must be positive for the observation corresponding to February 1994.

  - ► Narrative Sign Restriction 9. For the period specified by Restriction 8, the monetary policy shock is the most important contributor to the observed unexpected movements in the federal funds rate.

Narrative Sign Restrictions: Event for Forward Guidance

▶ August 2011: "the Committee currently anticipates that economic conditions ... are likely to warrant **exceptionally low levels for the federal funds rate at least through mid-2013**."

▶ New Narrative Sign Restrictions
  ▶ The forward guidance shock must be negative for the observation corresponding to August 2011.
  ▶ The forward policy shock is the most important contributor to the observed unexpected movements in the 2-year rate in August 2011.
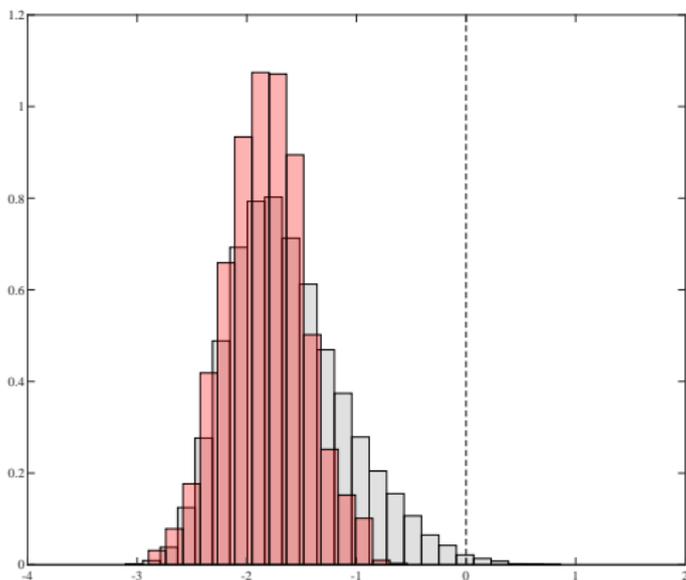
What does that imply?

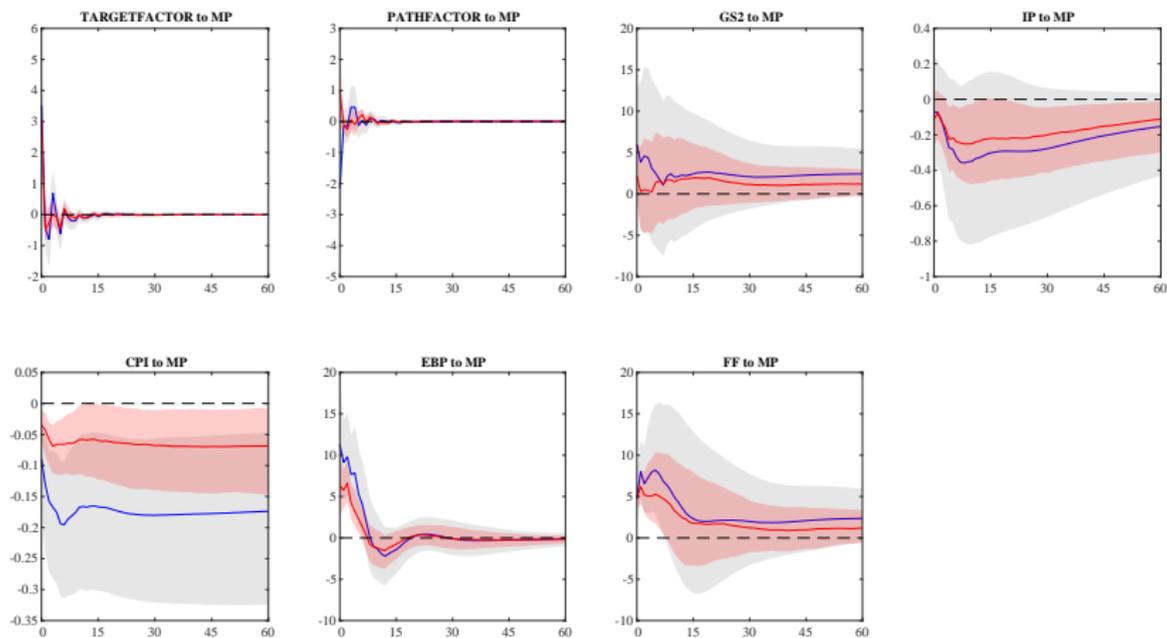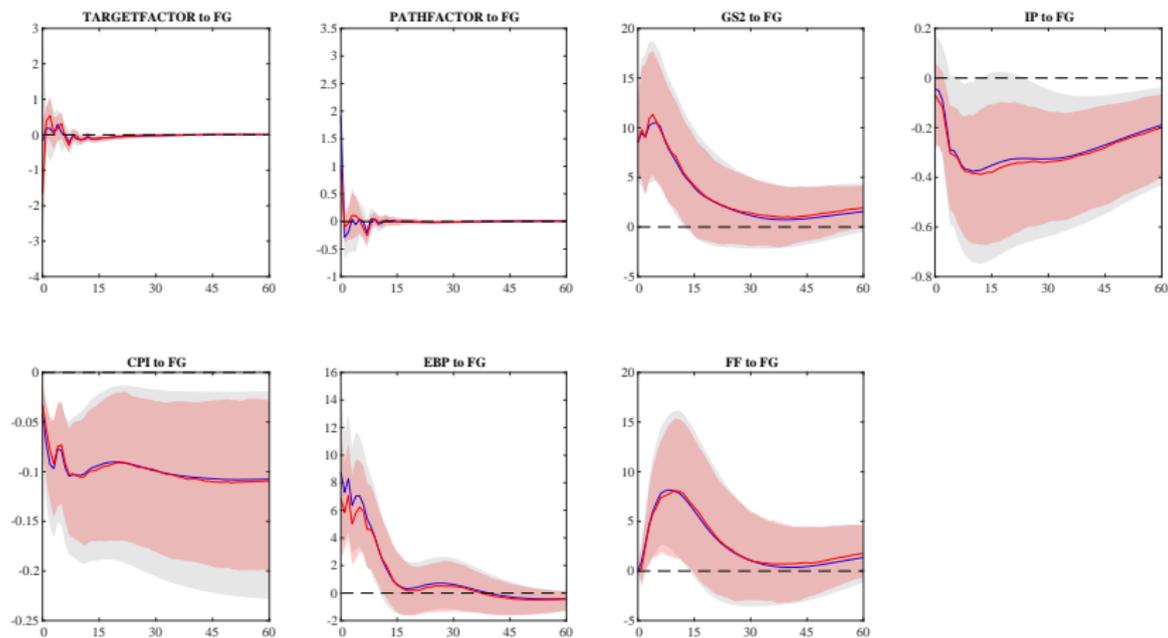Figure: Forward Guidance shock for August 2011

Outline

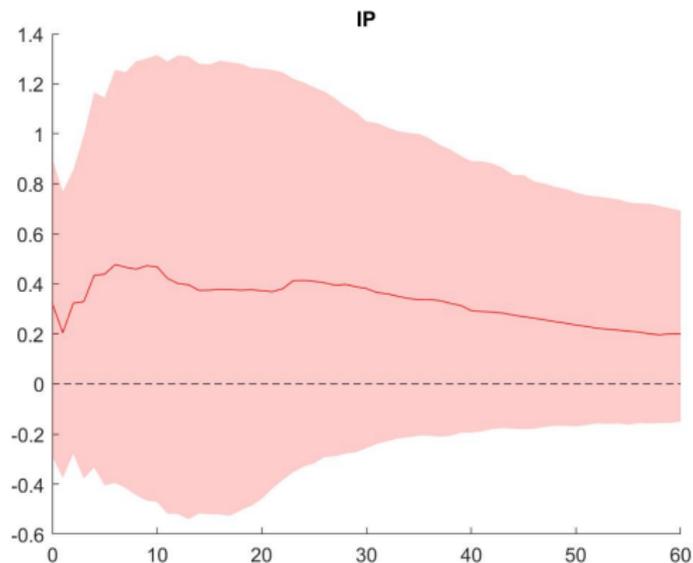# Results: MP shock

Results: FG shock

Results

Figure: Difference in Impulse Responses of IP

Notes: 68 percent (point-wise) HPD credible sets for the difference between the IRFs of IP after a FG shock and after a MP shock. In order to make the original impulse responses comparable, they are normalised so that the initial impact on GS2 is the same after both shocks: 8 basis points.

Outline

Informational Sufficiency

Figure: p-Values of the orthogonality F-test proposed by Forni and Gambetti (2014)

	2 lags			4 lags		
	PC=4	PC=7	PC=10	PC=4	PC=7	PC=10
MP shock	0.98	0.80	0.37	1.00	0.77	0.14
FG shock	0.86	0.27	0.30	0.94	0.52	0.23

▶ Orthogonality + Correct identification $\Rightarrow$ Desired Shock/"Structuralness"

Alternative Event for Forward Guidance

- Ludvigson et al. (2020) with $k = 0.3$ for January 2012
- Narrative Sign Restriction becomes
  - The forward guidance shock must be 0.3 standard deviation below zero for the observation corresponding to January 2012.

Results: FG shock - January 2012
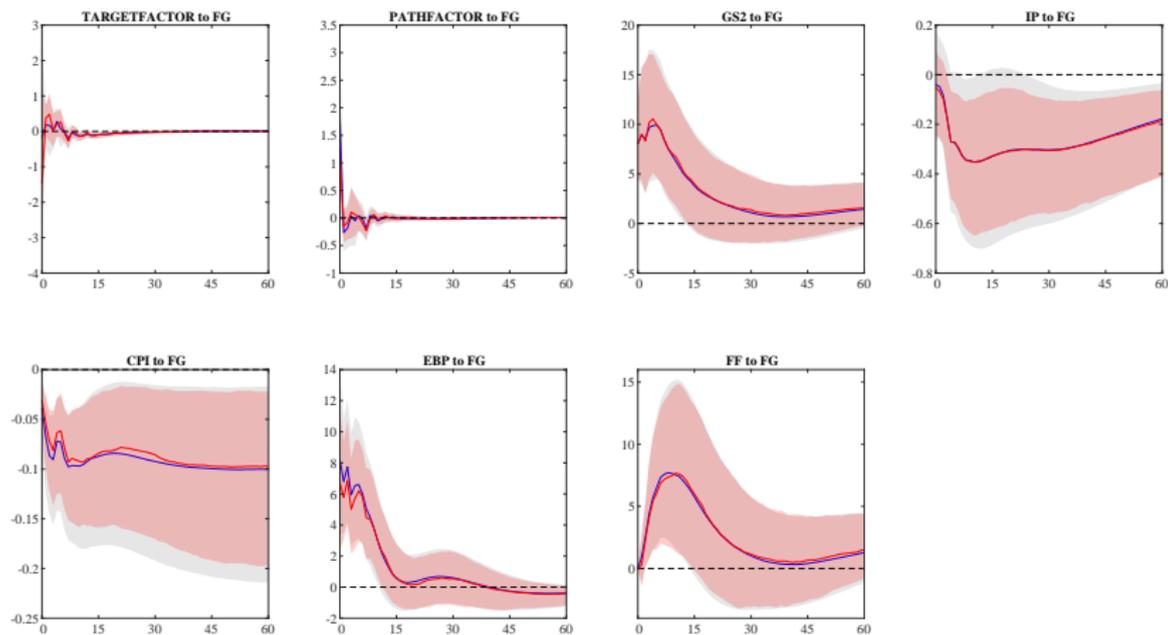
Outline

Summary

- Conventional monetary policy has the expected effects even in a recent US sample
- Forward guidance matters
    - ... not only to the proper identification of conventional monetary policy shocks
    - ... but also due to its effect on industrial production and other macroeconomic variables
- In fact, it is at least as strong as conventional monetary policy
- Results are robust to alternative specifications

Zooming in the Importance Sampler

- ▶ Selected Steps of the Algorithm
    - ▶ a. Check if the narrative restrictions are satisfied.
    - ▶ b. If not, discard the draw. If they are, compute the importance weights.
        - ▶ i. Simulate M independent draws of ε from the standard normal distribution.
        - ▶ ii. Compute the proportion of the M draws that satisfy the restrictions and set the importance weight to $\dfrac{1}{proportion}$.
    - ▶ c. Keep running until the required number of draws has been obtained
    - ▶ d. Draw with replacement from the set of (β, Σ, Q) using the importance weights

Full Algorithm

1. Independently draw (β, Σ) from the NIW(v, Ψ, β, S) distribution.

2. For $1 \leq j \leq N$, draw $\mathbf{x}_j \in \mathbb{R}^{N+1-j-z_j}$ independently from a standard normal distribution and set $\mathbf{w}_j = \mathbf{x}_j / \|\mathbf{x}_j\|$, where z_j is the number of zero restrictions associated with the jth structural shock.

3. Define $Q = [q_1 \dots q_N]$ recursively by $q_j = K_j w_j$ for any matrix K_j whose columns form an orthonormal basis for the null space of the $(j - 1 + z_j) \times N$ matrix

$$M_j = [q_1 \ \dots \ q_{j-1} \ (Z_j F(f_h^{-1}(\beta, \Sigma, I_n)))]$$

where Z_j defines the zero restrictions on the jth structural shock for $1 \leq j \leq N$, f_h^{-1} is the function that transforms draws over the orthogonal reduced-form parametrisation into draws from the structural parametrisation, and F is a function of the structural parameters defined as a matrix that vertically stacks the impulse responses over which the restrictions will be imposed.[3]

[3]For instance, make $L_0 = \text{chol}(\hat{\Sigma})$ an initial guess of the structural impact matrix multiplier. That implies $L_1 = \beta L_0$ and $F = [L_0; L_1]$.

Full Algorithm

4. Check if the sign restrictions are satisfied. If they are, compute the importance weights. Otherwise, discard the draw. Steps are provided in their online appendix.

5. Return to Step 1 until the required number of draws satisfying the zero and sign restrictions has been obtained.

6. Re-sample with replacement using the importance weights.

7. Check if the narrative sign restrictions are satisfied. If they are, approximate the new importance weights as the inverse of the probability of satisfying the narrative restrictions as in Antolin-Diaz and Rubio-Ramirez (2018). Otherwise, discard the draw.

8. Re-sample with replacement using the new importance weights.

Data

- m_t: GSS (2005) factors
  - Surprises in 5 futures in a 30-minute window around FOMC announcements:
    $$S_t = x_t - x_{t-1}$$

    - The current-month and 3-month-ahead federal funds futures contracts and the 2, 3, and 4-quarter-ahead eurodollar futures contracts.
  - PCA (2 factors) on 5 surprises
  - Rotate factors so they have a structural interpretation
  - Add up surprises occurring in month t; 0 if there is no meeting
    - **Path factor** influences only expected future rates and is associated with FOMC statements
    - (Residual) target factor accounts for most of the surprise in the current fed funds rate

Eurodollar

- A eurodollar futures contract expiring in a particular quarter is an agreement to exchange, about two weeks before the end of that quarter, the price of the contract p for 100 minus the then current three-month US dollar BBA LIBOR interest rate. The contract thus provides market-based expectations of the three month nominal interest rate on the expiration date.

- GSS (2005): "the second eurodollar futures contract can have as little as one quarter plus one day to expiration and as much as two quarters to expiration, with an average horizon of 1.5 quarters over our sample. On expiration, eurodollar futures settle based on the spot 90-day eurodollar rate, which is closely tied to expectations for the federal funds rate over the subsequent 90-day period. Thus, these three eurodollar futures contracts are related to federal funds rate expectations from 1.5-2.5, 2.5-3.5, and 3.5-4.5 quarters ahead, respectively."