What Are Empirical Monetary Policy Shocks? Estimating the Term Structure of Policy News

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Introduction

Motivation

- What are the effects of monetary policy? Recent work has developed carefully-identified *empirical* monetary policy shocks (EMPS) to answer this question.

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- EMPS can be high dimensional objects: information about policy rates at many future horizons.

- Understanding this structure is *essential* for interpretation.

- A framework to decompose an EMPS: the Term Structure of Monetary Policy News.

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- We use synthetic MPS to study effects of true policy surprises and news

Motivating Example

- A simple New Keynesian model:

New Keynesian Phillips curve: $\qquad \pi_t = \beta\mathbb{E}[\pi_{t+1}] + \kappa y_t$

Euler equation: $\qquad i_t = \mathbb{E}_t[\gamma(y_{t+1} - y_t) + \pi_{t+1}]$

Taylor rule: $\qquad i_t = \phi_y y_t + \phi_\pi \pi_t + \nu_t$

Policy news: $\qquad \nu_t = \nu_{0,t} + \nu_{1,t-1} + \nu_{2,t-2} + ...$

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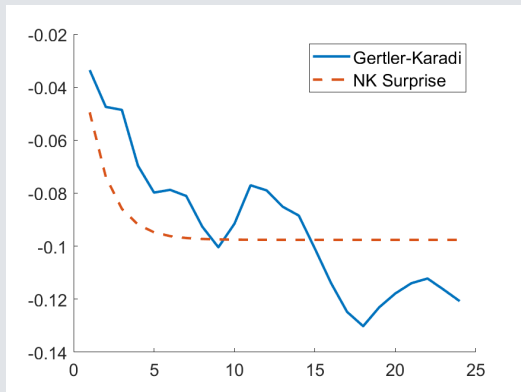 Euler equation: $\qquad i_t = \mathbb{E}_t[\gamma(y_{t+1} - y_t) + \pi_{t+1}]$

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- Each news shock has a unique IRF: *any* EMPS IRF can be rationalized by this model!
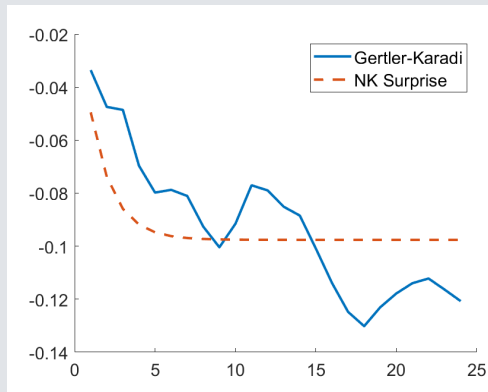
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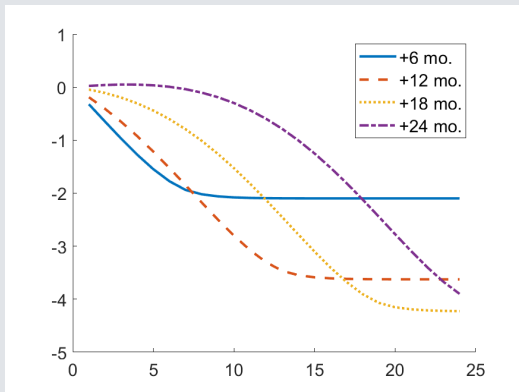

(a) EMPS vs. NK Surprise Shock   **(b)**

Figure 1: CPI Responses to Monetary Shocks
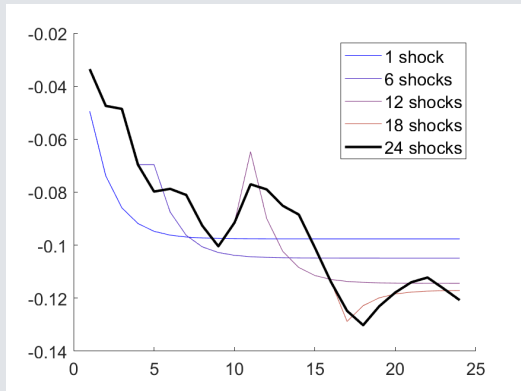
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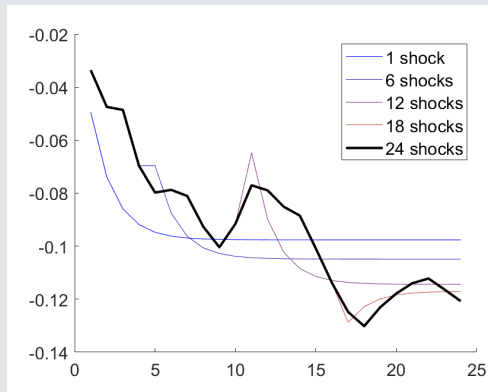
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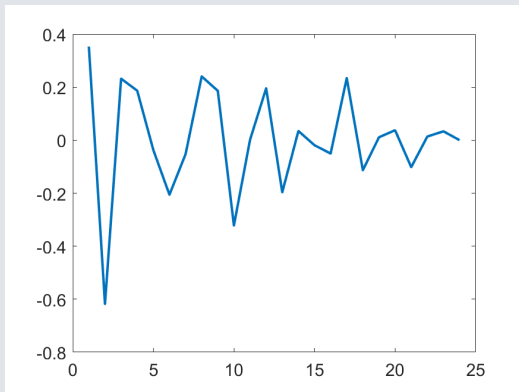
(b) Rationalizing Term Structure

Figure 2: Rationalizing Gertler-Karadi with a Combination of News Shocks

Theoretical Framework

General Framework: Monetary Policy

- Monetary policy is given by a Taylor-type rule (y_t is the policy instrument):

$$y_t = x_t \phi + r_t \tag{1}$$

- The residual r_t may be autocorrelated:

$$r_t = \sum_{\ell=1}^{L} \rho_{r,\ell} r_{t-\ell} + \nu_t \tag{2}$$

- The monetary policy *innovation* ν_t is a linear combination of independent news shocks:

$$\nu_t = \nu_{0,t} + \nu_{1,t-1} + \nu_{2,t-2} + ... + \nu_{H_\nu, t-H_\nu} \tag{3}$$

- EMPS contain some information about policy news at many horizons.
  EMPS w_t^j of type j is:

$$w_t^j = \sum_{h=0}^{H_w} \beta_h^j \nu_{h,t} + \xi_t^j \tag{4}$$

- ξ_t^j is iid orth. to $\nu_{h,t}$ (measurement error, CBI, etc.)

General Framework: Term Structure of Monetary Policy News

- The term stucture of EMPS j is the effect of the EMPS w_t^j on expectations of the MPI over many horizons:

$$\gamma_h^j \equiv \frac{d\mathbb{E}[\nu_{t+h}|w_t^j]}{dw_t^j}$$

- Given DGP (4), the term structure of EMPS can be written:

$$\nu_t = \sum_{h=0}^{H_w} \gamma_h^j w_{t-h}^j + u_t \tag{5}$$

with residual u_t

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Empirical Strategy

- Would like to regress $\nu_t = \sum_{h=0}^{H_w} \gamma_h^j w_{t-h}^j + u_t$, but ν_t is unobserved

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  - 4. Regress innovations on lags of EMPS to estimate the γ_h^j term structure coefficients

Estimation Strategy: One Step

- The 4-stage procedure can be estimated in one step:

$$\hat{\gamma} = (W'W)^{-1}W'M_{\mathbf{x}}(I - X(X'P_ZX)^{-1}X'P_Z)y$$

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- This representation is useful because it has analytical standard errors:

$$Var(\hat{\gamma}|W, X, Z) = (W'W)^{-1} W' M_{\mathbf{x}} ...$$
$$\times \left(I - X(X'P_Z X)^{-1} X' P_Z\right) \Omega \left(I - X(X'P_Z X)^{-1} X' P_Z\right)' M_{\mathbf{x}} W(W'W)^{-1}$$

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- Smoothed LP will be especially useful when we construct synthetic MPS

Data

- Monetary policy shocks from the literature
- Non-monetary macro shocks to use as instruments
- Standard macro time series for estimating the policy rule (inflation and output gap) and evaluating effects

Monetary Policy Shocks

Shock Source	Method	Notes	Range
Gertler and Karadi (2015)	HFI	30 min. window around FOMC decisions	1990:M1-2007:M12
Jarociński and Karadi (2020)	HFI	2 shocks: pure monetary and Fed information	1990:M1-2016:M12
Bundick and Smith (2020)	HFI	2 shocks to term structure uncertainty	1994:M2-2019:M06
Miranda-Agrippino and Ricco (2021)	HFI	Orthogonalized w.r.t. Greenbook forecasts	1991:M1-2009:M12
Bauer and Swanson (2023)	HFI	Includes Fed minutes and speeches	1988:M2-2023:M12
Swanson (2023)	HFI	Decomposed into 3 types of EMPS	1988:M2-2023:M12
Jarociński (2024)	HFI	Decomposed into 4 types of EMPS	1990:M2-2024:M9
Romer and Romer (2004)	Narrative	Orthogonalized w.r.t. Greenbook forecasts	1983:M1-2007:M12
Aruoba and Drechsel (2024)	Narrative	Natural language processing of Fed docs	1982:M10-2008:M10

Non-monetary Structural Shock Instruments

Shock Source	Method	Notes	Range
Government Spending Shocks			
Romer and Romer (2016)	Narrative	Social Security expansions	1951:M1-1991:M12
Fieldhouse et al. (2018)	Narrative	Government housing purchases	1952:M11-2014:M12
Oil Shocks			
Känzig (2021)	HFI	Oil supply news	1975:M1-2023:M6
Baumeister and Hamilton (2019)	SVAR	Oil supply, consumption/inventory demand	1975:M2-2024:M3
Other Shocks			
Kim et al. (2022)	External	ACI severe weather shocks	1964:M4-2019:M5
Adams and Barrett (2024)	SVAR	Shocks to inflation expectations	1979:M1-2024:M5

Estimation Results: Taylor Rule

- Baseline:
  - 12-month PCE inflation coeff.: 1.55
  - Monthly (filtered) real GDP coeff.: 0.75
  - r_t residual autocorr.: 0.95
- Robustness:
  - Inflation coefficient very robust across specifications, including inflation measure, lag selection, time periods, different IVs (but not inclusion of infl. expectations)
  - Real activity coefficient very sensitive to measure used
  - OLS not robust at all!
- We do expect coefficients to change depending on which variables appear in rule. Key question: are the implied term structures robust? (Mostly yes)

Estimation Results: Summarizing the Term Structures

- How should we quantify the term structures?

- R_k^2 statistic captures the proportion of ν_t variation that is explained by a shock at horizon k is

$$R_k^2 \equiv \frac{Var(\nu_t | w_{t-k}^j)}{Var(\nu_t | \{w_{t-h}^j\}_{h=0}^{H_w})} = \frac{(\gamma_k^j)^2}{\sum_{h=0}^{H_w} (\gamma_h^j)^2}$$

- Also report entire vectors ▸ Term Structure Plots

Shock	$R^2_{0:1}$	$R^2_{2:6}$	$R^2_{7:12}$	$R^2_{13:24}$
Swanson FG	0.01	0.22	0.59	0.18
Bu-Rogers-Wu	0.02	0.11	0.16	0.71
Jarocinski FG	0.04	0.35	0.36	0.25
Jarocinski Info	0.18	0.11	0.32	0.40
Bundick-Herriford-Smith Slope	0.21	0.17	0.43	0.19
Swanson LSAP	0.23	0.50	0.22	0.05
Bundick-Herriford-Smith Level	0.24	0.22	0.25	0.29
Bauer-Swanson	0.27	0.36	0.26	0.11
Jarocinski LSAP	0.28	0.45	0.07	0.20
Jarocinski-Karadi MPS	0.28	0.25	0.28	0.19
Miranda-Agrippino-Ricco	0.34	0.38	0.16	0.12
Jarocinski FFR	0.43	0.27	0.11	0.18
Gertler-Karadi	0.44	0.35	0.04	0.17
Aruoba-Drechsel	0.47	0.48	0.02	0.04
Swanson FFR	0.49	0.40	0.02	0.09
Romer-Romer MPS	0.52	0.36	0.05	0.07

Synthetic Monetary Policy Shocks

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Synthetic Monetary Policy Shocks: Method

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- **Proposition:** For a linear combination of MPS $w_t^c = \lambda_a w_t^a + \lambda_b w_t^b$, the resulting term structure of monetary policy news $\vec{\gamma}^c$ is proportional to the linear combination of term structures:

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- Valuable! Allows us to isolate the effects of specific components of monetary policy news, e.g. surprises or forward guidance.

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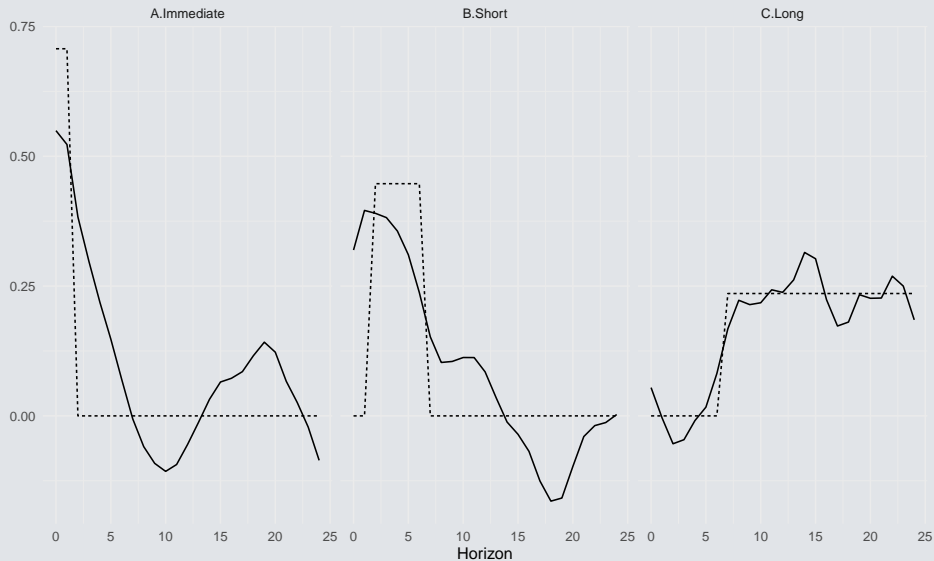 - Short-run: horizons $2 - 7$

Synthetic Monetary Policy Shocks: Application

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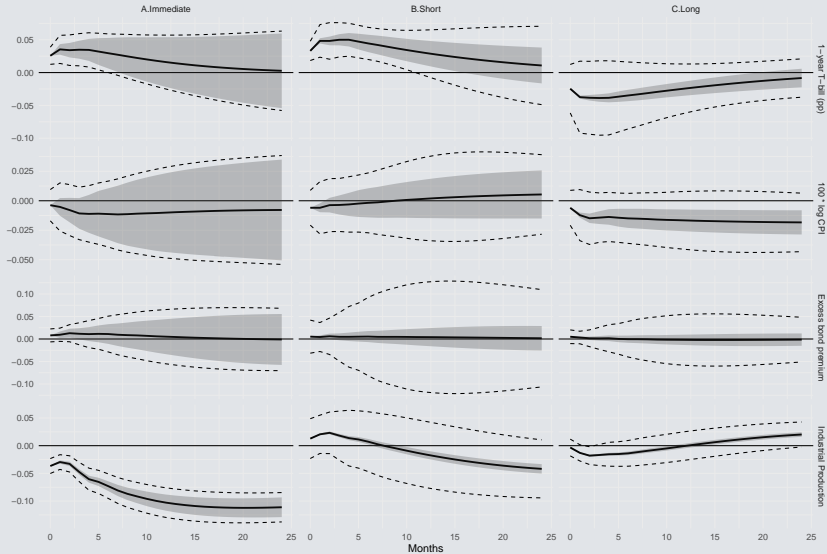# Synthetic Monetary Policy Shocks: Application

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- Then, estimate the macroeconomic effects using the standard Gertler-Karadi VAR

Synthetic Term Structures

Conclusions

- Analyzing an EMPS in a model requires knowing its term structure of monetary policy news; we derived a method to estimate it.

- Can use good EMPS to construct synthetic MPS with desired term structures

- Textbook-looking EMPS are not so ordinary when broken down into immediate shocks, forward guidance

- Main conclusions robust to most alternative specifications (except ZLB inclusion)

◂ Back
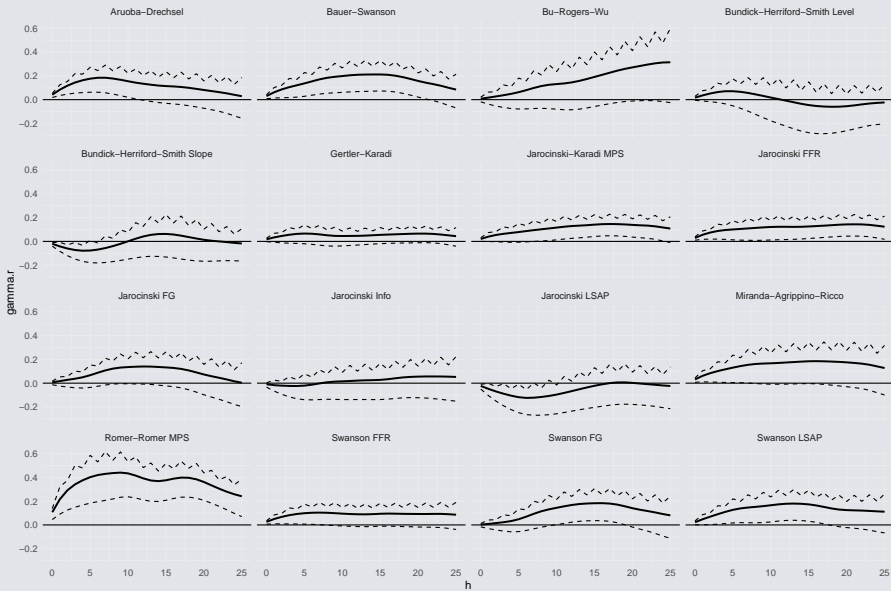
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