New evidence on monetary transmission: interest rate vs inflation target shocks

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October 7, 2021

Motivation

- **What are the co-movement properties of inflation and interest rates in response to monetary policy shocks?**

- Study monetary transmission with two shocks:

  temporary nom. interest rate shock $i \uparrow => \pi \downarrow$

  and *persistent* inflation target shock $i \uparrow => \pi \uparrow$, **?**

- This paper:

  empirical evidence on the **effects of persistent MP shocks**

  under the assumption that agents, in reality, *might not* understand the nature of the shock

- Result: $i \uparrow => \pi \uparrow$ **Yes, with a lag**

Full vs imperfect information in a DSGE model

How the shock is perceived depends on how agents form their expectations.

$$i_t = \rho_i i_{t-1} + (1-\rho_R)\left[\rho_\pi(\bar{\pi}_{4,t} - \boldsymbol{\pi_t^*}) + \rho_y(y_t - y_t^*)\right] + \boldsymbol{u_t} =$$

$$= \rho_i i_{t-1} + (1-\rho_R)\left[\rho_\pi(\bar{\pi}_{4,t}) + \rho_y(y_t - y_t^*)\right] + \boldsymbol{\varepsilon_t} \quad (1)$$

$$\boldsymbol{\varepsilon_t} \equiv (1-\rho_R)(-\rho_\pi)\,\boldsymbol{\pi_t^*} + \boldsymbol{u_t}. \quad (2)$$

$$\pi_t^* = \rho_{\pi^*}\pi_{t-1}^* + \varepsilon_{\pi^*,t}, \qquad \varepsilon_{\pi^*,t} \sim N\left(0, \sigma_{\pi^*}^2\right) \quad (3)$$

Full information:
Agents observe $\boldsymbol{\pi_t^*}$ and $\boldsymbol{u_t}$ separately. Inflation expectations adjust immediately: $\pi_t^* \uparrow \rightarrow \mathbb{E}_t\pi_t^* \uparrow$

Imperfect information:
Agents observe $\boldsymbol{\epsilon_t}$, they need time to learn the nature of the shock: $\pi_t^* \uparrow \not\rightarrow \mathbb{E}_t\pi_t^* \uparrow$

Impulse responses to a persistent inflation target shock

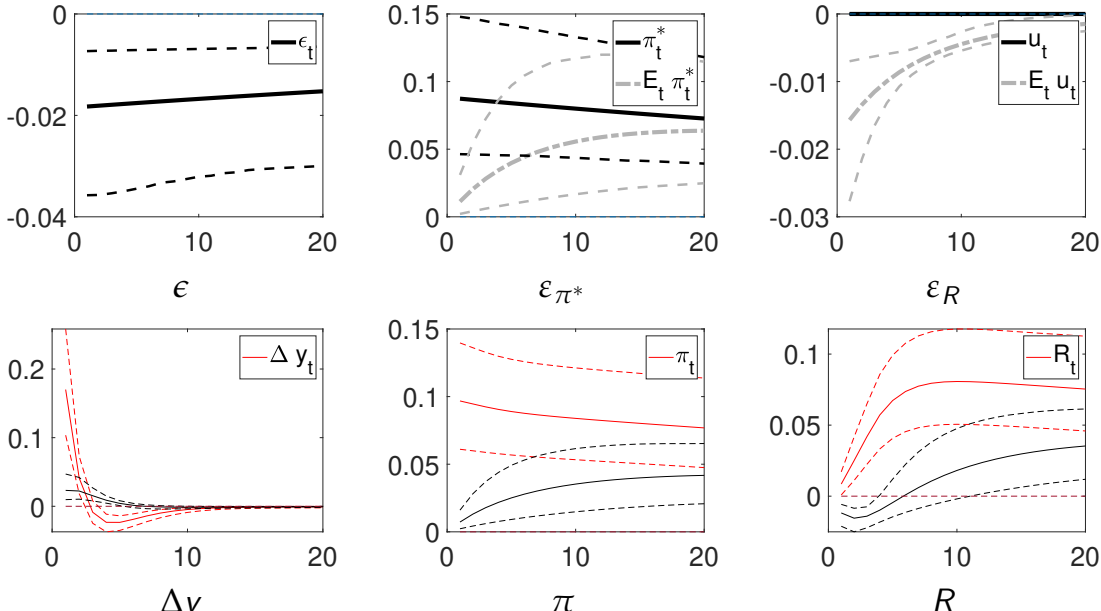


Figure: Red line - full information, black line - imperfect information, gray line - expectations under imperfect information.

VAR with uncertainty in identification

- **Problem**: full and imperfect information DSGE model give different predictions, which is true?

  Solution: address this through uncertainty in identifying assumptions

- Structural VAR model:

$$\boldsymbol{A}\boldsymbol{y_t} = \boldsymbol{B}\boldsymbol{x_{t-1}} + \boldsymbol{u_t},$$

$$y_t = [\pi_t^*, \Delta y_t, \pi_t, R_t]$$

- Reduced form:

$$\boldsymbol{y_t} = \boldsymbol{\Psi}\boldsymbol{x_t} + \boldsymbol{\epsilon_t},$$

where $\boldsymbol{\Psi} = \boldsymbol{A}^{-1}\boldsymbol{B}$, $\boldsymbol{\epsilon_t} = \boldsymbol{A}^{-1}\boldsymbol{u_t}$

- f. Baumeister & Hamilton (JME 2018, AER 2019) use $\boldsymbol{A}$ to introduce uncertainty about contemporaneous effects and impacts of shocks

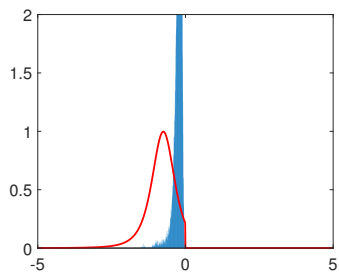


Figure: Prior (red line) and posterior (blue histogram) distributions for contemporaneous coefficient the a_{43} element of the A-matrix. Baseline model with perceived inflation target rate (PTR) measure from the FRB/US model (Brayton, Laubach, Reifschneider, 2014). Sample: 1962Q1 to 2019Q1. Horizontal axis: periods after the shock. Vertical axis: percentage change.

Identification

Data evidence is consistent with **IMPERFECT** information

- 1-2 quarters delay, then $i \uparrow \pi \uparrow$

Impulse responses to a persistent inflation target shock

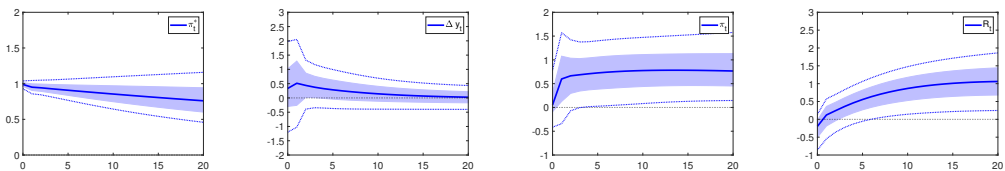


Figure: Shaded area - 68% confidence interval and blue dotted line 90% confidence interval to a persistent inflation target shock. Inflation target measure - SPF 10-year inflation expectations. Horizontal axis: periods after the shock. Vertical axis: percentage change. Sample: 1962Q1 to 2019Q1.

- Exclude ZLB, shadow rates: consistent with full information, i.e. $i \uparrow \pi \uparrow$ on impact
- Thus, an increase in nominal interest rate does not necessarily lead to deflation or contraction

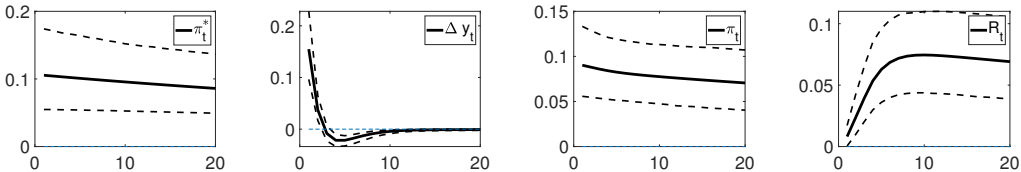
Data Model

Thank you!

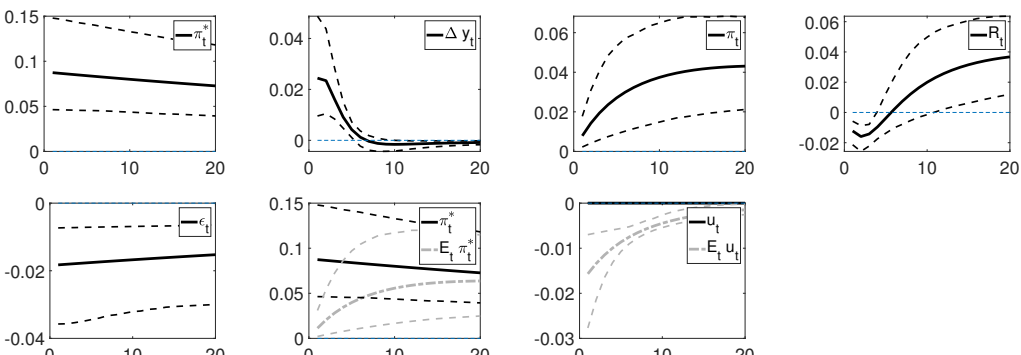
Appendix

Impulse responses to a persistent inflation target shock

DSGE estimated under FULL information



DSGE estimated under IMPERFECT information



ϵ ε_{π^*} ε_R

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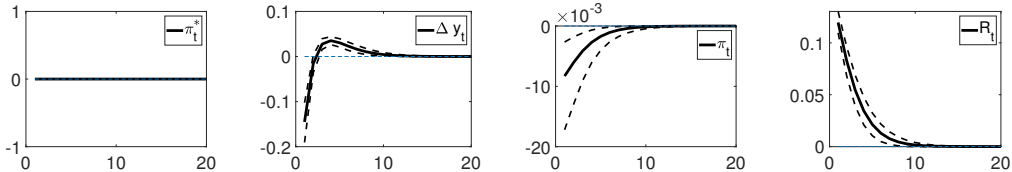
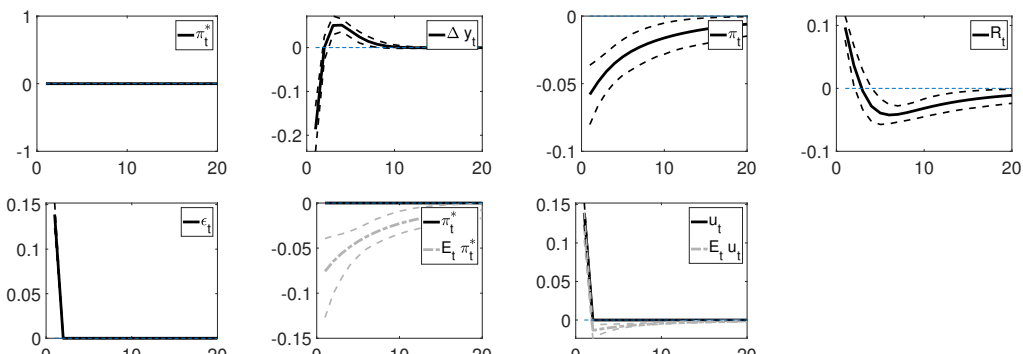
Impulse responses to a temporary monetary policy shock

DSGE estimated under FULL information



DSGE estimated under IMPERFECT information



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DSGE-implied inflation targets

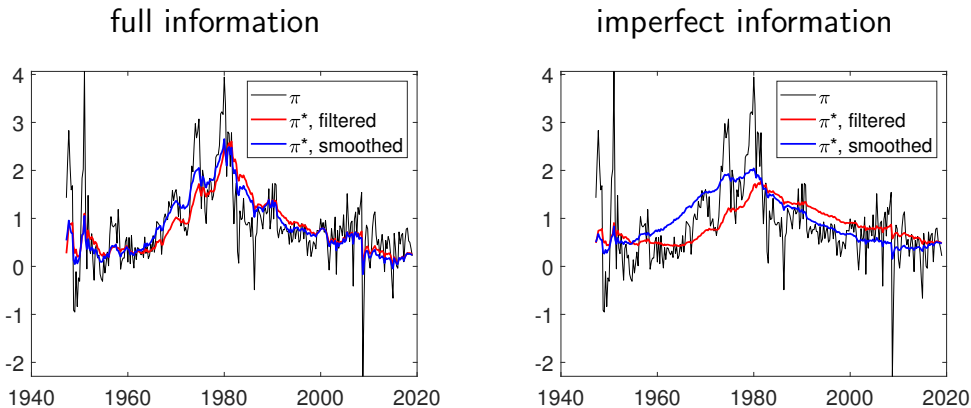

Figure: Dynamics of the inflation target series from the estimated New Keynesian DSGE model and actual inflation. Left panel: case of full information. Right panel: case of imperfect information. Black line: actual inflation. Blue line: smoothed inflation target estimate. Red line: filtered inflation target estimate.

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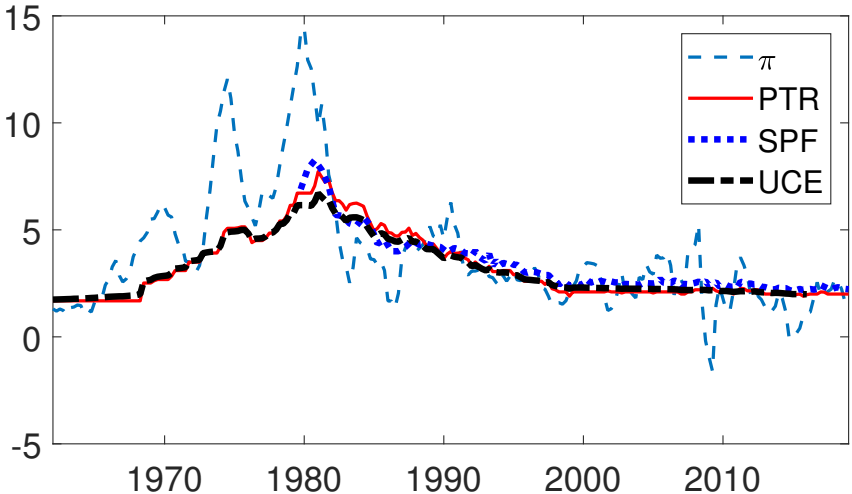
Data

We estimate the DSGE model with Bayesian methods using the following data:

- Quarterly US data from 1947Q2 to 2019Q1
- Time series (from FRED II):
  - real output growth
  - CPI-based inflation
  - 3-month Treasury Bill rate
- Robustness:
  - add inflation expectations
- Inflation target process is (strictly speaking not permanent), but highly persistent: $\rho_{\pi^*} = 0.9889$, $\sigma_{\pi^*} = 0.1095$

Data for long-run inflation expectations



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Empirical evidence from VAR model

$$y_t = \Psi x_t + \epsilon_t, \tag{4}$$

where $x_t = [\pi^*, \Delta y, \pi, i]$ and intercept

- Independent Normal-Wishart prior, 2 lags
- Robustness checks: exclude ZLB, include shadow rates, 4 lags, alternative prior

How to introduce inflation target shock?

- *long-run inflation expectations*
  - FRB/US model (baseline), *PTR*
  - SPF long-run inflation expectations
- *trend inflation*:
  - Chan, Clark, Koop (JMCB, 2017) trend inflation of Stock, Watson (JMCB, 2007) augmented with inflation expectations
- *DSGE-implied* inflation target measure: full and imperfect information

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Prior

all elements of $A \sim t - dist(\mu_h, \sigma_h, \nu_h, \lambda_h)$

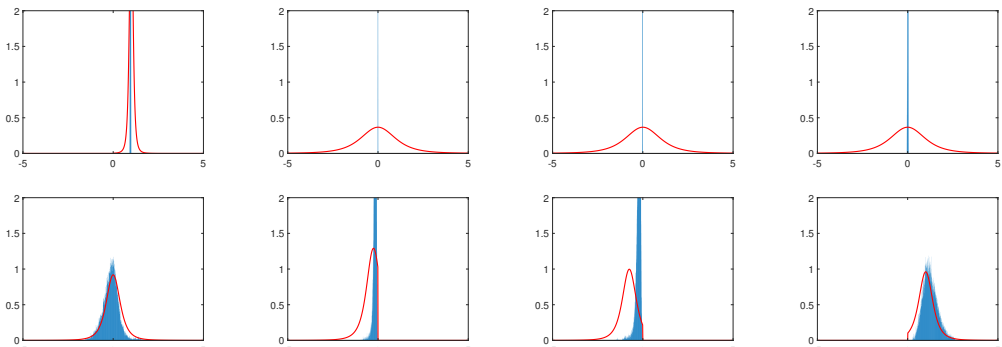

Figure: Prior (red line) and posterior (blue histogram) distributions for contemporaneous coefficients the elements of the A-matrix. Baseline model with perceived inflation target rate (PTR) measure from the FRB/US model (Brayton, Laubach, Reifschneider, 2014). Sample: 1962Q1 to 2019Q1. Horizontal axis: periods after the shock. Vertical axis: percentage change.

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VAR-based results: 1962Q1 to 2008Q3

Impulse responses to a persistent inflation target shock

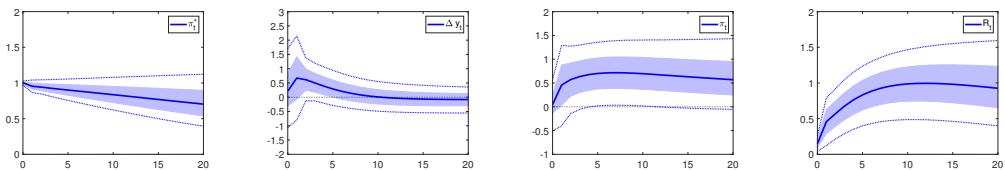

Figure: Baseline model with perceived inflation target rate (*PTR*) measure from the FRB/US model (Brayton, Laubach, Reifschneider, 2014). Shaded area - 68% confidence interval and blue dotted line 90% confidence interval to a persistent inflation target shock. Sample: 1962Q1 to 2008Q3. Horizontal axis: periods after the shock. Vertical axis: percentage change.

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VAR-based results: 1962Q1 to 2019Q1 with shadow rates

Impulse responses to a persistent inflation target shock

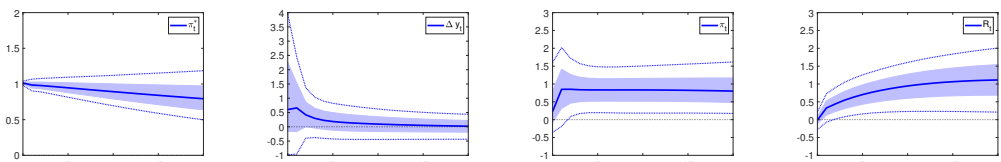

Figure: Model with shadow rates and perceived inflation target rate (PTR) measure from the FRB/US model (Brayton, Laubach, Reifschneider, 2014). Shaded area - 68% confidence interval and blue dotted line 90% confidence interval to a persistent inflation target shock. Sample: 1962Q1 to 2019Q1. Horizontal axis: periods after the shock. Vertical axis: percentage change.

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