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

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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 nominal 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.

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

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

\[ \varepsilon_t \equiv (1 - \rho_R) (-\rho_\pi) \pi_t^* + u_t. \]  
(2)

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

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

**Imperfect information:**
Agents observe \( \varepsilon_t \), 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:
    \[ Ay_t = Bx_{t-1} + u_t, \]
    \[ y_t = [\pi^*_t, \Delta y_t, \pi_t, R_t] \]

  - Reduced form:
    \[ y_t = \Psi x_t + \epsilon_t, \]
    where \( \Psi = A^{-1} B, \epsilon_t = A^{-1} u_t \)

  - f. Baumeister & Hamilton (JME 2018, AER 2019) use \( A \) 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.
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
Thank you!

Appendix
Impulse responses to a persistent inflation target shock

DSGE estimated under **FULL** information

DSGE estimated under **IMPERFECT** information

\[ \epsilon \quad \epsilon_{\pi^*} \quad \epsilon_R \]
Impulse responses to a temporary monetary policy shock

DSGE estimated under **FULL** information

DSGE estimated under **IMPERFECT** information

\( \epsilon \)  
\( \epsilon_{\pi^*} \)  
\( \epsilon_{R} \)
DSGE-implied inflation targets

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

![Graph showing data for long-run inflation expectations.](image-url)
Empirical evidence from VAR model

\[ y_t = \Psi x_t + \epsilon_t, \]  

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
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.
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.
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.