Empirical Properties of Inflation Expectations and the Zero Lower Bound

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Introduction

- Properties of inflation expectations in any model with complete information and rational expectations:
  1. All agents have same expectation of aggregate inflation.
  2. This inflation expectation responds instantly to realized shocks to future inflation.

- Properties of survey data on inflation expectations:
  1. Agents report heterogeneous inflation expectations.
  2. The average inflation expectation responds sluggishly to realized shocks to future inflation.

- Moreover, at the beginning of the Great Recession, most professional forecasters expected the slump to be highly transitory.

Introduction

- This paper: New Keynesian model with a zero lower bound (ZLB) that matches data on expectations

- Main lessons

  1. Households' incomplete information about the state of the economy at the ZLB is unambiguously a good thing. It raises ex-ante welfare.
  2. Firms' low perceived persistence completely resolves the missing deflation puzzle.
  3. Forward guidance puzzle, government spending multiplier

The Missing Deflation Puzzle

- New Keynesian Phillips curve:

$$\pi_t = \kappa \hat{y}_t + \beta E_t \left[\pi_{t+1}\right]$$

- Suppose inflation follows an AR(1) and thus $E_t \left[\pi_{t+1}\right] = \rho \pi_t$. Then

$$\pi_t = \frac{1}{1 - \beta\rho} \kappa \hat{y}_t$$

- With $\beta = 0.99$, $\rho = 0.95$, and $\kappa = 0.045$, we have $\pi_t = 0.76 * \hat{y}_t$.

- Resolving the puzzle:
  - Flat NKPC (Christiano-Eichenbaum-Rebelo, 2011)
  - Small output gap (Christiano-Eichenbaum-Trabandt, 2015)
  - New channel raising inflation (Gilchrist-Schoenle-Sim-Zakrajšek, 2017)
  - Non-linear NKPC and Kimball aggregator (Lindé-Trabandt, 2019)
  - This paper: Modeling of inflation expectations

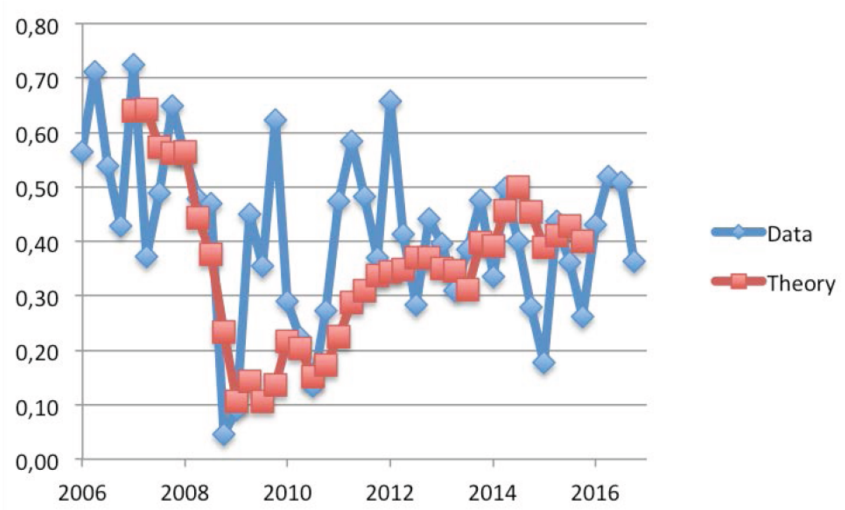
The Missing Deflation Puzzle

- New Keynesian Phillips curve:

$$\pi_t = \kappa \hat{y}_t + \beta E_t [\pi_{t+1}]$$

- Parameters and data:
  - $\kappa = 0.045$, $\beta = 0.99$
  - $\hat{y}_t$: deviation from trend from Fernald-Hall-Stock-Watson (2017)
  - π_t: quarterly core PCE inflation
  - $E_t [\pi_{t+1}]$: average forecast of quarterly core PCE inflation from SPF

The Missing Deflation Puzzle



Why Household Inflation Expectations Matter

- Consumption Euler equation

$$c_t = E_t \left[-\frac{1}{\gamma} \left(r_t - \pi_{t+1} \right) + c_{t+1} \right]$$

- Suppose a consumer expects the ZLB to be binding for exactly N periods. Solving the last equation forward yields

$$c_t = \frac{N}{\gamma} \left(-r \right) + \frac{1}{\gamma} \sum_{j=1}^{N} E_t \left[\pi_{t+j} \right] + E_t \left[c_{t+N} \right]$$

Model

- Start from benchmark New Keynesian model with zero lower bound (e.g., Eggertsson-Woodford, 2003):

$$c_t = E_t\left[-\frac{1}{\gamma}\left(\xi_{t+1} - \xi_t + r_t - \pi_{t+1}\right) + c_{t+1}\right]$$

$$\pi_t = \kappa \hat{y}_t + \beta E_t\left[\pi_{t+1}\right]$$

$$r_t = \max\left\{r, \phi \pi_t\right\}$$

- Shock: In period zero households hit by discount factor shock $\xi_0 < 0$.
- Decay: $\xi_{t+1} = \rho \xi_t$ ("deterministic"); or $\xi_{t+1} = \xi_t$ with probability μ and $\xi_{t+1} = 0$ with probability $1 - \mu$ ("stochastic").
- Expectation formation: complete information, rational expectations

Model

- There are two aggregate states, called "good" and "bad".
- $t = 0$: each household i hit by discount factor shock $\xi_{i,0} \in \{\xi_L, \xi_H\}$. In bad aggregate state, more households hit by large shock.
- Households observe own shock and form beliefs about aggregate state using Bayes' rule. Afterwards, slow updating of beliefs about aggregate state, as in Mankiw-Reis (2002).
- Simplifying assumption: Households can trade state-contingent claims in period minus one that insure them against idiosyncratic risk.

Parameters

- Preferences:

$$\beta = 0.99, \quad \gamma = 1$$

- Slope of Phillips curve:

$$\kappa = 0.045 \text{ (labor share} = 2/3, \text{ Calvo parameter} = 2/3, \ \psi = 10)$$

- Taylor rule:

$$\phi = 1.5$$

- Shocks:
  - size

$$\Delta_{i,0} \in \{0.42/100, 0.62/100\}, \quad \lambda \in \{1/4, 3/4\}$$

  - persistence

$$\rho = 0.99, \quad \mu = 0.95$$

  - prior probability of good state

$$\theta = 0.9$$

- Information diffusion:

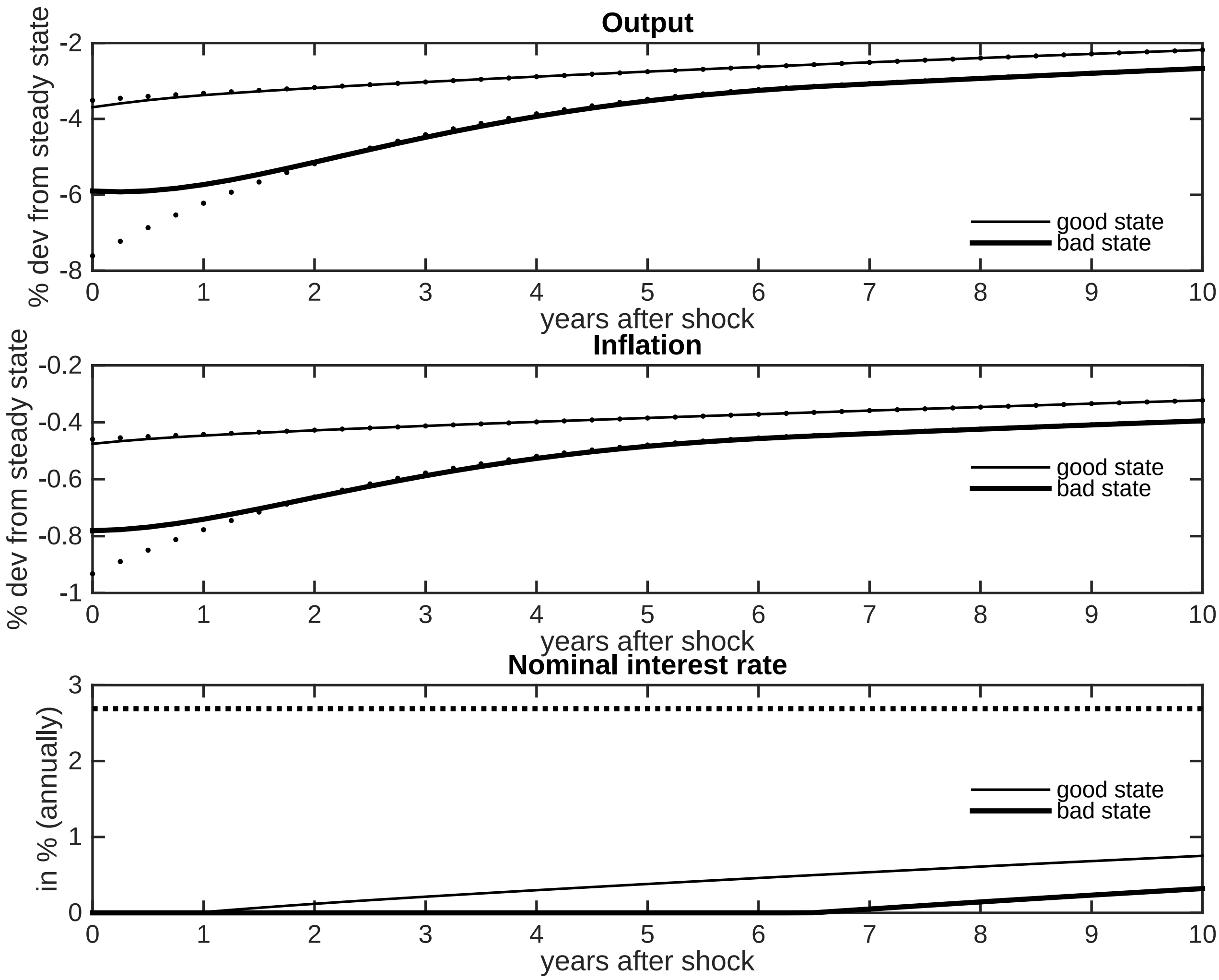
$$\omega = 0.125$$

Bayesian Learning about Persistence

- So far: Every period $t \geq 1$, economy switches to steady state with probability $1 - \mu$ and does not switch to steady state with probability μ. The parameter μ is common knowledge.
- Now: Bayesian learning about μ
- Prior for $1 - \mu$: beta distribution with parameters $\alpha > 0$ and $\beta > 0$
- Posterior for $1 - \mu$ in period $t \geq 1$: beta distribution with parameters $\alpha + n$ and $\beta + t - n$, where n is number of switches that have occurred.
- Agents take into account uncertainty about μ and anticipate how they will revise beliefs about μ.
- Parameters:

$$E[1 - \mu] = \frac{\alpha}{\alpha + \beta} = 0.25$$

α high



Output
% dev from steady state
-2
-4
-6
-8
0 1 2 3 4 5 6 7 8 9 10
years after shock
good state
bad state
Inflation
% dev from steady state
-0.2
-0.4
-0.6
-0.8
-1
0 1 2 3 4 5 6 7 8 9 10
years after shock
good state
bad state
Nominal interest rate
in % (annually)
3
2
1
0
0 1 2 3 4 5 6 7 8 9 10
years after shock
good state
bad state

Policy Implications

- Suppose the central bank can commit to a communication strategy in $t = 0$.
- Suppose the central bank considers two alternatives:
  1. Reveal aggregate state in all states ("speak").
  2. Reveal aggregate state in no state ("don't speak").
- Result: The communication strategy that maximizes ex-ante utility of households is "don't speak."

Conclusions

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