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.
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
New Keynesian Phillips curve:

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

Suppose inflation follows an AR(1) and thus $E_t [\pi_{t+1}] = \rho \pi_t$. 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 $\pi_t = 0.76 \times \hat{y}_t$.

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
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)
- \( \pi_t \): quarterly core PCE inflation
- \( E_t [\pi_{t+1}] \): average forecast of quarterly core PCE inflation from SPF
The Missing Deflation Puzzle

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Expectations and the Zero Lower Bound

Data
Theory
Why Household Inflation Expectations Matter

- **Consumption Euler equation**

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

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

\[ c_t = \frac{N}{\gamma} (-r) + \frac{1}{\gamma} \sum_{j=1}^{N} E_t [\pi_{t+j}] + E_t [c_{t+N}] \]
Start from benchmark New Keynesian model with zero lower bound (e.g., Eggertsson-Woodford, 2003):

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

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

\[ r_t = \max \{ r, \phi \pi_t \} \]

- **Shock**: In period zero households hit by discount factor shock \( \zeta_0 < 0 \).
- **Decay**: \( \zeta_{t+1} = \rho \zeta_t \) (“deterministic”); or \( \zeta_{t+1} = \zeta_t \) with probability \( \mu \) and \( \zeta_{t+1} = 0 \) 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 $\mu$. The parameter $\mu$ is common knowledge.
- Now: Bayesian learning about $\mu$
- 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 $\mu$ and anticipate how they will revise beliefs about $\mu$.
- Parameters:
  \[
  E[1 - \mu] = \frac{\alpha}{\alpha + \beta} = 0.25
  \]
  $\alpha$ high
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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