Discussion

of

Structural Inflation Modeling Papers

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Overview

1. Theory vs Data

a. Measuring and Modeling “Persistence”

b. Matching the Micro-Data

2. Implications of State Dependence
Baseline Model: (Gali Gertler (1999))

• “Hybrid” Phillips Curve (NKPC meets FM):

\[ \pi_t = \gamma_f E_t \pi_{t+1} + \gamma_b \pi_{t-1} + \lambda m c_t + u_t \]

• \((\lambda, \gamma_f, \gamma_b)\) depend on

\(\theta: \) degree of price rigidity
\(\omega: \) fraction of rule of thumb price setters
(or degree of indexation)
\(\beta: \) discount factor.
• Closed Form:

\[ \pi_t = \delta_1 \pi_{t-1} + \frac{1}{\delta_2 \gamma_f} \sum_{i=0}^{\infty} \left( \frac{1}{\delta_2} \right)^i E_t \{ \lambda m c_{t+i} + u_{t+i} \} \]

with

\[ \delta_1, \delta_2 = \frac{1 - \sqrt{1 - 4 \gamma_f \gamma_b}}{2 \gamma_f} \]

• \( \delta_1 \) measures “intrinsic persistence.”

• Two polar cases:

1. \( \gamma_b = \gamma_f = 0.5 \Rightarrow \delta_1 = 1 \)

2. \( \gamma_b = 0 \quad \Rightarrow \delta_1 = 0 \)
Results for baseline model

• $\gamma_b$ statistically significant but $\gamma_f$ predominant

\[
\gamma_b \approx 0.36 \\
\gamma_f \approx 0.63
\]

$\Rightarrow$

\[
\delta_1 \approx 0.6
\]

• For 1980:1 on: Estimates of $\gamma_b$ shrink in half

• Estimates of price rigidity too high - around five quarters
Subsequent Developments

• Real rigidities reduce estimates of price rigidity
  Gali, Gertler Lopez-Salido (2001)}

• System estimation, indexing
  {Christiano, Eichenbaum and Evans (2003)
  Smets and Wouters (2003)
  Giannoni, Woodford (2003)}

• Matching micro evidence on price rigidity
  Coenen and Levin (2004)}
Relevant Themes of IPN Papers

• Reduced persistence in stable monetary regimes

1. Structural estimates (Coenen, Levin), (Paloviita)
2. Reduced form evidence that controls for shifts in monetary regimes: (Levin, Natalucci and Piger)

• Open how to model persistence

1. “Taylor” contracts don’t work (Whelan)
2. “Learning” a possibility, but using survey data for expectations doesn’t eliminate persistence. (Paloviita)

• Need more thought about matching micro data (Alvarez et. al.)
Modeling Persistence: organizing facts

\[ \pi_t = \delta_1 \pi_{t-1} + \frac{1}{\delta_2 \gamma_f} \sum_{i=0}^{\infty} \left( \frac{1}{\delta_2} \right)^i E_t \{ \lambda mc_{t+i} + u_{t+i} \} \]

- 1. Estimates of \( \delta_1 \) lower in stable monetary regimes
- 2. Reduced form persistence high over whole sample
  May be lower in stable monetary regimes.
- 3. Pure forward looking model can deliver reduced form persistence
  But can’t explain intrinsic persistent inflation estimated for whole sample.
Learning

• Intrinsic persistence a feature of transitions across monetary policy regimes

• Lagged dependence may reflect serially correlated errors in expectations from learning

• Serial correlation of errors should diminish in stable regime: explains decline in lagged dependence.
• Survey data for expectations

Let $E^s_t \pi_{t+1} \equiv$ expected inflation from survey data

$$\pi_t = \beta E^s_t \pi_{t+1} + \lambda m c_t + u_t$$

with

$$E_t \pi_{t+1} = E^s_t \pi_{t+1} + \xi_t$$

where $\xi_t$ may be autocorrelated

• Mispecification from assuming R.E.

$$\pi_t = \beta E_t \pi_{t+1} - \beta \xi_t + \lambda m c_t + u_t$$

⇒ lagged dependence could reflect unobserved error
• Evidence suggest lagged dependence, even with $E_t^s \pi_{t+1}$

• Pure forward looking case

$$\pi_t = \sum_{i=0}^{\infty} \beta^i E_t \{ \lambda mc_{t+i} + u_{t+i} - \xi_{t+i} \}$$

$$\pi_t = \sum_{i=0}^{\infty} \beta^i E_t \{ \lambda mc_{t+i} + u_{t+i} \} - \sum_{i=0}^{\infty} E_t \{ \xi_{t+i} \}$$

⇒ evidence suggests $\sum_{i=0}^{\infty} \xi_{t+i}$ not strongly correlated with $\pi_{t-1}$

• Can explain smoother movement within stable monetary regime, but cannot explain persistence across how and low inflation regimes.
Shifting Trend (Cogley/Sbordone 2004):

\[ E_t \pi_t \equiv \text{expectation at } t \text{ of long term trend} \]

- Approximate phillips curve with shifting trend

\[ \pi_t = (1 - \beta)E_t \pi_t + \beta E^S \pi_{t+1} + \lambda mc_t + u_t + \Psi_t \]

\[ \pi_t = E_t \pi_t + \sum_{i=0}^{\infty} \beta^i E_t \{ \lambda mc_{t+i} + u_{t+i} + \Psi_{t+i} \} \]

- CS find, conditional on shifting trend, lagged inflation insignificant

- Need to model adjustment in beliefs about long run trend.
  \{Similar analyses in Levin and Williams (2004) and Kozicki and Tinsly (2004)\}
Figure 2: Inflation, Mean Inflation, and Trend Inflation
Matching micro data

• Time dependent models can match frequency of adjustment

  Caveat - Indexing model needs to be re-thought since it implies continuous adjustment

• Silence about matching the size of price adjustments

  Can appeal to large idiosyncratic shocks, but stretches assumption of time dependent pricing.

• Need to gather more information on adjustment hazards
• KEY ISSUE: Is time dependent framework good approximation of state dependent model for moderate inflation economies?

Maybe, maybe not.

• Adjustment frequencies stable for low inflation economies (Klenow/ Krytov)

But this is not a clear justification for time dependence (Golosov/Lucas)

With state dependence, those farthest away from target always adjust, unlike in time dependence.
\( \alpha_t \equiv \text{fraction who adjust price} \)
\( p_t^* - \hat{p}_{t-1} \equiv \text{average price change} \)
\( p \equiv \text{price index} \)

- By definition:
  \[ \pi_t = \alpha_t (p_t^* - \hat{p}_{t-1}) \]

- Pure time dependent model
  \[ \alpha_t = \alpha \]
  \[ \hat{p}_{t-1} = p_{t-1} \]

- Even if \( \alpha_t = \alpha \), state dependent models can differ because those farthest away from target adjust
  \( \Rightarrow \) more flexibility in time dependent model (roughly speaking)

  \[ | p_t^* - \hat{p}_{t-1} | > | p_t^* - p_{t-1} | \]
• Klenow and Krsytov (2004): For low inflation economy, state and time dependent models deliver similar results (Calvo vs. Dotsey, King and Wolman.)

• Golosov and Lucas (2004): With idiosyncratic shocks, state dependence can generate much greater price flexibility than equivalent time dependent model (numerical solution, no real rigidities)

• Gertler and Leahy (2004): Differences can be much smaller if we allow for real rigidities (approximate analytical solution, uniformly distributed/spatially separated idiosyncratic shocks)
Summary

• Very useful set of papers

• Future work

  1. Structural modeling of intrinsic persistence (perhaps learning with shifting trends.)

  2. Implications of state dependence.

• Future IPN project: wage dynamics.