Business Cycles
when Consumers Learn by Shopping

Ángelo Gutiérrez-Daza
Universitat Pompeu Fabra
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Consumers inflation expectations are different...

Large dispersion in beliefs about future $\pi$ ...

- Orders of magnitudes higher than that among professional forecasters

Consumers pay little attention to official $\pi$ statistics
- Rely instead on shopping experiences to form beliefs about $\pi$
- They learn by shopping
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... but also in beliefs about current $\pi$

- Heterogeneity in $\pi$ perceptions $\Rightarrow$ Heterogeneity in $\pi$ expectations
- Can’t be explained by observed heterogeneity

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The model: Standard NK model + HHs that Learn by Shopping

• Form beliefs about $\pi$ based on shopping experiences
• Information from shopping experiences is noisy
• Make decisions conditional on these beliefs
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Study the implications of learning by shopping for...

- Business Cycles (in the paper)
- Monetary Policy (in this presentation)
This paper: Learning by Shopping in a New-Keynesian Model

**The model:** Standard NK model + HHs that Learn by Shopping

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**Key takeaway:**

- Learning by shopping $\Rightarrow$ anchoring of HH’s beliefs
- Monetary policy $\Rightarrow$ Stabilize inflation $\Rightarrow$ increase degree of anchoring
- Anchored HH’s beliefs $\Rightarrow$ ↑ impact of MP shocks
The Model: Standard NK + Info. Frictions among HH’s

Firms and Central Bank: Business as usual

• Full information
• Firms face nominal rigidities a la Calvo
• Central bank follows a simple interest rate rule
The Model: Standard NK + Info. Frictions among HH’s

Firms and Central Bank: Business as usual

- **Full information**
- Firms face nominal rigidities a la Calvo
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Households $i$

- Dispersed information $\Rightarrow$ condition decisions on own information set
  - Individual **labor supply**
    $$\varphi n_{i,t} + \sigma c_{i,t} = w_{i,t} - E_{i,t} \pi_t$$
  - Individual **Euler equation**
    $$c_{i,t} = E_{i,t} c_{i,t+1} - \frac{1}{\sigma} (i_{i,t} - E_{i,t} \pi_{t+1})$$
- **Shopping experiences** $\Rightarrow$ **Idiosyncratic** and **noisy** signal about $\pi_t$
Beliefs about Inflation

• Shopping experiences ⇒ Noisy signal about the price level and inflation

\[
\pi_{i,t}^{*} = \pi_{t} + \epsilon_{i,t}, \quad \epsilon_{i,t} \overset{iid}{\sim} \mathcal{N}(0, \sigma_{\epsilon}^{2})
\]
Beliefs about Inflation

• **Shopping experiences** ⇒ Noisy signal about the *price level* and *inflation*

\[ \pi_{i,t}^* = \pi_t + \epsilon_{i,t}, \quad \epsilon_{i,t} \overset{iid}{\sim} \mathcal{N}(0, \sigma^2_\epsilon) \]

• **Bayesian updating** ⇒ Dispersion in perceptions ⇒ Dispersion in expectations

\[ E_{i,t} \pi_t = \psi_{\pi} E_{t-1} \pi_t + (1 - \psi_{\pi}) \pi_t + \epsilon_{i,t}^* \]

... and endogenous **degree-of-anchoring**:  
\[ \psi_{\pi} = 1 - \frac{\text{Var} \left[ \pi_t | I_{i,t} \right]}{\text{Var} \left[ \pi_t | I_{i,t} \right] + \sigma^2_\epsilon} \]
Beliefs about Inflation

- **Shopping experiences** ⇒ Noisy signal about the *price level* and *inflation*
  \[ \pi^*_i, t = \pi_t + \epsilon_{i,t}, \quad \epsilon_{i,t} \simiid \mathcal{N}(0, \sigma^2_\epsilon) \]

- **Bayesian updating** ⇒ Dispersion in perceptions ⇒ Dispersion in expectations
  \[ E_i, t \pi_t = \psi_\pi E_{t-1} \pi_t + (1 - \psi_\pi) \pi_t + \epsilon^*_i, t \]
  ... and endogenous **degree-of-anchoring**:
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- **Anchoring** ⇒ **Underreaction** of average beliefs
  \[ \overline{E}_t \pi_t = \psi_\pi E_{t-1} \pi_t + (1 - \psi_\pi) \pi_t \]
Inflation expectations in the Michigan Survey of Consumers

HH Expected Inflation over next 12m (Mean)
1–Std. Dev. Interval
Inflation expectations in the Michigan Survey of Consumers

HH Expected Inflation over next 12m (Mean)
Inflation expectations in the Michigan Survey of Consumers

- US 12m CPI Inflation Rate
- HH Expected Inflation over next 12m (Mean)
Anchored HH’s beliefs flatten the slope of the NKPC

Standard relationship between inflation and marginal costs...

\[ \pi_t = \beta E_t \pi_{t+1} + \lambda^{-1} (w_t - p_t); \quad \lambda \equiv \frac{\theta}{(1 - \theta)(1 - \beta \theta)} \]
Anchored HH’s beliefs flatten the slope of the NKPC

Standard relationship between inflation and marginal costs...

\[ \pi_t = \beta \mathbb{E}_t \pi_{t+1} + \lambda^{-1} (w_t - p_t); \quad \lambda \equiv \frac{\theta}{(1 - \theta) (1 - \beta \theta)} \]

...but not standard labor supply

\[ y_t = \left( \frac{1}{\varphi + \sigma} \right) \left( w_t - p_t + \frac{p_t - \mathbb{E}_t p_t}{\text{Disagreement}} \right) \]
Anchored HH’s beliefs flatten the slope of the NKPC

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\[ \pi_t = \beta E_t \pi_{t+1} + \lambda^{-1} (w_t - p_t); \quad \lambda \equiv \frac{\theta}{(1 - \theta) (1 - \beta \theta)} \]

...but not standard labor supply

\[ y_t = \left( \frac{1}{\phi + \sigma} \right) \left( w_t - p_t + \left( p_t - E_t p_t \right) \right) \]

⇒ NKPC when consumers learn by shopping

\[ \pi_t = (1 - \Psi_\pi) \beta E_t \pi_{t+1} + \Psi_\pi E_{t-1} \pi_t + \alpha_{PC} y_t \]

\[ \alpha_{PC} \equiv \frac{\sigma + \phi}{\lambda + \psi_\pi} \quad \Psi_\pi \equiv \frac{\psi_\pi}{\lambda + \psi_\pi} \quad \psi_\pi = 1 - \frac{\text{Var} [\pi_t | I_{i,t}]}{\text{Var} [\pi_t | I_{i,t}] + \sigma^2_\epsilon} \]
Monetary Policy: A Counterfactual Exercise

• Simple interest rate rule

\[ i_t = \phi_\pi \pi_t \]

• Calibration: post-Volcker period
  • Costs of attention ⇒ Behavior of HH inflation expectations in Mich. Survey
  • Volatility and persistence of shocks ⇒ Match behavior of inflation post-Volcker

• Counterfactual exercise
  • Change in MP stance: ↑\( \phi_\pi \) from 1.0 to 1.5
  • Study IRF to AD shock
Counterfactual: AD shock Pre-Volcker

Inflation ($\pi$)

Perceived Inflation ($\hat{\pi}$)

Output ($y$)

AD shock ($z$)
Counterfactual: AD shock Post-Volcker (Full Info)

Inflation ($\pi$)

Output ($y$)

Perceived Inflation ($\hat{\pi}$)

AD shock ($z$)
Counterfactual: AD shock Post-Volcker (LBS + Exog. Info.)

Inflation ($\pi$)

Output ($y$)

Perceived Inflation ($\hat{\pi}$)

AD shock ($z$)

\[
\tau = 1 + \text{Endog. Info.}
\]

\[
\tau = 1.5 + \text{Full. Info.}
\]

\[
\tau = 1.5 + \text{Exog. Info.}
\]
Counterfactual: AD shock Post-Volcker (LBS + Rational Inattention)

Inflation ($\pi$)

Output ($y$)

Perceived Inflation ($\hat{\pi}$)

AD shock ($z$)
Concluding remarks

- **HH’s inflation expectations**...
  - Reveal information about their expectations of future...
  - But also reveal information about their perceptions of current inflation and cost of living

- Success stabilizing inflation **anchors** HH’s beliefs about inflation
  - Reflected in lack of knowledge about CPI inflation
  - Slow reaction of average beliefs to news about inflation
  - Greenspan/Bernanke: “price stability is when no-one is talking about inflation (sic)”

- **Anchoring** HH’s beliefs ⇒ **Amplification** of the impact of monetary policy on economic activity
Thank you for your attention!