Learning by Shopping:

Consumers' Uncertainty and Monetary Shocks

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Introduction

Broad consensus:

- Information frictions play central role in household expectations
- Household inflation expectations key to monetary policy transm.

Novel evidence:

- Inflation expectations influenced by prices experienced in shopping

  Cavallo-Cruces-PerezTruglia (2017), D'Acunto-Malmendier-Ospina-Weber (2019)

This paper

- transmission of monetary policy when consumers learn from prices
- value of targeting communication to consumers vs firms

The framework in a nutshell

Consumers see local p but not aggregate P. Decide in sequence:

1. if switching to global seller (p vs P^e): extensive margin
2. consumption at expected income $W^e \propto P^e$: intensive margin

Aggregate demand:

$$C = \overbrace{\underbrace{n(p/P^e)}_{\text{ext.: customers}} \times \underbrace{c(p/P^e)}_{\text{int.: quantities}}}^{\text{from local seller}} + \overbrace{\underbrace{[1 - n(p/P^e)]}_{\text{ext.: customers}} \times \underbrace{\bar{c}(1)}_{\text{int.: quantities}}}^{\text{from global seller: } \bar{c} > c}$$

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Transmission of P to C:

- $P \uparrow \implies p/P^e \uparrow$ or $p/P^e \downarrow$? Consumer vs Firm uncertainty
- $p/P^e \uparrow \implies C \uparrow$ or $C \downarrow$? Extensive vs Intensive margin

Preview of the results

1. **Output effects** of P increase with firm-consumer information gap

2. **Welfare:** firm “signaling power” amplifies gains from stable P

3. **Communication:** to households is good, to firms is often bad

Roadmap

1. Literature review (not for today)

2. Backbone model with perfectly informed firms and 3 parameters
   - constant elasticity $\lambda > 0$ of extensive demand $n(p/P^e)$
   - constant elasticity $\gamma > 0$ of intensive demand $c(p/P^e)$
   - consumer learning from price:

$$\ln P^e = \omega \ln(p), \qquad \omega \in (0, 1)$$

3. General info structure: ω endogenous

4. Micro-founded consumer problem, GE, calibration and experiments

The supply

- Aggregate nominal shock to wage w; local shock to cost z
- *Global competitive* firm (e.g. discount superstore) posting price

$$P = w$$

- *Local monopolistic* firms (e.g. convenience stores) under <u>no commit.</u>:

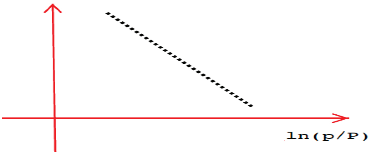
$$\max_p \; n(p/P^e)\, c(p/P^e)\; [p - w\, z]$$

Optimal pricing: $p = \mu \times w\, z$

$$\mu = \frac{\overbrace{(\lambda+\gamma)}^{\text{elasticity to } p/P} \quad (1-\omega)}{(\lambda+\gamma) \quad \underbrace{(1-\omega)}_{\text{signaling power}} \quad -1}.$$

An illustration of local firm demand

Perfectly informed consumers ($\omega = 0$):



(a) slope to idiosyncratic p/P: $-(\lambda + \gamma)$

(b) slope to aggregate P: 0

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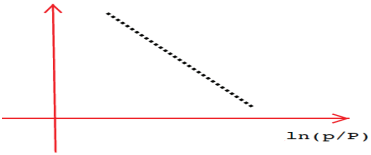

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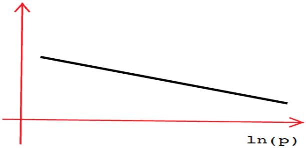
Uninformed consumers ($\omega > 0$):



(a) slope to p: $-(\lambda + \gamma)(1 - \omega)$

- lower elasticity to idiosyncratic; higher elasticity to aggregate

Transmission of nominal shocks

Proposition An inflationary shock is expansionary on output iff

$$\underbrace{(1-\omega)\,\lambda\,(\mu^{\gamma}-1)}_{demand\ gain\ of\ switchers} \quad > \quad \underbrace{(1-\omega)\,\gamma}_{demand\ loss\ of\ stayers}$$

Special case: $\gamma = 1$ (constant nominal expenditure)

- expansionary with signaling power, i.e. $\omega > 0$, <u>for all $\lambda > 0$</u>

- converges to neutrality as $\omega \to 0$

Uncertain Firms and Endogenous Learning

Information

1. $\ln z \sim N(0, \sigma_z^2)$ and $\ln P \sim N(0, \sigma_P^2)$ independent Gaussian
2. competitive firms have full information (normalization)
3. local firm info:

$$\Omega_j = \{x_j : \ln P + \eta_j,\ z_j\} \quad \text{with} \quad \eta_j \sim N(0, \sigma_x)$$

4. consumer $i \in n_j$ info:

$$\Omega_i = \{y_i : \ln P + \epsilon_j,\ p_j\} \quad \text{with} \quad \epsilon_j \sim N(0, \sigma_y)$$

Sufficient statistics for precision of information on aggregate state:

$$\text{firms: } \delta \equiv \frac{\partial E[\log P|\Omega_j]}{\partial \log P}, \quad \text{consumers: } \zeta \equiv \frac{\partial E[\log P|\Omega_i]}{\partial \log P}$$

Firms better informed than consumers if $\delta > \zeta$

Transmission of nominal shocks

Proposition An inflationary shock is expansionary on output iff

$$\underbrace{(\delta-\zeta)\,\lambda\,(\mu^{\gamma}-1)}_{\text{extensive margin}} - \underbrace{(\delta-\zeta)\,\gamma}_{\text{intensive margin}} > 0$$

- standard NK logic: $\lambda = 0$ and $\zeta > \delta$

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Proposition Pass-through to paid prices is incomplete if:

$$\frac{\partial \ln S(P)}{\partial \ln P} = \delta - (\delta-\zeta)\,\lambda\,\frac{\bar{n}\,(\mu-1)}{\bar{n}\,(\mu-1)+1} < 1$$

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- standard NK logic: $\lambda = 0$ & $\zeta > \delta \implies$ paid=sticky posted prices
- this paper: $\lambda > 0 \implies$ paid $\neq$ posted prices; paid stickier iff $\zeta < \delta$

Markups, Profits and Communication

Targeting ω has first order effects on welfare through markups:

$$\mu = \frac{(\lambda+\gamma)(1-\omega)}{(\lambda+\gamma)(1-\omega)-1}.$$

1. Targeting communication to consumers reduces markups:
   - $\sigma_y/\sigma_x \to 0 \implies \omega \to 0 \implies \mu \downarrow$ even if $\sigma_P >> 0$
   - Corollary: More info to firms ($\sigma_x \to 0$) may be bad for welfare!

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   - $\sigma_P \to 0 \implies \omega \to 0 \implies \mu \downarrow$

3. Targeting communication to consumers <u>increases</u> firm profits
   - Hint: pricing without commitment leads to too high μ

Micro-foundation of demand and Calibration

Households

Household $i \in n_j$ chooses $s_{it} \in \{0,1\}$, $c_{it} \in \mathbb{R}^+$ and $\ell_{it} \in \mathbb{R}^+$ to max

$$\sum_{\tau=t}^{\infty} \beta^{\tau-t} \left[\ln c_{i\tau} - \varphi\, \ell_{it} + \kappa \ln\left(\frac{\mathrm{m}_{i\tau+1}}{p_{i\tau}}\right) - (\bar{\psi} + \psi_{i\tau})\, s_{i\tau} \right],$$

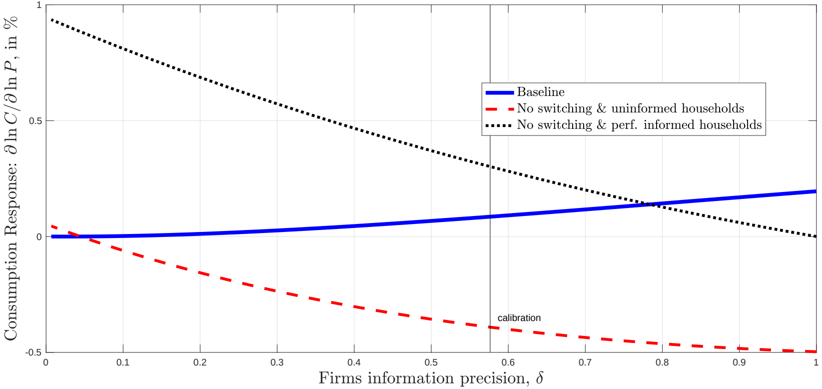
subject to: $$p_{it}\, c_{it} + \frac{b_{it+1}}{R_t} + \mathrm{m}_{it+1} \leq w_t\, \ell_{it} + b_{it} + \mathrm{m}_{it} + \Pi_t - T_t$$

$$p_{i\tau} = \begin{cases} p_{j\tau} & \text{if} \quad s_{i\tau} = 0 \quad \text{(local price)} \\ P_\tau & \text{if} \quad s_{i\tau} = 1 \quad \text{(competitive price)} \end{cases}$$

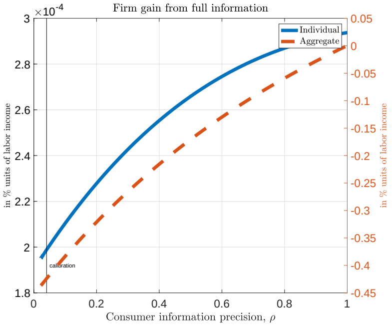
- $\ln R_t$ Gaussian nominal shock i.i.d. over time
- $\psi_{i\tau} \sim \exp(\lambda^{-1})$ i.i.d. across agents and time

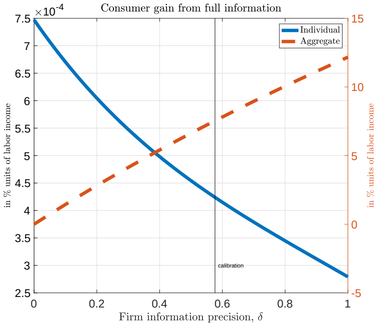
Model		Data	
Parameter	Value	Target Moment	Value
σ_P	0.0035	Volatility of CPI inflation	0.0035
$\bar{\psi}$	0.1264	Mkt share of e-commerce	0.25
λ	7	From Paciello et al. (2019)	7
		Firm uncertainty from Cavallo (2018):	
σ_x	0.0030	short/long run FX pass-through to p	0.57
		Consumer uncertainty from D'Acunto et al. (2018):	
σ_z	0.0053	slope of regression of Π^e on p, ω	0.19
σ_y	0.0163	R^2 of regression of Π^e on p	0.775

The propagation of Money Shocks



The Value of Communication





Conclusions

New theory of money non-neutrality that:

- does not rely on posted price stickiness
- is centered around consumers' uncertainty
- speaks to recent observable statistics on consumer behavior

We emphasize four points:

- consumers' uncertainty gives more market power to firms

- this increases markups, hurting welfare but also firms' profits

- nominal stabilization is desirable (different reasons than NK)

- releasing info is socially inefficient when mainly firms absorb it

Related Literature

- **Consumers' search in GE**: Coibion, Gorodnichenko, and Hong (AER, 2015); Kaplan and Menzio (JPE,2016),...
  - They have a real shock, switching linked to unemployment
- **Extensive margins**: Phelps and Winter (1970), Rotemberg and Woodford (1999), Paciello, Pozzi, and Trachter (IER, 2019),...
  - Switching occurs under no nominal uncertainty
- **Learning from Prices**: Lucas (AER, 1972), Amador and Weill (JPE, 2010), Gaballo (REStud, 2018), Chahrour and Gaballo (2020)
  - No signaling power
- **Consumers' expectations and shopping**: D'Acunto, Malmendier, Ospina, and Weber (2019), Menzio and Kaplan (IER, 2015) ...
  - No model

Consumers' decisions

1. Extensive margin: switch if $\psi_{it} \leq \hat{\psi}(p_{jt}, P^e_{jt})$ with

$$\hat{\psi}(p_{jt}, P^e_{jt}) = \ln \frac{P^e_{jt}}{p_{jt}} + V(F_{m_j}) - \bar{\psi}$$

2. Intensive margin:

$$c(p_{it}, P^e_{it}) = \frac{1}{\varphi} \frac{P^e_{it}}{p_{it}} e^{-\frac{1}{2}V(F_i)}$$

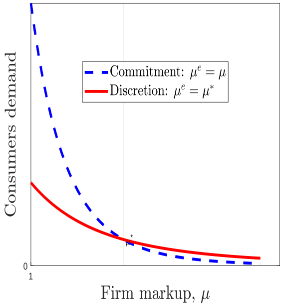
with $P^e_{it} = E\left[P_t \,|\, p_{it}, \Omega_{m_{jt}}\right]$ and $F_i \equiv \ln P_t - E\left[\ln(P_t) | \, p_{it}, \Omega_{m_{jt}}\right]$

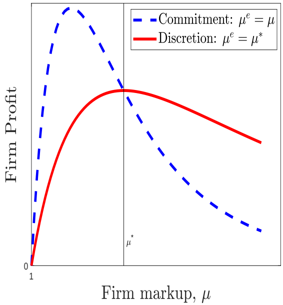
3. Saving/labor

$$w_t = \beta \, R_t \, \bar{w} \implies \ln P_t = \ln w_t \quad \sim N(0, \sigma^2_P)$$

Result I: Firm profit with signaling

Proposition As the signaling power increases, $\omega \uparrow$, firm's markup increases, $\mu \uparrow$, but profits fall for each realization of z and P.





Uncertainty: firms vs consumers

Sufficient statistics:

firms: $$\delta \equiv \frac{\partial E[\log P | \Omega_j]}{\partial \log P} = \frac{\sigma_P^2}{\sigma_P^2 + \sigma_x^2}$$

consumers: $$\zeta \equiv \frac{\partial E[\log P | \Omega_i]}{\partial \log P} = \omega\, \delta + \rho$$

with

$$\overbrace{\omega = \frac{(1-\rho)\, \delta\, \sigma_P^2}{\delta^2\, \sigma_P^2 + \delta^2\, \sigma_x^2 + \sigma_z^2}}^{\text{signaling power}}, \quad \overbrace{\rho = \frac{\sigma_y^{-2}}{\sigma_s^{-2} + \sigma_P^{-2} + \sigma_y^{-2}}}^{\text{consumer prior}}, \quad \sigma_s^2 = \delta^{-2}\, \sigma_z^2 + \sigma_x^2.$$