Spending Allocation under Nominal Uncertainty: A Model of Effective Price Rigidity

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The Paper in a Nutshell

⋆ Countercyclical markups in aggregate key to get $\pi\uparrow$ and $c\uparrow$

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facts →

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⋆ A demand-driven mechanism of **aggregate** countercyclical markups...

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⋆ A demand-driven mechanism of **aggregate** countercyclical markups...

...with fixed (but increasing with Hs' unc.) firm-level markups.

Related Literature

- **Consumers' search in GE**: Coibion, Gorodnichenko, and Hong (AER, 2015); Kaplan and Menzio (JPE,2016)
  - Them: real determinants (unemployment) of search cost;
  - Us: real search cost are fixed, nominal shocks influence exp. payoffs;
- **Extensive margins**: Phelps and Winter (1970), Rotemberg and Woodford (1999), Paciello, Pozzi, and Trachter (IER, 2019), Michelacci, Paciello, Pozzi (2020) - No nominal uncertainty;
- **Learning from Prices (IO)**: Fishman (QJE, 1996), Benabou and Gertner (REStud,1993), Janssen and Shelegia (AER, 2015) - they do not look to the typical firm's problem in macro;
- **Learning from Prices - Uncertainty (Macro)**:Lucas (AER, 1972), Amador and Weill (JPE, 2010), Gaballo (REStud, 2018), Chahrour and Gaballo (REStud, forth.) - Learning from competitive prices: no signaling power;
- **Households' uncertainty**: Angeletos and La' O (JPE, 2020); Farhi and Werning (AER, 2019); Gabaix (AER, 2020); McKay, Nakamura and Steinsson (AER, 2016) etc... + Mackowiak and Wiederholt (ReStud, 2015) - Non-neutrality relies anyway on firms' rigidity.

Outline

- Model
- Demand-Driven Business Cycles
  - Aggregate Counter-Cyclical Markup
  - Firm-level Markups: A-cyclical but Endogenous to Hs' Uncertainty
  - Welfare
- Empirics: a test of inflation-driven shopping reallocation
- Extensions
  - Households' vs Local Firms' Uncertainty
  - Targeted Communication
  - Local Varieties
  - Firms' Common Uncertainty (sticky prices)

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Elements of the model

- Two markets for goods: local (markups > 0) and competitive (no markups)
- Hs exert shopping effort to buy in competitive markets
  - drive to distant locations (Walmart vs local Safeway)
  - search info about local markets on temporary sale
  - search info to arbitrage across shops for different varieties
  - behavioral/psycological, shopping habits
- Local productivity blurs the correlation of local prices with aggregate nominal shocks
- When deciding on shopping effort Hs forecast inflation with local prices

  $\rightarrow$ firms set prices without any friction

Model: Households

Household $i \in [0,1]$ on island $j \in [0,1]$:

$$E\left[\sum_{\tau=t}^{\infty}\beta^{\tau-t}\left(\frac{c_{ij\tau}^{1-\frac{1}{\gamma}}}{1-\frac{1}{\gamma}} - \varphi\ell_{ij\tau} - \psi_{ij}\, s_{ijt}\right)\Big|\Omega^{u}_{i,j,t}\right] \tag{1}$$

with shopping effort cost ψ_{ij}, with $s_{ijt} \in \{0,1\}$.

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$$c_{ijt}\, \mathcal{P}(s_{ijt}) + R_t^{-1} b_{ijt} = W_t \ell_{ijt} + b_{ijt-1} - T_t \tag{2}$$

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where ψ_{ij} is distributed as in a generalized Pareto

$$G(\psi) = 1 - \kappa\left(1 - \frac{\psi}{\Psi}\right)^{\frac{\lambda}{\gamma-1}},$$

with $\kappa > 0$, $\lambda > 0$, and $\Psi = \frac{\varphi^{\gamma-1}}{\gamma-1}$ with support

$$[\underline{\psi}, +\infty] \text{ with } \gamma \leq 1 \qquad\qquad [\underline{\psi}, \Psi + \underline{\psi}] \text{ with } \gamma > 1$$

where $\underline{\psi}$ such that $G(\underline{\psi}) = 0$.

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Model: Timing

Shocks and prices
P_t and p_{jt} realize

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Stage 1,

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Observe
$\Omega^s_{ijt} = \{p_{jt}\} \cup \Omega_{t-1}$

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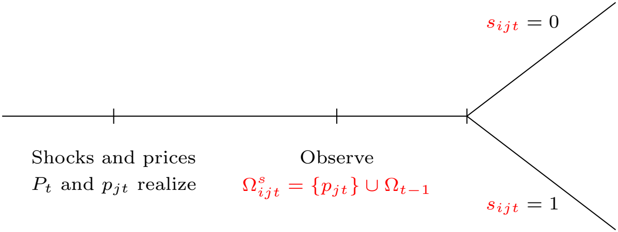
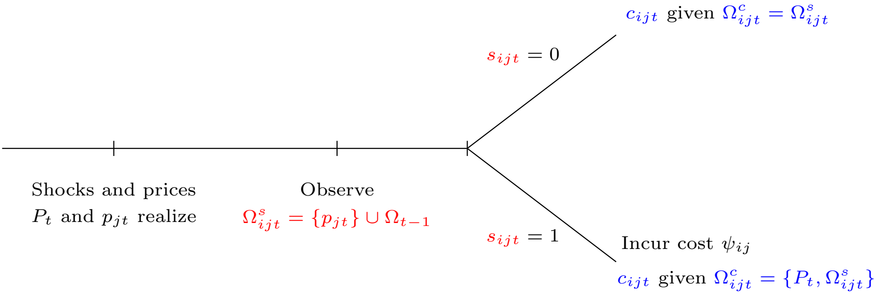


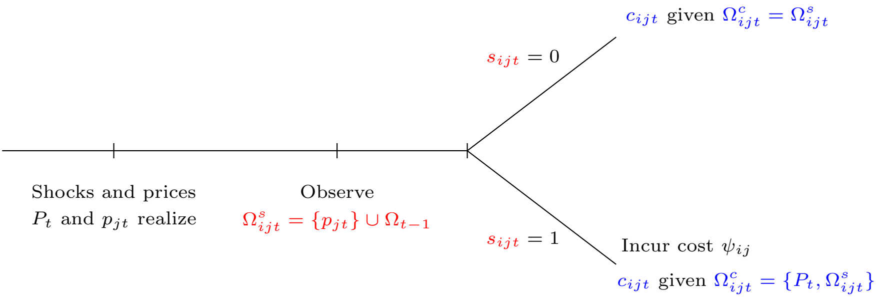
Model: Timing

Stage 1, Stage 2,



Model: Timing

Stage 1, Stage 2, Stage 3



$\{\ell_{ijt}, b_{ijt}\}$ in centralized markets $\Rightarrow$ full info $\Omega_t = \{P_t, \Omega_{t-1}\}$.

Model: Firms

- *Distant* competitive firms : linear technology in labor, thus

$$P_t = W_t \tag{3}$$

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- *Local* heterogeneous monopolist : maximize real profits under full info

$$\max_{p_{jt}} \left\{ \underbrace{\mathcal{N}(p_{jt})\,\mathcal{C}(p_{jt})}_{D(p_{jt})} \left(\frac{p_{jt}}{W_t} - z_{jt} \right) \right\} \tag{4}$$

where :

- $\ln z_{jt} \sim N(z, \sigma_z)$ are i.i.d. productivity shocks
- $\mathcal{N}(p_{jt}) \subset (0,1)$ is the mass of agents buying local
- $\mathcal{C}(p_{jt})$ denotes individual local consumption

- Aggregate shocks to:

$$\pi_t^w \equiv \ln W_t - E[\ln W_t|\Omega_{t-1}]$$

with $\pi_t^w \sim N(0, \sigma^2_{\pi^w})$, where $\pi_t^w = \pi_t$ from perf. competitive behavior.

Model: Aggrgeate Shocks and Monetary Policy

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- In particular, Monetary Policy implements the following AR(1) process

$$\ln \Pi_t = \chi \ln \Pi_{t-1} + \pi_t, \tag{5}$$

by appropriately setting R_t and T_t.

Equilibrium Definition

Definition

Given the past price level and inflation $\{P_{t-1}, \Pi_{t-1}\}$ and a distribution of bond holdings $\{b_{ijt-1}\}_{i,j\in[0,1]\times[0,1]}$, the realizations of aggregate and idiosyncratic shocks, π_t and $\{z_{jt}\}_{j\in[0,1]}$ respectively, a *log-normal equilibrium* is a collection of log-normally distributed prices $\{P_t, W_t, R_t, \{p_{jt}\}_{j\in[0,1]}\}$, and quantities $\{s_{ijt}, c_{ijt}, b_{ijt}, \ell_{ijt}\}_{i,j\in[0,1]\times[0,1]}$ at time t such that:

- in each island j, each household i chooses $\{s_{ijt}, c_{ijt}, b_{ijt}, \ell_{ijt}\}$ to maximize the expected utility (1) subject to the sequence of budget constraints in (2);
- s_{ijt} and c_{ijt} are chosen first, according to the infromation sets Ω^s_{ijt} and Ω^c_{ijt} respectively, b_{ijt} and ℓ_{ijt} are chosen at the end of the period under perfect information;
- in each island j, p_{jt} solves the firm problem in (4);
- W_t and P_t are determined, respectively, by equations (3) and (5);
- R_t and T_t guarantee the equilibrium in the bond market, consistently with the monetary policy target in (5);
- $\int s_{ijt}di > 0$ holds almost surely in all islands.

A non-trivial fixed point: demand elasticity along extensive margins influence pricing, in turn pricing influences shopping choices by affecting Hs' expectations on p_{jt}/P_t.

Markets open sequentially. At time t, H chooses:

STAGE 1 $s_{ijt} = 0$ iff:

$$E\left[V_{jt}(\psi_{ij};0) - V_{jt}(\psi_{ij};1) \mid \{p_{jt}\}\right] \geq 0.$$

i.e. iff $\psi_{ij} > \hat{\psi}_{jt}$, with $\hat{\psi}_{jt}$ being an equilibrium object.

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STAGE 2 Consumption c_{ijt}:

$$c_{ijt}^{-\frac{1}{\gamma}} = \varphi\, E\left[\frac{\mathcal{P}(s_{ijt})}{W_t} \;\middle|\; \{\mathcal{P}(s_{ijt}), p_{jt}\}\right].$$

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STAGE 3 Labor ℓ_{ijt} and Bonds b_{ijt}:

$$1 = \beta\, R_t\, E_t\left[\frac{W_t}{W_{t+1}} \,\middle|\, \{\mathcal{P}(s_{ijt}), p_{jt}, W_t,\, R_t\}\right].$$

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Shocks to R_t translates in shocks to

$$\pi_t^w \equiv \ln W_t - E[\ln W_t | \Omega_{t-1}]$$

where $\pi_t^w \sim N(0, \sigma^2_{\pi^w})$ represents a stochastic innovation to wage inflation.

Equilibrium Proposition

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$\star$ the mass of households purchasing in island j is given by

$$\mathcal{N}_{jt}(p_{jt}) = \kappa^{\frac{\lambda}{\gamma-1}}\, e^{-\lambda\left(\ln p_{jt} - E\left[\ln P_t \,|\, \Omega^s_{jt}\right] + \frac{1}{2}\mathcal{S}\right)},$$

with $\hat{\psi}_{jt} = \frac{\Psi}{\kappa}[1 - e^{(1-\gamma)\left(\ln p_{jt} - E\left[\ln P_t \,|\, \Omega^s_{jt}\right] + \frac{1}{2}\mathcal{S}\right)}] \geq 0$ for any j almost surely;

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⋆ the consumption of household i initially matched to a island j is

$$c_{ijt} = \begin{cases} \mathcal{C}_{jt}(p_{jt}) \equiv C^*\, e^{-\gamma\left(\ln p_{jt} - E\left[\ln W_t \,|\, \Omega^s_{jt}\right] + \frac{1}{2}\mathcal{S}\right)} & \text{if } \psi_{ij} > \hat{\psi}_{jt} \\ C^* \equiv \varphi^{-\gamma} & \text{otherwise} \end{cases};$$

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$\star$ the optimal price posted by the monopolistic firm in island j is

$$p_{jt} = \underbrace{\frac{(\gamma+\lambda)(1-\omega)}{(\gamma+\lambda)(1-\omega)-1}}_{\mu} \times \frac{W_t}{z_{jt}},$$

provided z is suff. large relative to σ_z, and $(\gamma+\lambda)(1-\omega) > 1$.

Cartoon Summary

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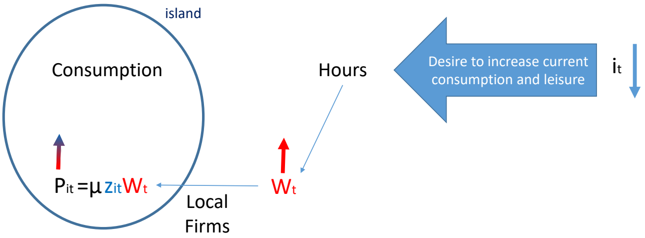

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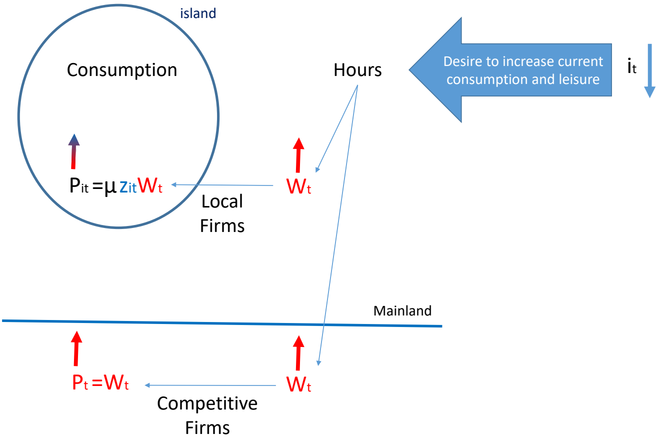

Two types of firms: local (high markup) and competitive (low/no-markup)

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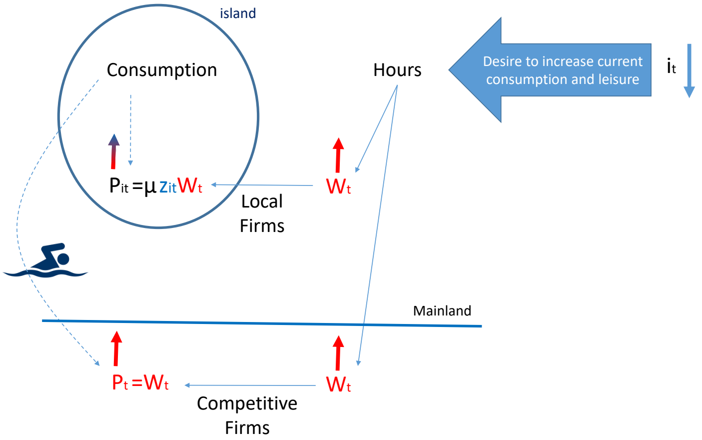

Two types of firms: local (high markup) and competitive (low/no-markup)

Real rigidity: Shopping costs individual-specific effort.

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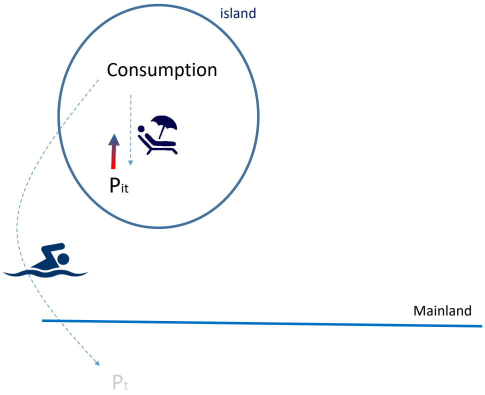

Two types of firms: local (high markup) and competitive (low/no-markup)

Info rigidity: Shopping choice conditional to local prices only.

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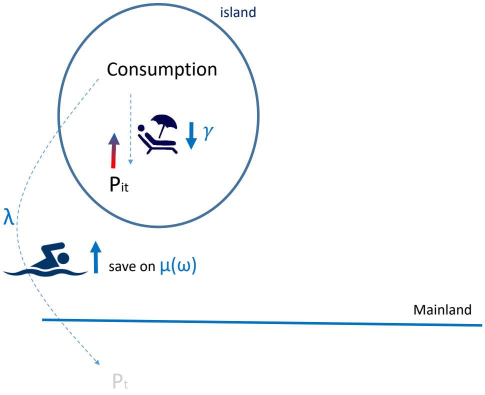

Conditional to an aggregate nominal shock:

- swimmers: $\uparrow$ consumption due to $\downarrow$ markup $\Rightarrow$ ***effective* price rigidity**

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Demand-Driven Business Cycle Fluctuations

Agg. consumption (switchers + non-switchers) of agents type j:

$$C_{jt} - C^* = \underbrace{\mathcal{N}(p_{jt})}_{\substack{\text{mass of local buyers} \\ \downarrow \text{ with } P_t \\ \text{less positive}}} \times \underbrace{(\mathcal{C}(p_{jt}) - C^*)}_{\substack{\text{local consumption loss} \\ \downarrow \text{ with } P_t \\ \text{more negative}}}$$

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In particular:

$$\ln C_t - \ln \bar{C} \approx [\lambda \, \mu(\omega)^\gamma - \lambda - \gamma] \, \bar{\alpha} \, (1 - \omega) \, \pi_t,$$

with $\bar{\alpha}$ denoting the steady state share of expenditure in the local market, and $\bar{C}$ steady state aggregate consumption.

Agg. consumption (switchers + non-switchers) of agents type j:

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⋆ N.B.: With $\lambda = 0$ the comovement would be negative!

Demand-Driven Business Cycle Fluctuations

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⋆ N.B.: With $\lambda = 0$ the comovement would be negative!

- This is why firms must be bad compared to Hs in the NK framework.

Aggregate Countercyclical Markup

The effective average markup:

$$\mathcal{M}_t^{eff} \equiv \frac{P_t^{eff}}{W_t} = 1 + \alpha_t \, (\mu - 1) \, ,$$

where α_t denotes the market share of local sellers and is given by

$$\alpha_t = \frac{\bar{\mathcal{N}} \, \bar{\mathcal{C}} \, e^{-(\lambda+\gamma)\,(1-\omega)\pi_t}}{1 - \bar{\mathcal{N}} \, e^{-\lambda\,(1-\omega)\pi_t} + \bar{\mathcal{N}} \, \bar{\mathcal{C}} \, e^{-(\lambda+\gamma)\,(1-\omega)\pi_t}} .$$

where $\bar{\mathcal{C}}$, $\bar{\mathcal{N}}$ denote steady states values.

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where $\bar{\mathcal{C}}$, $\bar{\mathcal{N}}$ denote steady states values.

α_t co-moves negatively with π_t, in fact:

$$\ln \alpha_t - \ln \bar{\alpha} \approx - \left[\bar{\alpha} \, \lambda \, \mu^{\gamma} + (1 - \bar{\alpha}) \, (\gamma + \lambda) \right] \, (1 - \omega) \pi_t$$

where $\bar{\alpha}$ is the value of α_t at $\pi_t = 0$.

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The aggregate markup is countercyclical.

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The aggregate markup is countercyclical.

Let us now turn to how ω shapes μ

→ ω denotes the elasticity of Hs' inflation exp. w.r.t. local prices.

$$E[\pi_t \,|\, \Omega_t^s] = \underbrace{\frac{\sigma_z^{-2}}{\sigma_\pi^{-2} + \sigma_z^{-2}}}_{\omega} \left(\ln p_{jt} - E[\ln p_{jt} | \Omega_{t-1}] \right).$$

Learning from Prices and Local Markups

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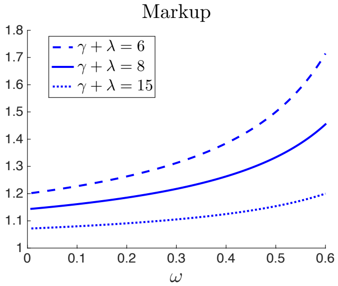
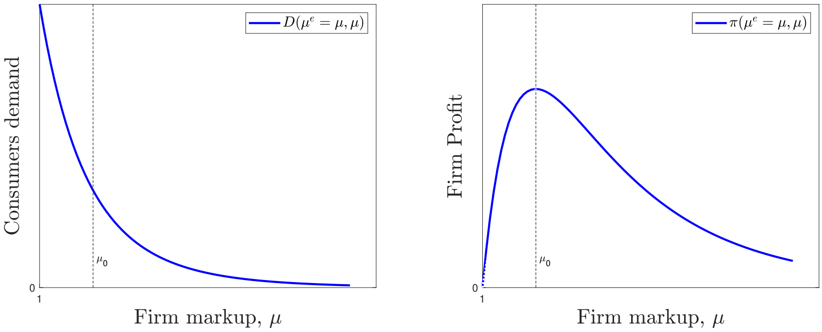
$$E[\pi_t \,|\, \Omega_t^s] = \underbrace{\frac{\sigma_z^{-2}}{\sigma_\pi^{-2} + \sigma_z^{-2}}}_{\omega} \left(\ln p_{jt} \;-\; E[\ln p_{jt} | \Omega_{t-1}] \right).$$



The optimal markup set by firm j is endogenous but time/state-invariant:

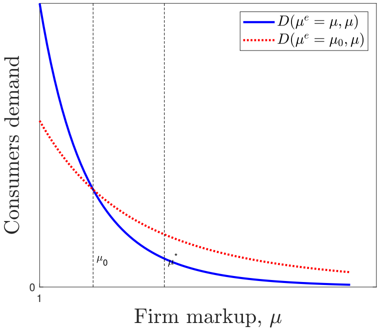
$$\mu(\omega) = \begin{cases} \frac{(\gamma+\lambda)(1-\omega)}{(\gamma+\lambda)(1-\omega)-1} & \text{with} \quad \omega < \frac{\gamma+\lambda-1}{\gamma+\lambda}, \\ +\infty & \text{with} \quad \omega \geq \frac{\gamma+\lambda-1}{\gamma+\lambda}, \end{cases}$$

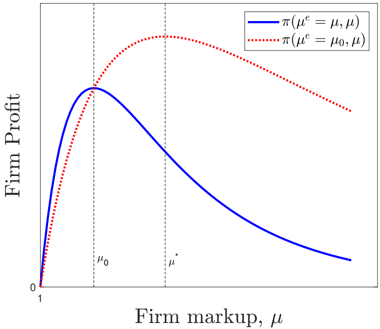
Confusion and discretion in pricing



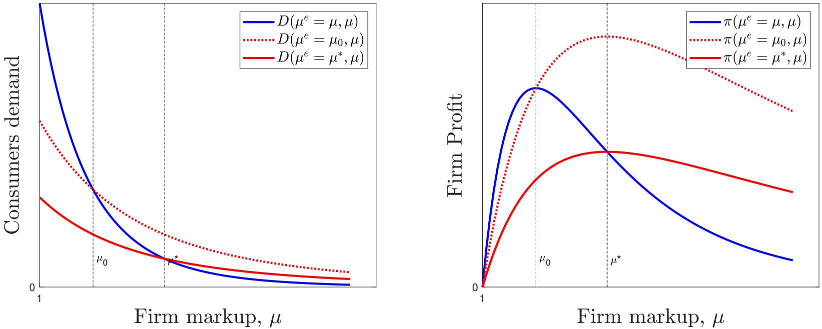
Without any signaling power we have the standard firm problem.

Confusion and discretion in pricing



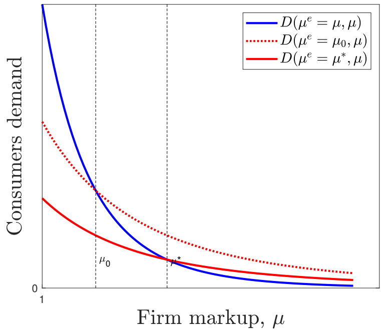


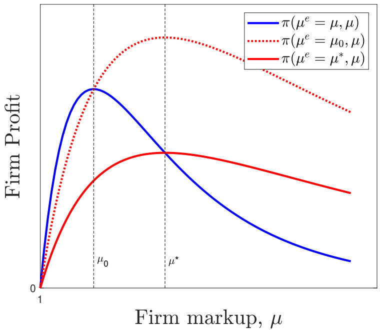
Signalling power induces firms to increase their markups.



However, as Hs anticipate μ^*, their demand shifts down!

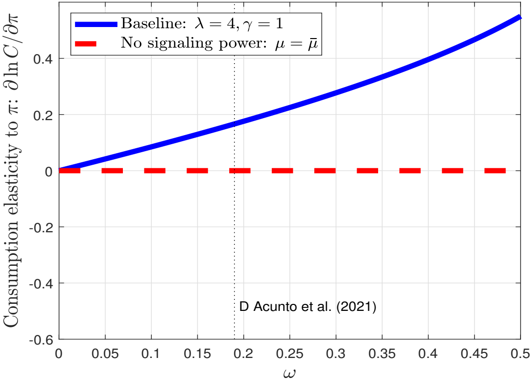
Confusion and discretion in pricing





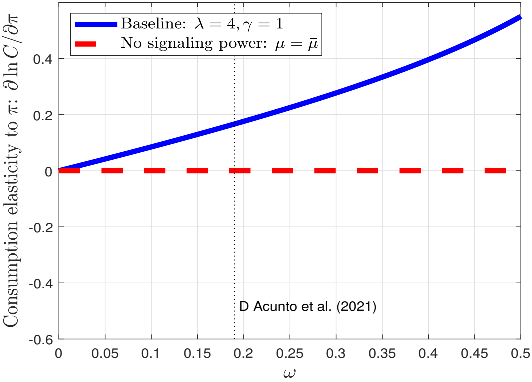
Signaling power creates a commitment problem, hurting firms' profits.

Figure: The consumption-inflation comovement



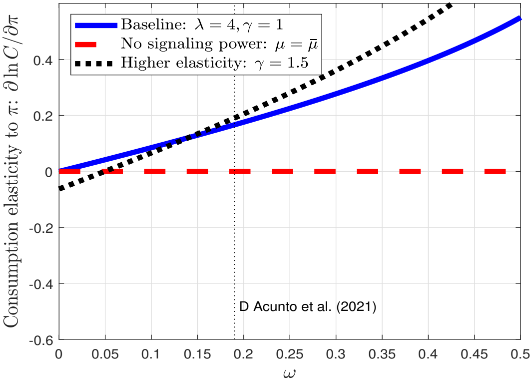
$$\text{dashed}: (\gamma = 1, \omega = 0) \Rightarrow [\lambda\, \mu(\omega)^{\gamma} - \lambda - \gamma] = 0$$

FIGURE: The consumption-inflation comovement



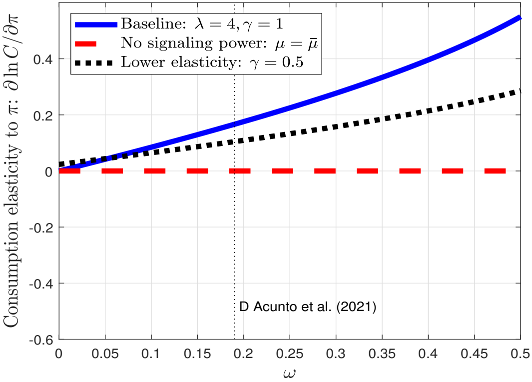
$$\text{solid}: \ (\gamma = 1, \omega > 0) \Rightarrow [\lambda\, \mu(\omega)^{\gamma} - \lambda - \gamma] > 0$$

Figure: The consumption-inflation comovement



$$\text{dotted : } (\gamma = 1.5, \omega > \bar{\omega}) \Rightarrow [\lambda\,\mu(\omega)^{\gamma} - \lambda - \gamma] > 0$$

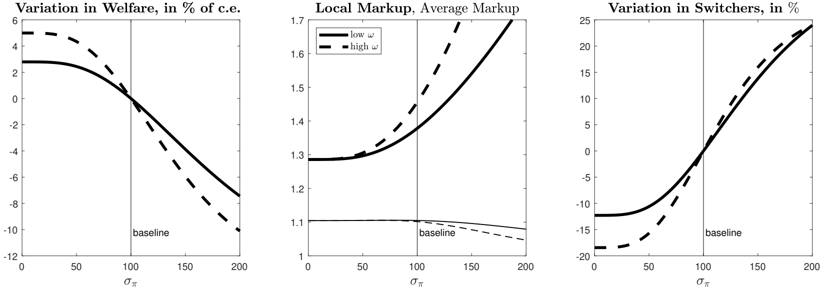
Figure: The consumption-inflation comovement



$$\text{dotted} : (\gamma = 0.5, \omega \geq 0) \Rightarrow [\lambda\, \mu(\omega)^\gamma - \lambda - \gamma] > 0$$

Welfare and Policies of Uncertainty Reduction

$$\uparrow \text{inflation volatility} \quad \Rightarrow \quad \uparrow \omega = \frac{1}{1+\frac{\sigma_z^2}{\sigma_\pi^2}} \quad \Rightarrow \quad \uparrow \mu$$



Note: The figure shows how welfare varies with σ_π^2. The vertical dotted line corresponds to the baseline value of $\sigma_\pi = 0.35\%$. Welfare is calculated in equivalent consumption growth with respect to baseline consumption. We fixed $\gamma = .5, \lambda = 4$ and $\varphi = 1$. Calibration is such that at baseline, $\rho = 0.1$ and $\omega = 0.29$ for the dashed line and $\omega = 0.19$ for the solid line.

Outline

- Model
- Demand-Driven Business Cycles
  - Aggregate Counter-Cyclical Markup
  - Firm-level Markups: A-cyclical but Endogenous to Hs' Uncertainty
  - Welfare
- Empirics: a test of inflation-driven shopping reallocation
- Extensions
  - Households' vs Local Firms' Uncertainty
  - Targeted Communication
  - Local Varieties
  - Firms' Common Uncertainty (sticky prices)

Empirics: Effective vs Posted Inflation

- **effective inflation**: π_t^{eff} effective per unit price
- **posted inflation**: π_t^{pos} counterfactual with fixed spending shares

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  - covariance with inflation: 0 in NK fig NK;

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- **inflation gap** $\pi_t^{eff} - \pi_t^{pos}$ from spending reallocation
  - covariance with inflation: 0 in NK fig NK;
  - $\neq 0$ in our model

$$\pi_t^{eff} - \pi_t^{pos} \approx -\bar{\alpha}\,(\mu - 1)\,\underbrace{\left[\bar{\alpha}\,\lambda\,\mu^{\gamma} + (1-\bar{\alpha})\,(\lambda+\gamma)\right]}_{\log \alpha_t - \log \bar{\alpha}}(1-\omega)\,\pi_t.$$

  - < 0 if households less informed than firms

Data

- Information Resources Inc. ("IRI"), weekly price and quantity information 2001-2011 on items (UPC $\times$ Store $\times$ Market).

- Method: Coibion et al. (AER15), Gagnon et al. (AER17)

- Effective vs Posted price and inflation for UPC j in market m:

$$p^{eff}_{mj,t} = \frac{\sum_{s \in S_m} TR_{mjs,t}}{\sum_{s \in S_m} TQ_{mjs,t}} \implies \pi^{eff}_{mj,t} = \ln p^{eff}_{mj,t} - \ln p^{eff}_{mj,t-1}$$

$$p^{pos}_{mj,t} = \sum_{s \in S_m} \bar{w}_{msj} \frac{TR_{mjs,t}}{TQ_{mjs,t}} \implies \pi^{pos}_{mj,t} = \ln p^{pos}_{mj,t} - \ln p^{pos}_{mj,t-1}$$

- Average over j within category c and market m, monthly:

$$\pi^{eff}_{mc,t} = \frac{1}{J} \sum_{j \in c} \pi^{eff}_{mj,t} \quad \text{and} \quad \pi^{pos}_{mc,t} = \frac{1}{J} \sum_{j \in c} \pi^{pos}_{mj,t}$$

Monetary shock

- Romer-Romer (2004) updated by Wieland-Yang (2019), 2001-2007, monthly
- Instrument $\pi^{pos}_{mc,t}$ with MP shock ϵ_t
- First stage:

$$\pi^{pos}_{mc,t} = \beta\, \epsilon_t + h_{mc} + error_{mc,t}$$

- Significant effect on posted price inflation: $\hat{\beta} = -1.82^{***}$

Effective vs Posted Inflation

We estimate the following relationship:

$$\pi^{eff}_{mc,t} - \pi^{pos}_{mc,t} = \varrho\, \pi_{m,t} + \iota\, u_{m,t} + f_t + h_{mc} + error_{mc,t},$$

where $\pi_{m,t} = (1/N_c) \times \sum_{c \in S_m} \pi^{pos}_{mc,t}$.

	(1)	(2)	(3)	(4)	(5)
Inflation, $\pi_{m,t}$	-0.44^{***}	-0.45^{***}	-0.42^{***}	-0.42^{***}	-1.93^{***}
	(0.043)	(0.044)	(0.032)	(0.034)	(0.425)
Unemployment, $u_{m,t}$		-0.15^{***}		-0.013	-1.25^{***}
		(0.04)		(0.04)	(0.27)
Stratum F.E.	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes	Yes	No
IV regression	No	No	No	No	Yes
Weighted regression	No	No	Yes	Yes	No

Robust prediction: when inflation increases (decreases), effective paid inflation increases (decreases) less than posted inflation $\Longrightarrow$ sticky effective inflation

Effective vs Posted Inflation

Run regression for effective inflation and sales growth, $s_{mc,t}$:

$$x_{mc,t} = \varrho\, \pi^{pos}_{mc,t} + \iota\, u_{m,t} + h_{mc} + error_{mc,t}$$

	(1) $\pi^{eff}_{mc,t}$	(2) $\pi^{eff}_{mc,t}$	(3) $\pi^{eff}_{mc,t}$	(4) $s_{mc,t}$
Inflation, $\pi^{pos}_{m,t}$	0.79***	0.36**	0.34**	3.59***
	(0.015)	(0.18)	(0.19)	(0.75)
Unemployment, $u_{m,t}$			−0.55***	
			(0.11)	
Robust S.E.	Yes	Yes	Yes	Yes
Stratum F.E.	Yes	Yes	Yes	Yes
Month F.E.	Yes	No	No	No
IV regression	No	Yes	Yes	Yes

- Incomplete pass-trough of posted price to effective price inflation
- Meaningful expenditure reallocation across retailers

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An extended info structure

⋆ Local firms' uncertainty about inflation innovations:

$$E[\pi_t \,|\, \Omega^f_{jt}] = \delta\,(\pi_t + u_{jt})$$

so that $p_{jt} = \mu\, e^{E\left[\ln W_t \,|\, \Omega^f_{jt}\right] + \frac{1}{2}\mathcal{V} - \ln z_{jt}}$;

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⋆ Households' expectations are expressed as

$$E[\pi_t \,|\, \Omega^s_{jt}] = \rho\,(\pi_t + \nu_{jt}) + \omega\,(\ln p_{jt} - E[\ln p_{jt} | \Omega_{t-1}]),$$

where $\nu_{jt} \sim N(0, \sigma^2_\nu)$ and $u_{jt} \sim N(0, \sigma^2_u)$ i.i.d.

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where $\nu_{jt} \sim N(0, \sigma^2_\nu)$ and $u_{jt} \sim N(0, \sigma^2_u)$ i.i.d.

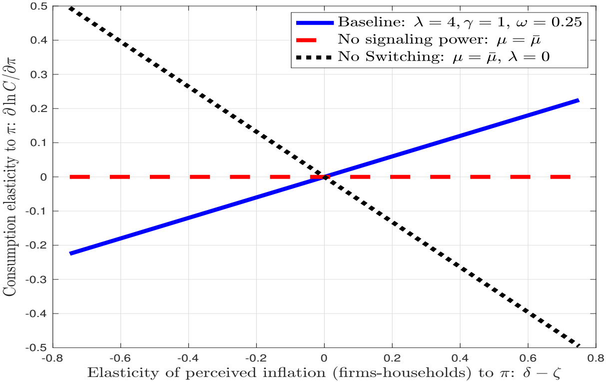
⋆ Households perceived real local price is

$$\int_0^1 \ln p_{jt} - E\left[\ln P_t \,|\, \Omega^s_{jt}\right] dj = \ln \mu + \underbrace{(\delta - \zeta)}_{\text{info gap}}\, \pi_t.$$

where $\zeta \equiv \omega\delta + \rho$.

Information gap

FIGURE: The consumption-inflation comovement and the information gap



Note: We set σ_z/σ_π so that $\omega = 0.25$ and κ so that $\bar{\alpha} = 0.66$ in all simulations. We report the elasticity of consumption to an inflation shock at different combinations of λ and γ, and for different values of $\delta - \zeta$ on the horizontal axis obtained either by varying δ and/or ρ. In the baseline specification we use $\lambda = 4$ and $\gamma = 1$ (solid blue line). The red dashed line plots a counterfactual where $\mu = (\lambda+\gamma)/(\lambda+\gamma-1)$. The black dotted line also sets $\lambda = 0$.

Extension with firms' common uncertainty

A firms – distant and local – receive a common signal:

$$\vartheta_t : \pi + u_t$$

with $u_t \sim N(0, \sigma_u^2)$. Thus $P_t = E[W_t | \Omega_t^f]$.

Aggregate consumption is now expressed as:

$$\begin{aligned}
\ln C_t - \ln \bar{C} \approx\ & \bar{\alpha}\,(\lambda\,\mu^{\gamma} - \gamma - \lambda)\ ((\delta - \zeta)\,\pi_t\ +\ \delta(1-\omega)\,u_t) \\
& + \bar{\alpha}\ \Big(\lambda\,(\mu^{\gamma} - 1)\,(\mu^{\lambda} - 1) + \gamma\Big)\ \hat{\rho}\,(1-\delta)\,\pi_t \\
& + \bar{\alpha}\,\mu^{\gamma}\,\mu^{\lambda}\,(1 - \mu^{-\lambda})\,\gamma\,\tilde{\rho}\ ((1-\delta)\,\pi_t\ -\ \delta\,u_t)\,.
\end{aligned}$$

with $\hat{\rho}$ being the loading of Hs' signal on the expected difference $P_t - W_t$.

- First line: main case + (exp.) noise.
- Second line: positive effect of Hs info about real wage on switching
- Third line: positive effect of Hs info on intensive margins + (contr.) noise.

Local Varieties

c_{ijt} is an aggregate over the X varieties,

$$c_{ijt} = X \left(\frac{1}{X} \sum_{x=0}^{X} c_{xijt}^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}}$$

with $\epsilon > 1$ being the elasticity of substitution across varieties, whose price is:

$$p_{jt} = \left(\frac{1}{X} \sum_{n=0}^{N} p_{xjt}^{1-\epsilon} \right)^{\frac{1}{1-\epsilon}} .$$

Each local firm $x \in \{1, 2, ..., X\}$ chooses the price p_{xjt} that maximizes profits

$$p_{xjt} = \text{argmax}_p \, \mathcal{N}_{jt}(p) \, \mathcal{D}_{xjt}(p) \left(\frac{p}{W_t} - z_{jt} \right)$$

with $\mathcal{D}_{xjt}(p) = \int c_{xijt} \, di = c_{ijt} \left(\frac{p}{p_{jt}} \right)^{-\epsilon} di.$

In equilibrium, $\mu = \frac{\xi}{\xi - 1}$ where

$$\xi = \left(1 - \frac{1}{X} \right) \epsilon + \frac{1}{X} (\gamma + \lambda)(1 - \omega).$$

Conclusions

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Demand-driven Countercyclical Aggregate Markup +

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A *pencil-and-hand* model where:

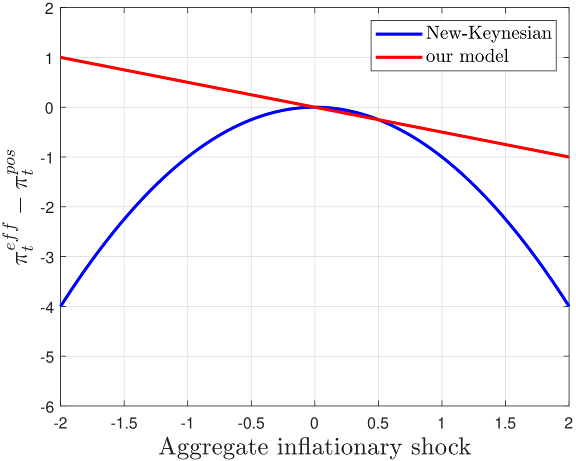
Demand-driven Countercyclical Aggregate Markup +

...but fixed firm-level markups!

Thanks

Appendix

R.3. The response of the inflation gap



With deflationary shocks consumers reallocate towards local markets to save shopping effort.

back

Micro-evidence on Markup Cyclicality

- **Macro models call for countercyclical markups**

  Bils, Klenow and Malin (2018): "Thus, countercyclical price markups deserve a central place in business-cycle research."

- **Micro evidence seems pointing towards a-cyclical markups**

  Anderson, Rebelo and Wong (2018): "markups are relatively stable over time and mildly procyclical";

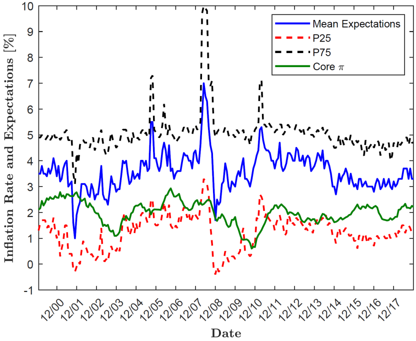
  Burstein, Carvalho and Grassi (2020): "exploiting different reduced-form measures of markup cyclicality, two researchers may arrive at opposing conclusions even within a single dataset."

Q: How to reconcile Macro call with Micro evidence?

back

How well households predict inflation?

Figure 5: **Inflation Expectations and Realized Core Inflation over Time**



Notes. This figure plots average inflation expectations over time from the Michigan Survey of Consumers together with the 25^{th} and 75^{th} percentiles as well as the realized core inflation rate for a sample period from January 2000 until December 2018.

Source: D'Acunto et al. (2019)

Three Facts on Expectations and Shopping

- **Shopping prices influence expectations**

  Expectation Survey Bank of England: first source of information

  D'Acunto, Malmendier, Ospina and Weber (2021): CPI Household ~ 0.2; CPI Frequency ~ 0.3

- **Arbitrage across shops: valuable but limited**

  Menzio and Kaplan (2016): visiting one additional store: $\sim -0.6\%$ Indiv-CPI; shopping concentrated: 2.3 shops visited on average per quarter

- **Expected[2] inflation less dispersed than experienced[1]**

  [1] Michigan Survey: inter. range 3.8%

  [2] Kaplan and Schulhofer-Wohl (2017): inter. range 7.3%

Q: how to reconcile the frictional household (micro) with output-inflation comovement (macro)?

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Model predictions

$$\ln C_t - \ln \bar{C} \propto (\lambda \, \mu^{\gamma} - \gamma - \lambda) \, (1 - \omega) \, \pi_t.$$

- Fix $\lambda = 4$, $\gamma = 1$, $\bar{\alpha} = 0.66$ from the literature.
- Use regression to pin down info gap $1 - \omega$.
- How large is the response of consumption to inflation as we vary μ?