Price Selection in the Microdata

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Sticky-prices in a GHF framework: overview of paper

- Empirically analyze price setting behavior through a GHF framework
- Discuss implications for shock propagation: how important is selection?
- More specifically: measure firms' desired adjustment $\hat{x}_{i,t}$ and :
  1. use micro data to estimates a GHF : $\Lambda(\hat{x}_{i,t})$, and other moments
  2. identify a time series for aggregate "monetary" shocks: ϵ_t
  3. use OLS to study effect of $\hat{x}_{i,t}$, ϵ_t , $\underbrace{\hat{x}_{i,t} \cdot \epsilon_t}_{\text{"selection"}}$ on prob. of adjustment

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- Main results (emphasized in the paper):
  - Price-setting behavior shows strong elements of state dependence
  - The GHF linear in $|\hat{x}|$, as in Eichenbaum, Jaimovich, Rebelo (AER 2011)
  - Find no role for interaction term: $\hat{x}_{i,t} \cdot \epsilon_t$ (selection is overrated!)

Short summary of GHF models (Caballero-Engel)

- Setup for models with fixed cost of adjustment:
  - Firm i controls gap: $x_i \equiv (p_i - mc_t) - \mu^*$ where μ^* is the ideal markup
  - Uncontrolled state x_i follows diffusion: $dx_i = \sigma dW_i$
  - Optimal policy gives GHF: $\Lambda(x_i)$ if $x_i \in (\underline{x}, \bar{x})$, adjust otherwise
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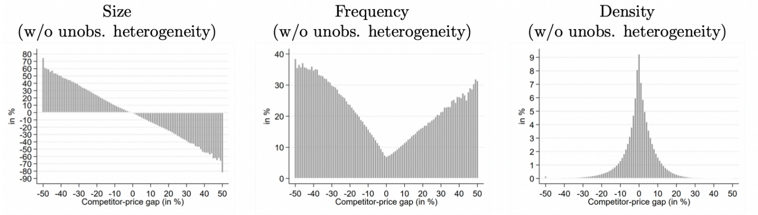
- Aggregation for many firms: Given $\{\Lambda(\cdot), \underline{x}, \bar{x}, \sigma\}$ we have
  - cross-section distribution of gaps: $f(x)$ KFE: $\Lambda(x)f(x) = \frac{\sigma^2}{2} f''(x)$
  - Frequency of price changes: N , $N = 2\int_0^{\bar{x}} \Lambda(x)f(x)dx - \sigma^2 f'(\bar{x})$
  - cross-section distribution of price changes: $q(\Delta x)$, $q(-\Delta x) = \frac{\Lambda(x)f(x)}{N}$

Interesting Results: New important facts (fig. 2)



Price changes: Δx GHF $\Lambda(x)$ density: $f(x)$

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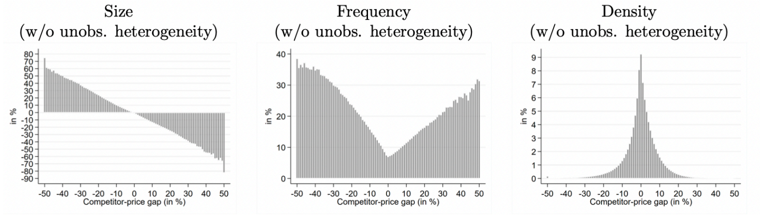

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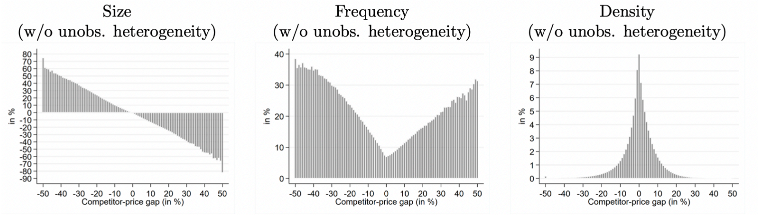
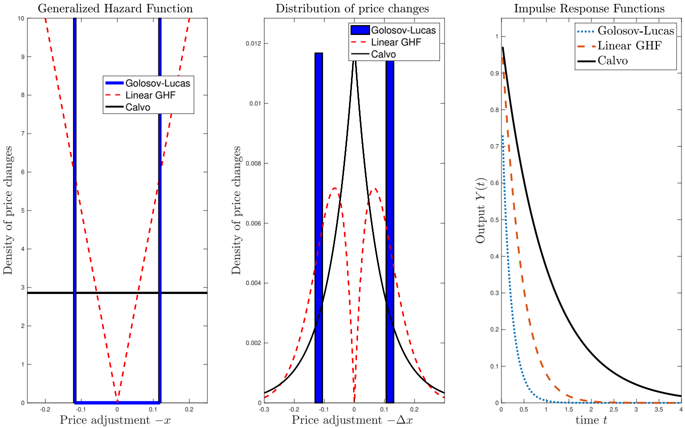


Price changes: Δx	GHF $\Lambda(x)$	density: $f(x)$
closing the gap!	linear and symmetric! (no fairies in sight)	Convex and Symmetric

If price-setting follows GHF model, then shock propagation fully known

Shock propagation in GHF models: analytic results

three models with same frequency N and different aggregate flexibility



GHF encodes all you need to study shock propagation

Authors' analysis of "selection" in the empirical model

- Price setting probability depends on "gap", "shock", and "selection"

Linear probability model

$$I^{\pm}_{pst,t+h} = \beta^{\pm}_{xih} x_{pst-1} \hat{\text{ebp}}_t + \beta^{\pm}_{xh} x_{pst-1} + \beta^{\pm}_{ih} \text{ebp}_t + \gamma^{\pm}_h T_{pst-1} + \Gamma^{\pm}_h \Phi(L) X_t + \alpha^{\pm}_{psh} + \alpha^{\pm}_{mh} + \varepsilon^{\pm}_{psth},$$

- $I^{\pm}_{pst,t+h}$ indicator of price increase (resp. decrease) of product p in store s between t and $t+h$
- x_{pst-1}: price gap (to control for its regular effect)
- ebp_t is the aggregate shock (to control for its average effect)
- $x_{pst-1}\text{ebp}_t$ gap-shock interaction (selection: focus of analysis)

Probability model: estimates

Table 3: Estimates, scanner data, competitor-price gap, credit shock

	(1)	(2)	(3)	(4)	(5)	(6)
	Price increase $\left(I^{+}_{pst,t+24}\right)$			Price decrease $\left(I^{-}_{pst,t+24}\right)$		
Gap (x_{pst-1})	-1.75^{***}	-1.75^{***}		1.55^{***}	1.55^{***}	
	(0.06)	(0.06)		(0.06)	(0.06)	
Shock (ebp_t)	-0.03^{***}		-0.04^{***}	0.03^{***}		0.03^{***}
	(0.01)		(0.01)	(0.01)		(0.01)
Selection $(x_{pst-1}\hat{\text{ebp}}_t)$	-0.00	-0.00		0.01	0.01	
	(0.04)	(0.04)		(0.05)	(0.04)	
Age (T_{pst-1})	0.02^{***}	0.02^{***}	0.02^{***}	0.00^{**}	0.01^{***}	0.01^{***}
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Let us explore the theory behind the metrics

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- monetary shock ϵ_t affects firm's marginal cost $\implies$ Prob P-change
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  - Paper measures gap $\hat{x}_i = p_i - p$ where p is competitors avg. price
  - theory-based gap: $x_i = \hat{x}_i + \alpha\epsilon_t$ and hazard: $\Lambda(x_{i,t}) = \Lambda(\hat{x}_{i,t} + \alpha\epsilon_t)$

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example #1 : $$\Lambda(\hat{x}_{i,t} + \alpha\ \epsilon_t) = \left|\hat{x}_{i,t} + \alpha\ \epsilon_t\right|$$

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example #2 : $$\Lambda(\hat{x}_{i,t} + \alpha\ \epsilon_t) = \left(\hat{x}_{i,t} + \alpha\ \epsilon_t\right)^2$$

Use theory as a LAB to test the metrics

example #1 $\Lambda(\hat{x}_{i,t-1} + \alpha\ \epsilon_t) = \left|\hat{x}_{i,t-1} + \alpha\ \epsilon_t\right|$ with $\alpha = 1$

Dependent variable: Prob of price decrease I^{-}_{t+h}

h period
$\left\lvert\hat{x}_{i,t-1} + \alpha\ \epsilon_t\right\rvert$
t-stat
$\hat{x}_{i,t-1}$
t-stat
ϵ_t
t-stat
$\hat{x}_{i,t-1} \cdot \epsilon_t$
t-stat
age_t
t-stat

12 aggr. shocks per year, 10 years data, 50 k products ($\Longrightarrow$ asymptotic stats)

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Dependent variable: Prob of price decrease I^-_{t+h}

h period	+1 daily
$\left|\hat{x}_{i,t-1} + \alpha\, \epsilon_t\right|$	0.055
t-stat	130
$\hat{x}_{i,t-1}$	-
t-stat	
ϵ_t	-
t-stat	
$\hat{x}_{i,t-1} \cdot \epsilon_t$	-0.005
t-stat	-0.1
age_t	
t-stat	

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$\left\|\hat{x}_{i,t-1} + \alpha\ \epsilon_t\right\|$	0.055	
t-stat	130	
$\hat{x}_{i,t-1}$	-	0.027
t-stat		200
ϵ_t	-	0.026
t-stat		14
$\hat{x}_{i,t-1} \cdot \epsilon_t$	-0.005	0.14
t-stat	-0.1	9
age_t		0.0036
t-stat		130

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Dependent variable: Prob of price decrease I^{-}_{t+h}

h	+1	+1	+1
period	daily	daily	monthly
$\left\|\hat{x}_{i,t-1} + \alpha\, \epsilon_t\right\|$	0.055		
t-stat	130		
$\hat{x}_{i,t-1}$	-	0.027	0.76
t-stat		200	400
ϵ_t	-	0.026	0.84
t-stat		14	270
$\hat{x}_{i,t-1} \cdot \epsilon_t$	-0.005	0.14	4.3
t-stat	-0.1	9	140
age_t		0.0036	0.12
t-stat		130	430

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- Time or state-dependent models? should we care?
  - Matters under stress: energy shocks, supply bottlenecks, trade wars, ...

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- Calvo or GL? neither really, and even a good GHF is still “not enough”

  Look for strategic complementarities? $\Lambda(x, X)$

Summing up

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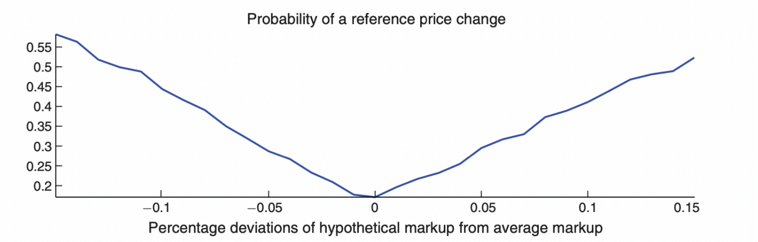
- The paper has some very interesting micro evidence
- Direct evidence on GHF and behavior upon adjustment (closing the gap)
- Results are new and important for macro! (no Calvo behavior)
- The discussion of "selection" needs a tighter link to theory
  - Does "interaction" matter? depends on fct form of Λ, horizon h, sample size
- The data could be used to test strategic complementarities $\Lambda(x, X)$

Background material

Eichenbaum, Jaimovich, Rebelo, AER 2011

Roughly linear hazard (in absolute value)



data from large US supermarket chain

Pitfalls of the Euristic approach

State dependence (extending Caballero and Engel, 2007)

- Focus: shape of the adjustment hazard $\Lambda(x)$.
- Steep hazard: price changes are large unconditionally (state-dependence, not selection)

$$\pi^- = \int_{x\geq 0} -x\Lambda(x)f(x)dx = -\bar{x}^-\bar{\Lambda}^- + \underbrace{\text{Cov}\left(-x, \Lambda(x)|x \geq 0\right)}_{\text{state-dependence}},$$