Market concentration and the dynamics of prices and mark-ups

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Motivation

- “How markups move, in response to what, and why, is however nearly terra incognita for macro. . . . But we are a long way from having either a clear picture or convincing theories, and this is clearly an area where research is urgently needed. - “The State of Macro,” Blanchard (2009), p. 18."

Motivation

- The dynamics of mark-ups are an important question in macroeconomics.
- They are important for understanding the transmission of business cycle shocks and can have important implications for the welfare costs of business cycles.
- They are also an important way in which researchers evaluate the validity of macroeconomic models.

Motivation

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- Blanchard (2009) goes on to note this difficulty: "I have found IO economists to be reluctant to help us on this front: They seem to find the notion that one could reliably measure movements in markups over time, or the notion that one could trace and explain the evolution of an aggregate markup, both naive and doomed..."

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- Experiments!

Empirical Evidence - Mark-ups

- Empirical evidence on the cyclicality of mark-up fluctuations over the business cycle is mixed.
- Early papers in I/O tend to find that price-cost margins are significantly procyclical (e.g. Domowitz et al. (1986))

- Other methods to measure mark-ups use generalizations of the Solow residual to estimate their cyclicality, typically find procyclical mark-ups.
- A series of papers in the early 90s estimate the cyclicality by making various assumptions about the production function and allowing for overhead labor find countercyclical mark-ups (e.g. Rotemberg and Woodford (1991) and (1999) and others)

- More recent papers find procyclical or acyclical mark-ups (Nekarda and Ramey (2013),Vavra and Stroebel (2016), and Anderson et al. (2018))

Theoretical Considerations

- Possible drivers of mark-ups:
  - Productivity shocks, demand shocks.
  - Also, there is growing evidence that consumers spend more effort shopping during recessions: Aguiar and Hurst (2007), Coibion et al. (2012), Kaplan and Menzio (2013), Nevo and Wong (2015), Munro (2018)
  - A recent paper by Vavra and Stroebel (2016) documents an empirical link between local house prices and mark-ups, and argues that shopping behavior is the key transmission mechanism.

- Imperfect Competition/Sensitivity to shocks:
  - In a famous paper thinking about the dynamics of mark-ups, Rotemberg and Woodford (1991) highlight the importance of imperfect competition and implicit collusion in the theoretical predictions on the cyclicality of mark-ups.

This work

- In this paper, we're going to explore the dynamic response of prices and mark-ups in a model of imperfect competition.
- The important thing this shows is that substantial heterogeneity emerges in the predicted responses of prices and mark-ups to both a) the types of shocks hitting the market and b) market structure (degree of implicit collusion).
- With these predictions in hand, we take them to the laboratory to explore their validity.
- An experimental approach is important here in that the responsiveness of the dynamics of mark-ups are very sensitive to the to the degree of implicit collusion in a market and laboratory experiment allows us to observe the strategic response of price setters in these markets.

Model

- Simple spatial differentiation model (Salop (1979))
- Circle has circumference = 1 and there is a unit mass of consumers uniformly distributed along the circle: $\int_0^1 1dz = 1$
- Assume consumers have unit demand and consume only quantities from the set $\{0, 1\}$
- Utility: $u = v - p - s * d$
- where v is the value of consuming 1 unit, p is price, s is shopping cost, and d is distance travelled.
- Assume that firms follow a maximum differentiation strategy: distance 1/N between firms, where N is the number of firms in the market.

Model

- Consumer who is located at distance $\tilde{x}$ between the firms is indifferent from purchasing from either firm if:
  $v - p_i - s * \tilde{x} = v - p - s * (1/N - \tilde{x})$
- $\tilde{x} = \frac{p - p_i}{2s} + \frac{1}{2N}$
- Demand for firm i: $D_i(p_i, p) = 2 * \tilde{x} = \frac{p - p_i}{s} + \frac{1}{N}$
- Maximization problem: $\Pi^i(p_i, p) = (p_i - c)(\frac{p - p_i}{s} + \frac{1}{N})$
- F.O.C. gives: $p_i = \frac{p + c + s/N}{2}$
- In symmetric equilibrium: $p_1 = ... = p_N = p^*$
- Therefore, $p^* = c + \frac{s}{N}$
- From this we can see that prices depend on marginal costs (c), shopping costs (s), and competition (N)

Model: Some baseline predictions

- Some simple predictions from the model...
- Define the mark-up, μ, as: $\mu = \frac{P}{MC}$
- Mark-ups will be smaller in more competitive markets (potentially countercyclical with firm entry/exit):
  $\frac{\partial \mu}{\partial N} = \frac{-s}{cN^2} < 0$
- Mark-ups will respond negatively to cost shocks:
  $\frac{\partial \mu}{\partial c} = \frac{-s}{c^2 N} < 0$
- Mark-ups will have a positive relationship with "shopping costs" :
  $\frac{\partial \mu}{\partial s} = \frac{1}{cN} > 0$
- Mark-ups will have a no relationship relationship with marginal utility of consumption:
  $\frac{\partial \mu}{\partial v} = 0$

Model

- What about collusion?
- It is possible that the competitive price ($p^* = c + \frac{s}{N}$) leaves the indifferent consumer with a positive surplus
- Namely, $v - p - \frac{s}{2N} > 0$
- If this is true, colluding firms could increase profits by collectively raising prices.

Model-collusion

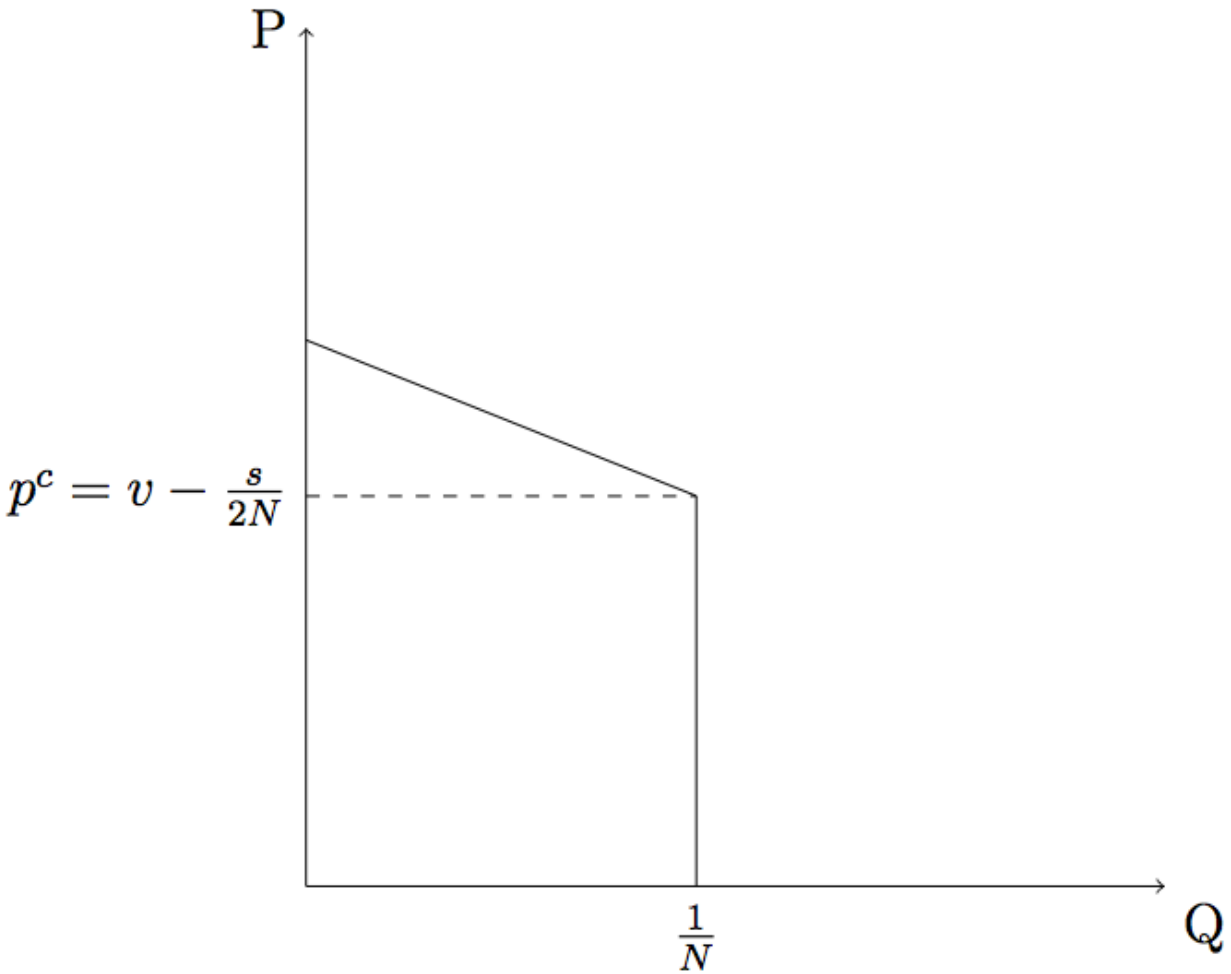

Figure: Plots the demand curve for an individual firm when all firms are choosing the same price, P

Model - Collusion

- In the collusive world, firms should price at $p^c = v - \frac{s}{2N}$ (keeps all customers in the market)
- With collusion the response of mark-ups to cost shocks becomes stronger: $\frac{\partial \mu^c}{\partial c} = -\frac{v - \frac{s}{2N}}{c^2} < \frac{\partial \mu}{\partial c} < 0$
- The response of mark-ups response to s reverses: $\frac{\partial \mu^c}{\partial s} = \frac{-1}{2Nc} < 0 < \frac{\partial \mu}{\partial s}$
- Cyclicality (from shopping costs) depends on the nature of competition in the market.
- Response of mark-ups to marginal utility increases: $\frac{\partial \mu^c}{\partial v} = \frac{1}{c} > 0$

Model - Summary of hypotheses

- Mark-ups will be lower in more competitive (higher N environments)
- Responsiveness of mark-ups depends crucially on the degree of competition in the market:

	Nash			Collusion		
	c	v	s	c	v	s
p	+1	0	+	0	+1	-
$M.U.$	-	0	+	-	+	-

Table: *Summary of comparative static predictions from the Nash and Collusion solutions.*

Experiments

- The experiment consisted of 15 periods, each of which had 20 rapid (7-second) rounds. During each period subjects were randomly matched with other people in the room to form a market of either 2 or 4 and subjects were rematched at the end of each period.
- As in the model, subjects only make price choices and locations are fixed.
- These experiments were conducted at the Social Science Experimental Lab at New York University, Abu Dhabi in 2017. There were 120 subjects and average earnings were 118 AED ($ 32.15 USD)

Experiments

- Each of the 15 periods had 20 7-second sub periods.
- Market parameters are held constant for the first 10 sub-periods then changed after period 10 and held constant for the last 10 sub periods
- Parameter sets:
  - v={0.8, 0.9, 1}
  - c={0.05, 0.15, 0.25}
  - s={0.1, 0.2, 0.4, 0.5, 0.6}

Experiments

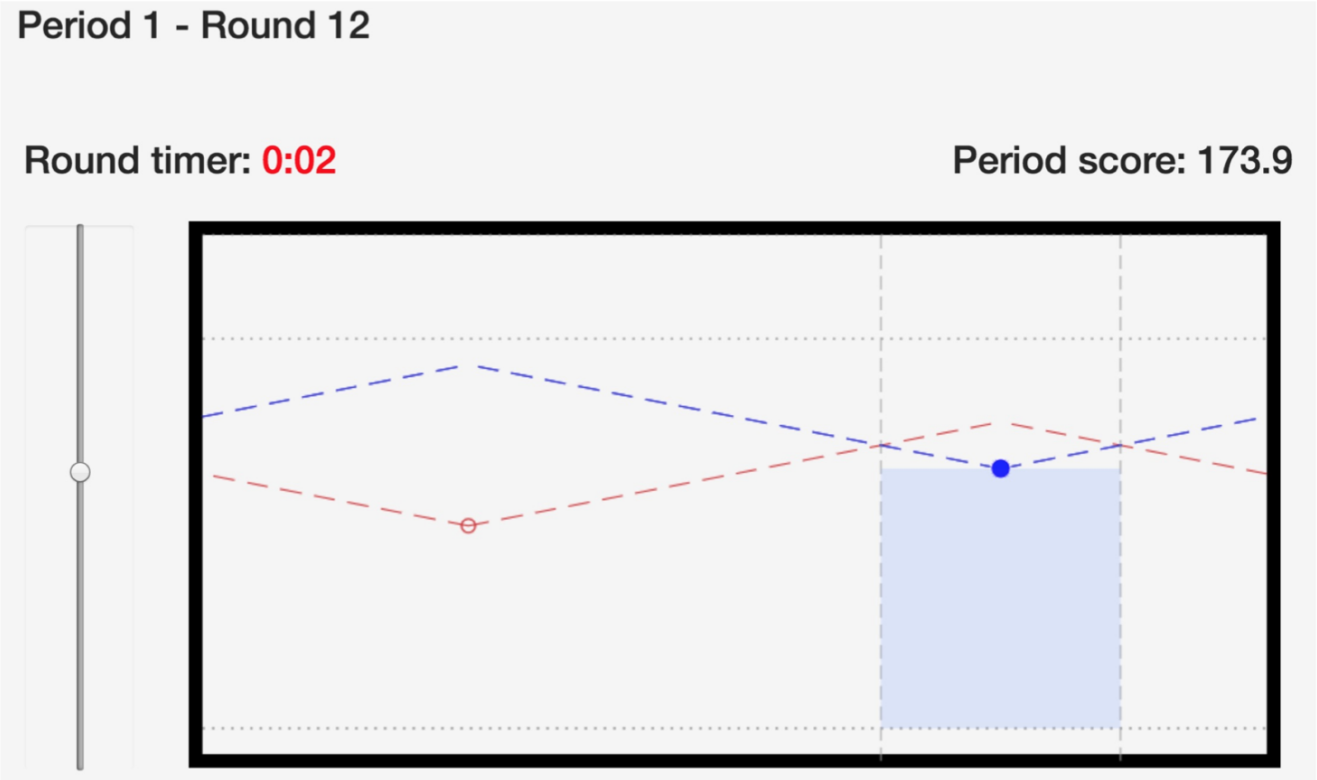

Figure: Example of User Interface

▸ Link

Experiment Results - Static Mark-ups

- Hypothesis 1: Mark-ups will be lower in higher N (more competitive) markets.

Indep. Var.	Coeff.
4p	-2.810***
	(0.0457)
cons.	6.502***
	(0.0389)

Table: *Reports results from specification (1). The adjusted R^2 is 0.11. Robust standard errors are reported and ***, **, * denote significance at the 1, 5, and 10% levels, respectively.*

Experiments - Comparative Statics

	Dependent Variable	
Indep. Var.	Price	Mark-up
c	0.3826***	-37.69***
	(0.0275)	(0.4644)
v	0.3046***	3.593***
	(0.0286)	(0.4439)
s	-0.0559***	-0.3272
	(0.0117)	(0.2070)
4p*c	0.3890***	22.84***
	(0.0305)	(0.5140)
4p*v	-0.2985***	-3.713***
	(0.03423)	(0.5163)
4p*s	0.1912***	2.437***
	(0.0140)	(0.2538)
Adj. R^2	0.8161	0.7573
Obs.	36000	36000

Experiments - Comparative Statics

	c		v		s	
	Empirics	Theory	Empirics	Theory	Empirics	Theory
p	0.389	1	-0.2985	-1	0.1912	0.75
$M.U.$	22.84	[9.6,300]	-3.71	[-4,-20]	2.437	[2,10]

Table: *Reports the change in the responsiveness of prices and mark-ups to changes in c, v, and s from moving to a collusive (2-player) market to a competitive (4-player) market derived from the theory and observed in the experiments.*

Experiments - Extent of collusion

Group Size	Mean Error Nash	Mean Error Collusion	Error Nash/(Coll.-Nash)
2	0.252	-0.3747	0.3953
4	0.1088	-0.61899	0.1495

Table: *Reports mean differences between theoretical predictions and observed prices*

Experiment vs. Retail data

- Understanding the dynamics of mark-ups is really about understanding price setting behavior.
- To better understand how/why price setting behavior differs between the 2-player and 4-player markets, we also examine the distribution of price changes.
- Some interesting patterns emerge, which we compare against price setting behavior in retail data in product categories with different levels of concentration.
- i.e. do we see similar characteristics in price setting behavior when market concentration changes in both our experiments and in real-world pricing data.

AC Nielsen Disclaimers

- Researcher(s) own analyses calculated (or derived) based in part on data from The Nielsen Company (US), LLC and marketing databases provided through the Nielsen Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business.

- The conclusions drawn from the Nielsen data are those of the researcher(s) and do not reflect the views of Nielsen. Nielsen is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

Distribution of Price Changes- Experiments

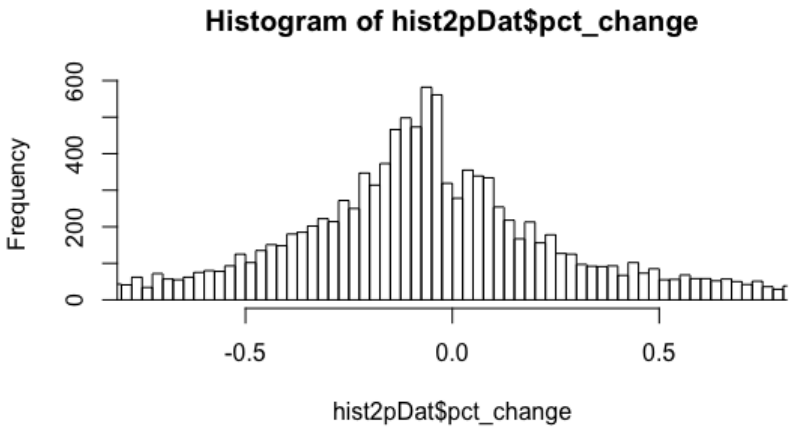

Figure: Distribution of non-zero price changes in 2-player markets

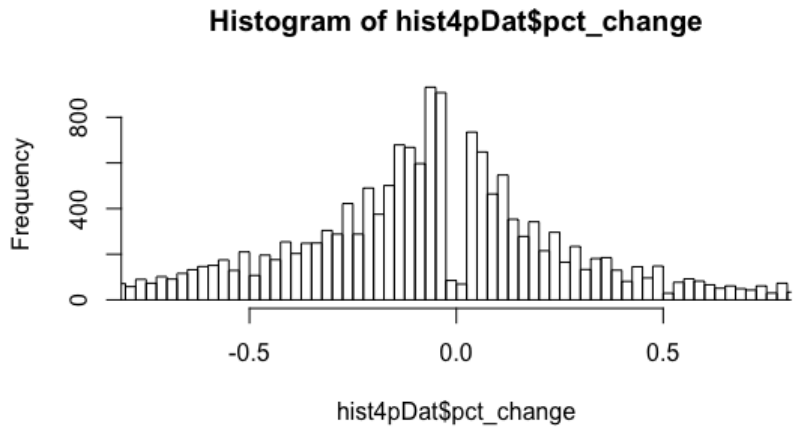

Figure: Distribution of non-zero price changes in 4-player markets

Distribution of Price Changes

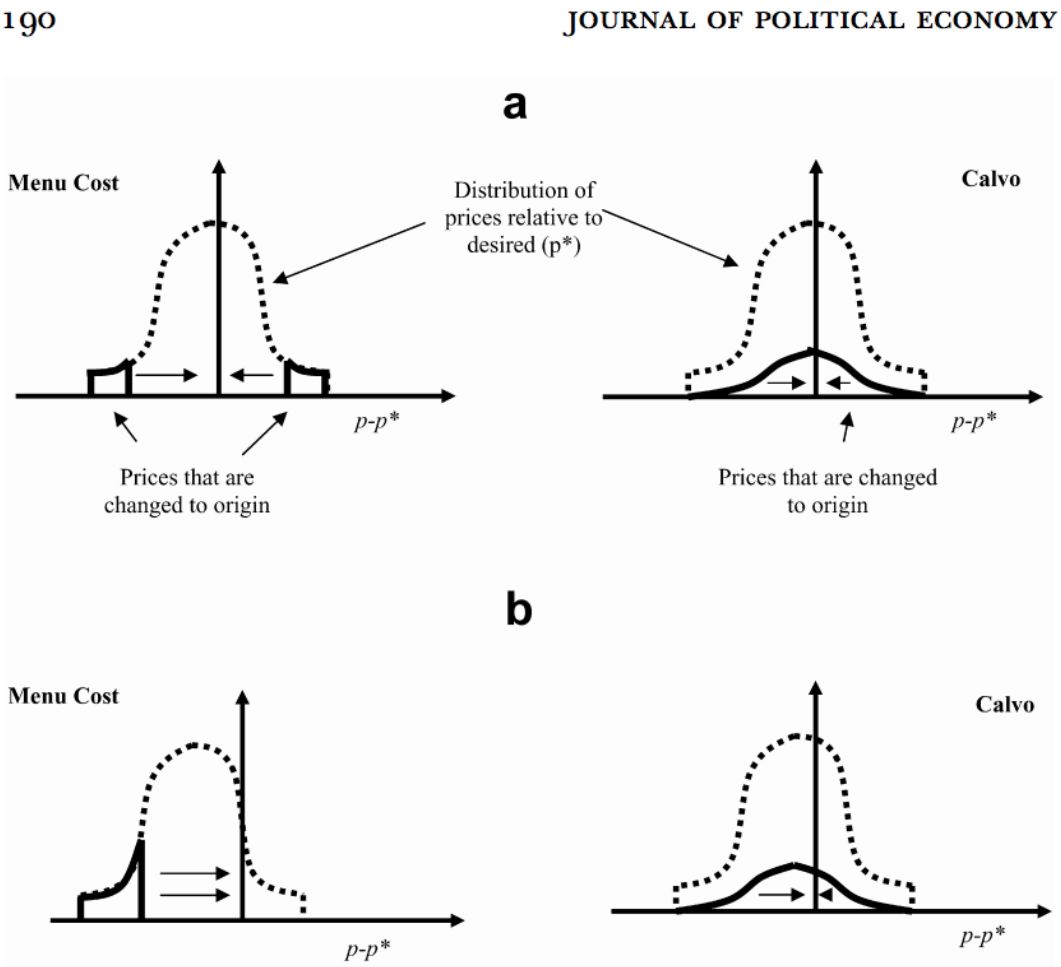

FIG. 6.—Price adjustment in menu cost and Calvo models. *a*, Price adjustment before aggregate shock. *b*, Price adjustment after aggregate shock.

Figure: Menu-cost models: Golosov and Lucas 2007 JPE

Distribution of Price Changes- AC Nielsen Data

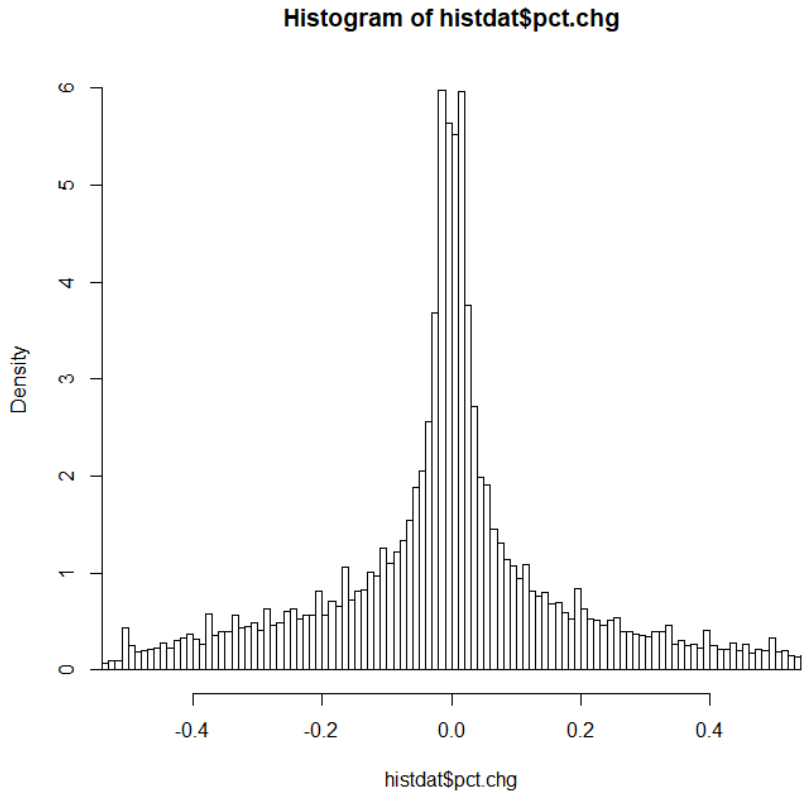

Figure: Distribution of non-zero price changes in breakfast cereal, HHI=0.213

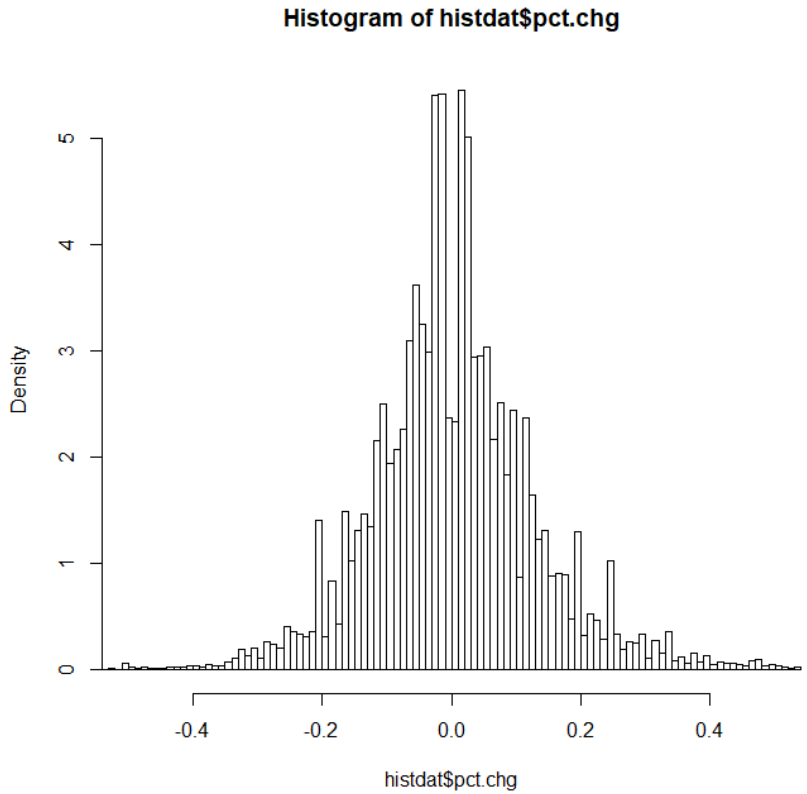

Figure: Distribution of non-zero price changes in pet food, HHI=0.136

Distribution of Price Changes- AC Nielsen Data

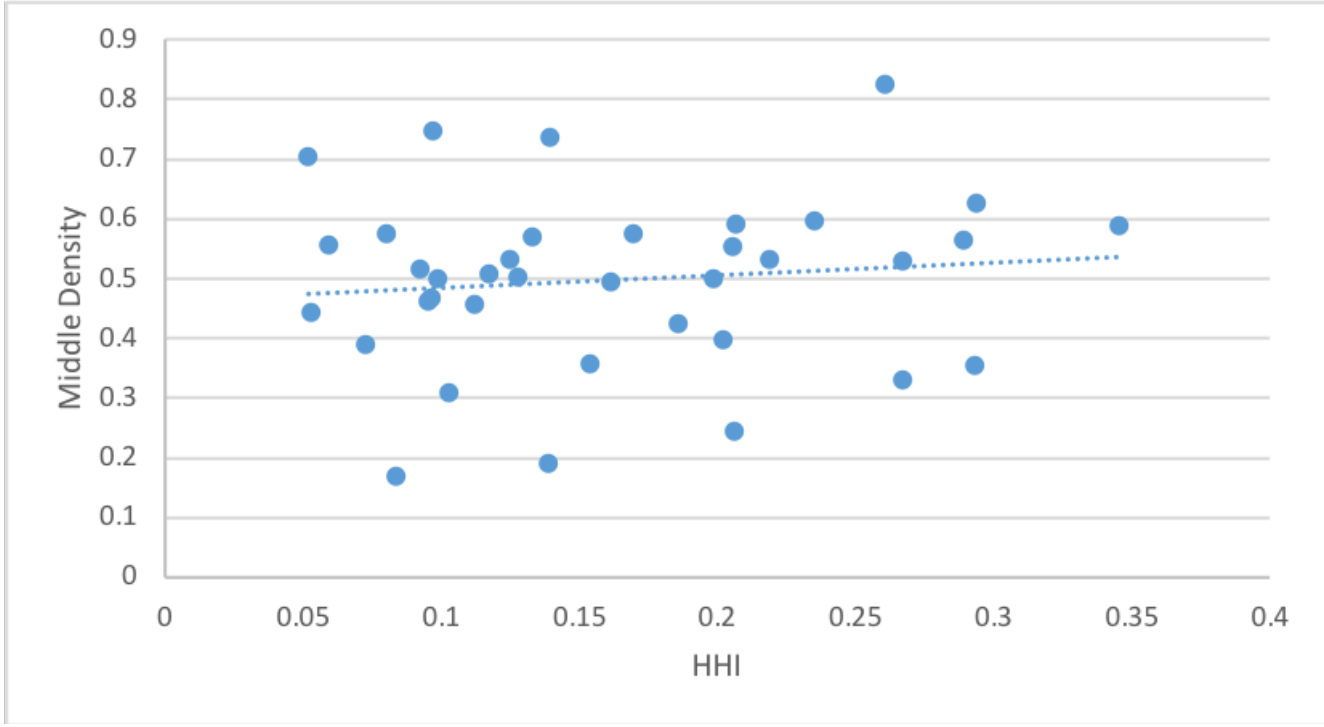

Figure: Size of the middle of the density of price changes across product categories in AC Nielsen Data.

Sticky Prices - Experiment Data

- Across all experiment periods:
  - 2-player games 13% are zero price changes
  - 4-player games 16% are zero price changes
- Thus prices appear to be "stickier" in markets with higher levels of competition.
- We can explore the relationship between levels of competition and the degree of price stickiness in retail data.

Sticky Prices - AC Nielsen Data

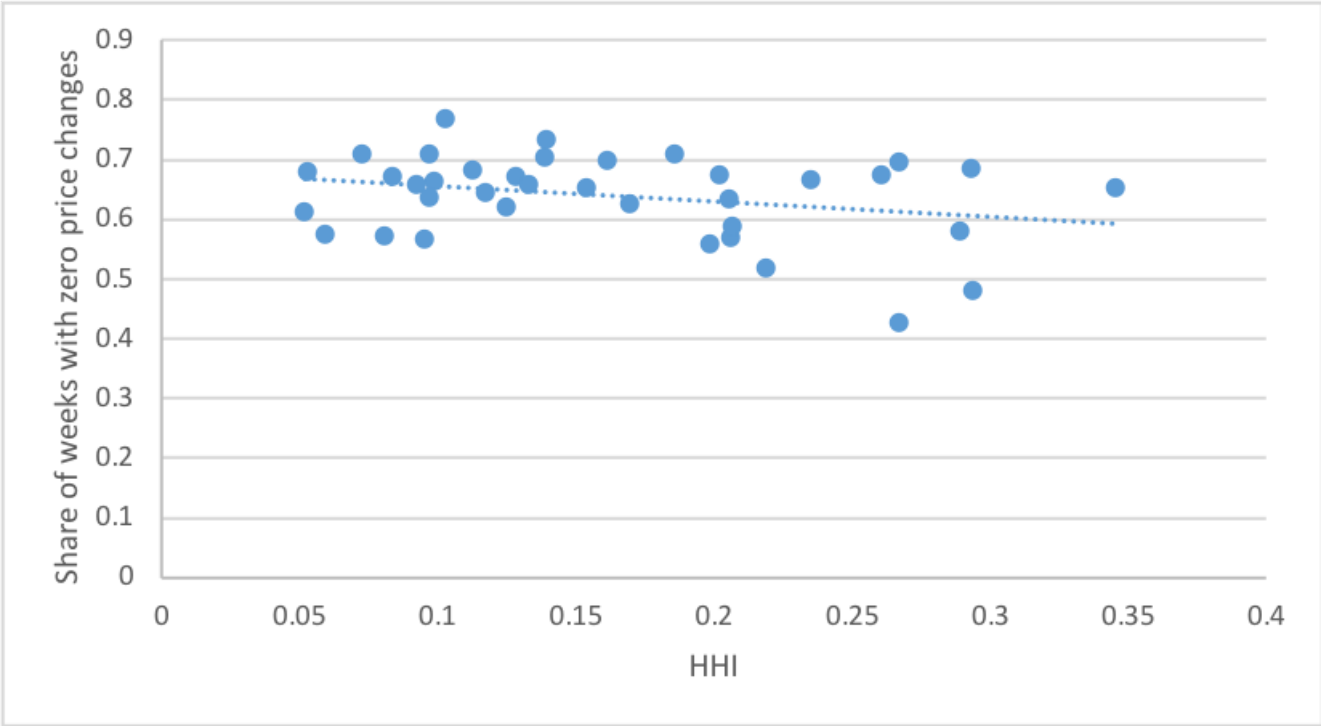

Figure: Share of zero price changes across product categories in AC Nielsen data.

Price Changes-Correlation with Inflation

- For 2 of the 3 shocks, prices in 4-player markets responded more strongly
- Looking at the retail data, preliminary results suggest that price changes become less correlated with inflation as HHI increases.
- This is interesting because the normal assumption we make when calibrating macro models is that observed infrequent price adjustment=non-responsiveness to shocks. However, these results suggest that product categories with "sticker" prices are more responsive to inflation.
- Important distinction between experimentation and responding to shocks.

Summarizing Retail vs. Experiment Data

- In general, similar patterns in price setting behavior.
- Two things seem to help understand the results:
  - Strategic interaction seems to loom large.
  - An important distinction between experimentation and responding to shocks.
- These may be important for the following reasons:
  - Help inform us about the appropriate price adjustment model we should be using. Models which incorporate coordination failures/strategic interaction concerns can give us very different results regarding the non-neutrality of money (Ball and Romer 1994).
  - It also suggests we should think more deeply about the calibration of the degree of price stickiness. In the experiments observed price stickiness $\neq$ non-responsiveness to shocks.

Conclusion/Take away points

- In understanding the dynamics of prices and mark-ups the type of shock and differences in market structure matter a lot!

- Thus, our results potentially shed light on the the often conflicting empirical estimates in the literature on the cyclicality of mark-ups and highlight the importance of accounting market structure in their estimation. (also interesting relative to the discussion of declining competition in the US)

- Examining pricing behavior more closely, we see that in more competitive markets there is less experimentation and fewer small price adjustments (consistent with what we observe in retail data), even though these are the markets that respond the most to the shocks.

- This is relevant in thinking about modeling price setting behavior and how we calibrate our models from data on price adjustments.