Using List Prices to Collude or to Compete?

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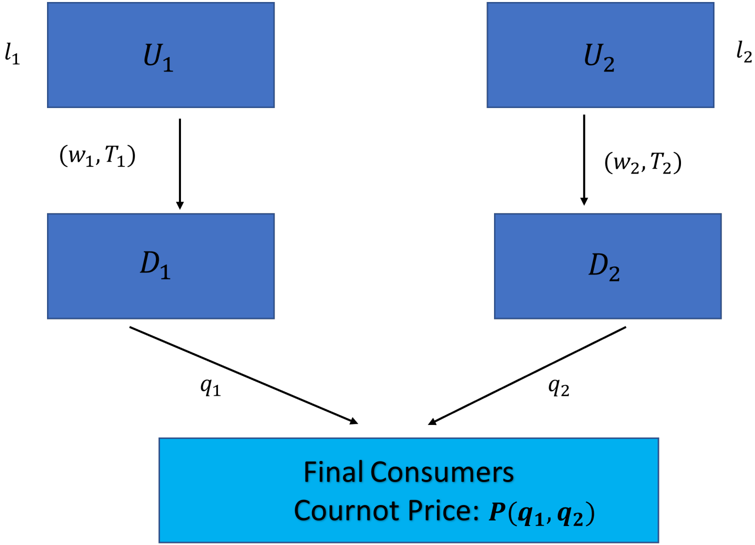
Wholesale-Retail Setting (Horn and Wolinsky)



Research questions

- what role do list prices l_1 and l_2 play?
- can suppliers use them to sustain collusion?
- since suppliers and buyers negotiate bilaterally, collusion is subject to a secret discount problem (Stigler, JPE 1964).
- cartel may solve the "problem" by allocating consumers or setting quotas (Harrington & Skrypacz, AER 2011; Bernheim & Madsen, AER 2017).
- but what if such allocation schemes are not observed/possible?
- yet, there are antitrust cases of collusion based just on the announcement of list prices (e.g., thred, polyurethane, fiberglass).
- Adding to the cases is recent evidence from Chile's fresh-egg market...

Motivating evidence: The wholesale fresh-egg market

- In October of 2018, Chile's main newspaper decided to terminate (after two decades) publication of eggs' wholesale list prices
- Egg producers were taken by complete surprise, so it serves as a natural experiment to test for the role of list prices
- (Other products also saw their publications terminated around the same time)

Motivating evidence: The wholesale fresh-egg market

- Using transaction-level data from two of the largest egg suppliers, we estimate the following “before-and-after” model

$$w_{ilt} = \alpha + \gamma Post_t + \beta Large_i + \phi Large_i \times Post_t + \mu' X_{ilt} + \delta' Y_t + \varepsilon_{ilt}$$

- where
  - w_{itl} is the unit price paid by buyer i located in municipality l on day t

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  - (omitted category of buyers are small buyers, who pay list prices)

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  - (omitted category of buyers are small buyers, who pay list prices)
  - X includes several controls: day of the week, supplier and municipality fixed effects
  - Y includes additional controls, e.g., a price index for corn, a main input

Motivating evidence: The wholesale fresh-egg market

	(1)	(2)	(3)	(4)
Large	-18.114***	-23.580***	-18.172***	-23.894***
	(2.322)	(3.200)	(2.325)	(3.052)
Post	-11.678***	-13.905***	-13.142***	-13.560***
	(3.489)	(3.475)	(3.505)	(3.413)
Post × *Large*	8.691***	10.894***	8.520**	11.317***
	(3.279)	(3.207)	(3.506)	(3.207)
Corn Price Index			0.167***	0.391***
			(0.024)	(0.048)
Constant	108.224***	113.327***	92.440***	75.350***
	(2.045)	(2.952)	(3.478)	(6.135)
Observations	200566	108723	200566	108723
F-tests, p-values				
$\gamma + \phi = 0$	0.000	0.000	0.000	0.000

standard errors in parenthesis; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Some possible explanations

- Publicly available list prices helped suppliers to sustain collusion...
- ...it would have supposedly facilitated the monitoring of compliance with the collusive agreement (see, e.g., Luco, AEJ 2019)
- But, why did the price paid by large buyers also fall?.....
- ...is it that higher list prices serve to establish an "artificially inflated baseline for negotiations" (Tenth Circuit Court, Harrington 2022)?
  - but discounts look very different before and after

Our explanations

- We advance an alternative collusive explanation, one based on the fact that large and small buyers compete for final consumers: the **multibuyer contact effect**

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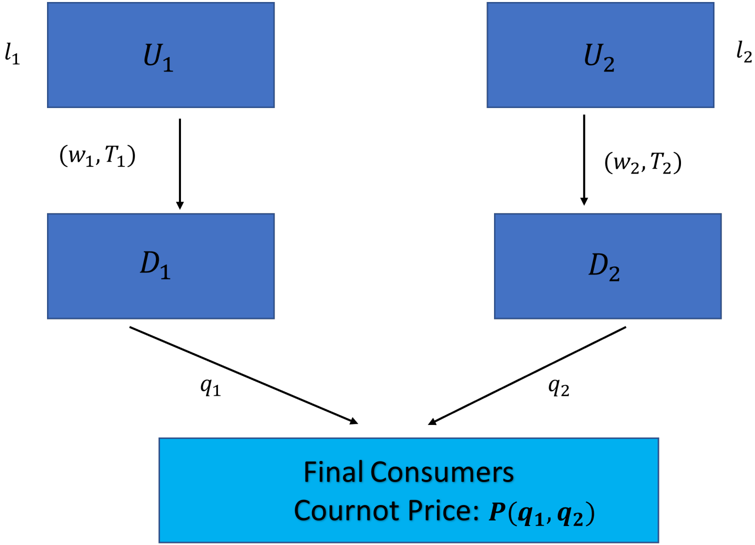
- We advance an alternative collusive explanation, one based on the fact that large and small buyers compete for final consumers: the **multibuyer contact effect**
- But this multibuyer competition gives also rise to an alternative, non-collusive explanation, akin to Hart and Tirole's (BPEA 1990) **commitment effect**
- The evidence shown in Table 1 is consistent with both explanations: prices paid by all buyers fell, but more so those paid by small buyers

A model of irrelevant list prices



Two results to highlight in this only-large-buyer setting

- list prices play no role, for either competition or collusion
- no collusion under linear contracts (i.e., $w_i > 0$ and $T_i{=}0$)

Timing

- two upstream suppliers, U_1 and U_2, and two downstream distributors/retailers, D_1 and D_2 (production costs normalized to zero)

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    - Nash-bargaining solution
    - allow for contractual frictions a la Calzolari et al (RAND 2020): supplier gets only $(1 - \kappa)T_i$, with $\kappa \in [0, 1]$

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- at stage 3, distributors compete Cournot in the retail market, with

$$p(q_1, q_2) = a - q_1 - q_2$$

- this three-stage game is repeated indefinitely (δ is the discount factor)

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- where on-path payoffs are given by

$$\hat{\pi}_{D_i}(w_i, w_j, T_i) = (p(w_i, w_j) - w_i)q_i(w_i, w_j) - T_i$$

$$\hat{\pi}_{U_i}(w_i, w_j, T_i) = w_i q_i(w_i, w_j) + (1 - \kappa)T_i$$

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- and off-path payoffs by $\bar{\pi}_{D_i} = \bar{\pi}_{U_i} = 0$
- (list prices not longer available!, even if not high enough)

Competitive (one-shot game) equilibrium

Proposition 1

If $\kappa \geq 1/2$, then the one-shot game exhibits an equilibrium with $w_1^* = w_2^* = a/7$ and $T_1^* = T_2^* = 0$; otherwise

$$w_1^* = w_2^* = w^* = \frac{4\kappa - 1}{4\kappa + 5} a$$

and

$$T_1^* = T_2^* = T^* = \frac{3 - 6\kappa}{25 - 16\kappa^3 - 24\kappa^2 + 15\kappa} a^2 > 0$$

- unless contractual frictions are sufficiently low, parties rely on linear contracts (Crawford and Yurukoglu, AER 2012; Noton and Elberg, EJ 2018)

Stage 1: List prices play no role

- Suppose that at stage 1 U_i announces a list price l_i that D_i accepts and skips negotiation with U_i
- Does U_i have incentives to announce such list price?
  - Strictly worse off under low frictions, when $\kappa < 1/2$
  - Indifferent under high frictions, $\kappa \geq 1/2$

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Collusive equilibrium

Suppliers maximize their collective payoff

$$\max_{w,T} wq(w,w) + (1-\kappa)T$$

subject to buyers' ICCs (return to Proposition 1 after a deviation)

$$\pi_D(w,w) - T \geq (1-\delta)\left(\pi_D(w^d,w) - T^d\right) + \delta\left(\pi_D(w^*,w^*) - T^*\right)$$

and their own ICCs

$$\begin{aligned} wq(w,w) + (1-\kappa)T \quad &\geq \quad (1-\delta)\left(w^d q(w^d,w) + (1-\kappa)T^d\right) \\ &\quad\; +\delta\left(w^* q(w^*,w^*) + (1-\kappa)T^*\right) \end{aligned}$$

where (w^d, T^d) is the "deviating" contract that U_i and D_i negotiate if either one deviates

Best collusive equilibrium, $\delta \to 1$

Proposition 2

If $\kappa \geq 1/2$, then the solution to suppliers' collusive problem is the one-shot equilibrium, $w^c = w^* = a/7$ and $T^c = T^* = 0$; otherwise

$$w^c = \left(1 - \frac{3}{5+4\kappa}\sqrt{\frac{1+2\kappa}{1-\kappa}}\right) a > w^*$$

and $T^c = 0$ if $\kappa \in [\kappa_0, 1/2)$, where $\kappa_0 \approx 1/5$, or

$$w^c = \frac{1+2\kappa}{2(2+\kappa)} a > w^*$$

and

$$T^c = \frac{3\left(3 - 8\kappa^3 - 20\kappa^2 - 11\kappa\right)}{4\left(1-\kappa\right)\left(4\kappa^2 + 13\kappa + 10\right)^2} a^2 > 0$$

if $\kappa \in [0, \kappa_0)$.

Best collusive equilibrium

- again, list prices play no role
- contractual frictions may prevent any collusion, even with infinitely patient players (buyers' participation constraints cannot be satisfied)
- slotting allowances (i.e., negative transfers) are never used (too costly)

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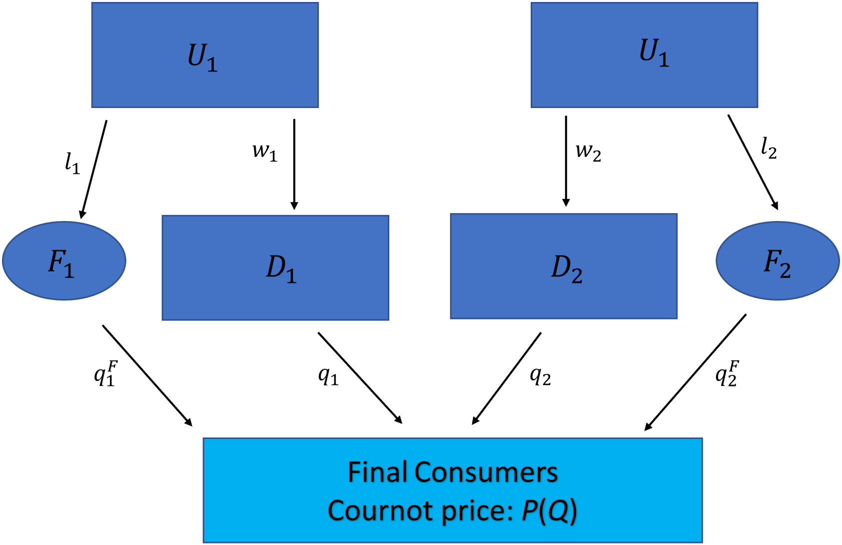
- more importantly for our theory, no collusion could be sustained without transfers
- we have omitted this far the presence of small buyers:
    - large buyers: those who negotiate
    - small buyers: those who do not (pay list prices, which may be subject to 2nd or 3rd degree price discrimination)

A model with a fringe of small, price-taking buyers



Public vs private list prices

- we refer to list prices before the cease of their publication in the local newspaper as **public** list prices: publicly and readily available in a single place, where they were posted simultaneously
- and after the cease of publication as **private** list prices: more disperse and asynchronously informed
- formally:
  - public list prices: announced at stage 1, before negotiations with large buyers
  - private list prices: announced at stage 2, simultaneously with negotiations
- in what follows, linear contracts

Adding small buyers

- Inverse demand in the downstream market is now given by

$$p = a - q_1^F(l_1, p) - q_2^F(l_2, p) - q_1 - q_2$$

- where $q_i^F(l_i, p)$ is fringe i's supply and given by the linear function

$$q_i^F(l_i) = \gamma(p - l_i) > 0$$

for $\gamma > 0$ not too large so in all equilibria small and large buyers share the retail market (otherwise, suppliers would sell only through large buyers)

Competitive equilibrium with public list prices

- the main difference with previous analysis is that now a supplier's outside option (off-path payoff) in case of a negotiation breakdown is not longer zero

$$\bar{\pi}_{U_i} = l_i \gamma \left(\frac{\tilde{a} + (1+2\gamma) w_i}{2(1+2\gamma)} - l_i \right) > 0$$

  where $\tilde{a} = a + \gamma(l_i + l_j)$

- the implication is that suppliers can negotiate better terms now (higher wholesale prices)

Competitive equilibrium with public list prices

- In fact, D_i and U_i Nash bargaining solution is given by:

$$w_i^*(w_j) = \frac{a + (1+2\gamma)w_j + \gamma(4l_i + l_j)}{8(1+2\gamma)}$$

which together with $w_j^*(w_i)$ leads to

$$w_i^*(l_i, l_j) = \frac{3a + \gamma(11l_i + 4l_j)}{21(1+2\gamma)}$$

- higher list prices allow suppliers to negotiate better terms with large buyers
- this is mainly explained by U_i's outside option to sell through the fringe of buyers in case of a negotiation breakdown

Competitive equilibrium with public list prices

Proposition 3

The one-shot game with public list prices exhibits an equilibrium in which suppliers post list prices

$$l_1^* = l_2^* \equiv l^* = \frac{43}{147 + 149\gamma} a$$

at stage one, and then negotiate wholesale prices

$$w_1^* = w_2^* \equiv w^* = \frac{21 + 52\gamma}{(1 + 2\gamma)(147 + 149\gamma)} a < l^*$$

with large buyers at stage two.

Collusive equilibrium with public list prices

Proposition 4

Suppose $\delta \geq \underline{\delta} \in (1/2, 1)$ (distributors' ICCs don't matter anymore). The best collusive agreement on public list prices is for suppliers to post

$$l_1 = l_2 \equiv l^c = \frac{17}{49 + 27\gamma} a > l^*$$

at stage one and then negotiate wholesale prices

$$w_1 = w_2 \equiv w^c = \frac{7 + 16\gamma}{(1 + 2\gamma)(49 + 27\gamma)} a > w^*$$

which large buyers at stage two.

From competition to collusion with public list prices

Propositions 3 vs. 4: Collusion, if sustained, leads to

(i) an increase in list prices, l_i

(ii) an increase in prices paid by large buyers, w_i

(iii) a decrease in the sales of small buyers

(iv) an increase in the sales of large buyers

(iv) a decrease in total sales (higher retail prices)

(v) an increase in the profits of suppliers and large buyers

From public to private list prices

- all prices are determined at the same time
- simultaneous "negotiations" with all buyers, large and small
- solution concept: Nash-in-Nash (Horn and Wolinsky, RAND 1988; Collard-Wexler et al., JPE 2019)

Competitive equilibrium with private list prices

- Let w_i^s, l_i^s, w_j^s and l_j^s be the Nash-in-Nash solution
- Small buyers don't bargain, so l_i^s is given by U_i's best response:

$$l_i^s = \arg\max_{l_i}\{w_i^s q_i(w_i^s, l_i, w_j^s, l_j^s) + l_i\gamma(p(w_i^s, l_i, w_j^s, l_j^s) - l_i)\}$$

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- To obtain w_i^s, we maximize the Nash product (recall that $\bar{\pi}_{D_i} = 0$)

$$w_i^s = \arg\max_{w_i}\{(\hat{\pi}_{U_i}(w_i, l_i^s, w_j^s, l_j^s) - \bar{\pi}_{U_i}(l_i^s, w_j^s, l_j^s))\hat{\pi}_{D_i}(w_i, l_i^s, w_j^s, l_j^s)\}$$

where $\bar{\pi}_{U_i} = l_i^s\gamma(\bar{p}(l_i^s, w_j^s, l_j^s) - l_i^s)$ and $\bar{p}(\cdot)$ is the off-path price.

Competitive equilibrium with private list prices

Proposition 5

The one-shot game with private list prices exhibits an equilibrium in which suppliers make take-it-or-leave-it (list price) offers

$$l_1^s = l_2^s \equiv l^s = \frac{5}{3(7+8\gamma)}a$$

to small buyers and simultaneously negotiate wholesale prices

$$w_1^s = w_2^s \equiv w^s = \frac{3+7\gamma}{3(1+2\gamma)(7+8\gamma)}a < l^s$$

with large buyers.

Collusion with private list prices?

- in principle collusion could be also sustained with private list prices, but this requires of some communication between suppliers and large buyers
    - soft: communicate only the list prices suppliers will charge
    - hard: communicate also an offer that may depart from the corresponding Nash-bargaining solution

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  - soft: communicate only the list prices suppliers will charge
  - hard: communicate also an offer that may depart from the corresponding Nash-bargaining solution
- we assume for now that collusion, if present, ends as list prices become private
- so, if the cease of publication of list prices moved suppliers to the equilibrium in Proposition 5 (competitive equilibrium with private list prices), then.....

Theory provides support for both "collusive" and "competitive" explanations

- prices fell with the cease of the publication of list prices because collusion ended
  - relative to the "public" collusive equilibrium (Proposition 4), the "private" competitive equilibrium (Proposition 5) leads to lower prices exactly as the empirical evidence suggests: l falls more than w
- prices fell with the cease of the publication of list prices because suppliers could not longer (unilaterally) commit to higher list prices
  - relative to the "public" competitive equilibrium (Proposition 3), the "private" competitive equilibrium (Proposition 5) leads to lower prices exactly as the empirical evidence suggests: l falls more than w

Conclusions

- Colluding in list prices is possible, under the presence of small distributors who pay them
- Whether suppliers compete or collude, antitrust action to forbid the (simultaneous) publication of list prices should lead to lower retail prices
- Can a fall in list (and retail) prices after such prohibition be interpreted unequivocal as evidence of collusion?...No
- But to distinguish between the collusive and competitive explanations, further (empirical) analysis is required