

*Coordination on List Prices and
Collusion in Negotiated Prices*

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Introduction

Consider many intermediate goods markets in which firms announce list prices and routinely offer privately-negotiated discounts.

- Collusion in such markets often involves
 - ▶ coordination on transaction prices
 - ▶ market allocation in terms of sales, territories, or customers
 - ▶ monitoring of sales or customers
- But there are cases in which colluding firms
 - ▶ coordinate on list prices
 - ▶ do not coordinate on discounts
 - ▶ do not monitor sales.
- Markets with coordination only in list prices
 - ▶ U.S.: insulation, polyurethane, banks and lending rates
 - ▶ E.U.: bananas, pasta (Italy)
 - ▶ U.K.: cement

Introduction

Reserve Supply v. Owens-Corning Fiberglas (7th Circuit, 1992)

[Plaintiff] Reserve points to [defendants] Owens-Corning and CertainTeed's practices of maintaining price lists for products and ... asserts that these lists have no independent value because no buyer in the industry pays list price for insulation. Instead, it claims that the price lists are an easy means for producers to communicate and monitor ... by providing a common starting point for the application of percentage discounts. ... Owens-Corning and CertainTeed counter by arguing that the use of list prices to monitor pricing would not be possible because the widespread use of discounts in the industry ensures that list prices do not reflect the actual price that a purchaser pays.

Introduction

Reserve Supply v. Owens-Corning Fiberglas (7th Circuit, 1992)

The 7th Circuit Court expressed skepticism with regards to the plaintiffs' claim:

[T]he industry practice of maintaining price lists and announcing price increases in advance ... would be ... an awkward facilitator of price collusion because the industry practice of providing discounts to individual customers ensured that list price did not reflect the actual transaction price.

Introduction

Cement (United Kingdom, 2016)

- Annually, suppliers sent letters to their customers announcing a price increase.
- Prices were individually negotiated so the full price increase was rarely implemented.
- Competition & Market Authority: Price announcement letters served to coordinate on list prices and soften customer resistance to price increases.
- Justin Coombs (head of Compass Lexecon's London office):

How do price announcements help firms coordinate on prices if prices are ultimately individually negotiated?

Introduction

- Research questions
 - ① How can coordination on list prices result in supracompetitive transaction prices when very few customers pay list price?
 - ② Having identified a mechanism whereby announced list prices impact negotiated prices, what market conditions are conducive to coordinating list prices?
- Overview
 - ▶ List prices are cheap talk announcements.
 - ▶ Desideratum #1: All customers pay negotiated prices, and list prices affect those prices.
 - ▶ Desideratum #2: Coordinating on list prices is profitable and stable.
 - ▶ Some implications for competition policy.

Model

- Two sellers offer identical products
 - ▶ A seller can be a "low cost" or "high cost" type.
 - ▶ A type t seller's unit cost is a random draw from the cdf

$$F_t : [\underline{c}_t, \bar{c}_t] \rightarrow [0, 1], t \in \{L, H\}.$$

- ▶ $h_t(c) \equiv F_t(c)/F'_t(c)$, $h'_t(c) \geq 0$, $h_L(c) > h_H(c)$.
- Continuum of heterogeneous buyers
 - ▶ A buyer buys 0 or 1 unit and v is a buyer's valuation.
 - ▶ Buyers' valuations represented by the cdf $G : [\underline{v}, \bar{v}] \rightarrow [0, 1]$.

Model

Buyer-seller interaction

- Intent is to capture many intermediate goods market for which
 - ▶ sellers post list prices.
 - ▶ after observing list prices, buyers negotiate with some sellers.
 - ▶ negotiation is an iterative bargaining process.
- "Negotiation" is modelled as a second-price auction with a reserve price.
 - ▶ A buyer "invites" $w \in \{1, 2\}$ sellers to the auction.
 - ▶ Buyer sets a reserve price (so as not to be passive)
 - ▶ Sellers submit bids.
 - ▶ Transaction occurs if the lowest bid is below the buyer's reserve price.
- Fraction $b \in [0, 1]$ of buyers "negotiate" with one seller and a fraction $1 - b$ of buyers "negotiate" with both sellers.

Model

Extensive form

- Stage 1: Two sellers draw types from $\{L, H\}$ and choose a list price (cheap talk message) from $\{l, h\}$.
- Stage 2: Buyers learn their valuations, observe sellers' list prices, and choose 1 or 2 sellers.
- Stage 3: Each seller draws its cost.
- Stage 4: For each buyer's auction, the selected sellers submit a bid and the buyer chooses a reserve price.

Model

- Strategy for a seller
 - ▶ **List price function** maps from $\{L, H\}$ to $\{l, h\}$.
 - ▶ Weakly dominant **bid function** is to bid cost (given it is a second-price auction)
- Strategy for a buyer who chooses
 - ▶ one seller - selects a seller and a reserve price conditional on the observed list prices and the buyer's valuation.
 - ▶ two sellers - selects a reserve price conditional on the observed list prices and the buyer's valuation.
- Solution concept: Perfect Bayes-Nash equilibrium

Equilibrium

Seller's strategy

- Two industry states: {**competition**, **collusion**}
- Under **competition**, a seller's strategy is to choose
 - ▶ low list price l when low cost L
 - ▶ high list price h when high cost H
- Under **collusion**, a seller's strategy is to choose
 - ▶ high list price h when low cost L or high cost H
- Buyers assign probability κ to collusion, where $\kappa > 0$ (and small).

Equilibrium

Buyer's beliefs

- If both list prices are not high then buyers believe
 - ▶ sellers are competing
 - ▶ a seller with a low (high) list price is a low (high) cost type
- If both list prices are high then buyers believe
 - ▶ sellers are competing with prob. $1 - \kappa$ and colluding with prob. κ
 - ▶ a seller is a low-cost type with prob.

$$\frac{\kappa q}{\kappa + (1 - \kappa)(1 - q)}$$

where q is the prior prob. that a seller is a low-cost type.

Equilibrium

b=1: All buyers negotiate with one seller

- If at least one list price is low then a buyer chooses a seller with a low list price and the optimal reserve price is

$$R_L(v) \equiv \arg \max (v - R) F_L(R).$$

- If both list prices are high then the optimal reserve price is

$$R_K(v) \equiv \arg \max (v - R) F_K(R)$$

where

$$F_K \equiv \left(\frac{\kappa q}{\kappa q + (1 - q)} \right) \circ F_L + \left(\frac{1 - q}{\kappa q + (1 - q)} \right) \circ F_H.$$

- **Lemma:** $R_K(v) > R_L(v), \forall v.$

Equilibrium (Competition)

b=1: All buyers negotiate with one seller

Seller's equilibrium conditions under competition

- A type L seller prefers to choose l (and signal it is a low-cost type) iff

$$\begin{aligned} & \left(\frac{q}{2} + 1 - q \right) \int_{\underline{v}}^{\bar{v}} \int_{\underline{c}_L}^{R_L(v)} (R_L(v) - c) dF_L(c) dG(v) \\ & \geq \left(\frac{1-q}{2} \right) \int_{\underline{v}}^{\bar{v}} \int_{\underline{c}_L}^{R_K(v)} (R_K(v) - c) dF_L(c) dG(v). \end{aligned}$$

- A type H seller prefers to choose h iff

$$\begin{aligned} & \left(\frac{1-q}{2} \right) \int_{\underline{v}}^{\bar{v}} \int_{\underline{c}_H}^{R_K(v)} (R_K(v) - c) dF_H(c) dG(v) \\ & \geq \left(\frac{q}{2} + 1 - q \right) \int_{\underline{v}}^{\bar{v}} \int_{\underline{c}_H}^{R_L(v)} (R_L(v) - c) dF_H(c) dG(v). \end{aligned}$$

Equilibrium (Competition)

$b=1$: All buyers negotiate with one seller

When a buyer selects one seller, a seller's list price has two effects.

- ➊ **Inclusion effect:** List price affects the chances of being approached by a buyer.
 - ▶ A low list price makes it more likely a buyer will include a seller in the negotiation process because it signals a seller is a low cost type.
 - ➋ **Bargaining effect:** List price affects a buyer's aggressiveness as reflected in its reserve price
 - ▶ If selected, a low list price induces the buyer to set a lower reserve price.
- Inclusion and Bargaining effects are present in a competitive search model of the labor market - Menzio (2007)

Equilibrium (Competition)

$0 < b < 1$: General case

- b is the fraction of buyers who "negotiate" with one seller.

Theorem

If κ is sufficiently small and a separating equilibrium exists for $b = 1$ then $\exists b^ \in (0, 1)$ such that a separating equilibrium exists if and only if $b \in [b^*, 1]$.*

- If b is sufficiently high then the inclusion effect is sufficiently strong that a low-cost seller prefers to post a low list price in order to increase the chances of being selected by a buyer even though a buyer will be more aggressive.

Equilibrium (Collusion)

- Infinitely repeated game
 - ▶ Sellers live forever with common discount factor δ .
 - ▶ Buyers live for one period (and do not know the history)
- Collusive strategy in list prices with grim punishment.
 - ▶ Sellers choose list price h (regardless of type) as long as both sellers have chosen h in the past (while in the "collusion" state).
 - ▶ Otherwise, sellers revert to the "competition" state.
- Cartel birth and death
 - ▶ f = prob. that a cartel forms (competition \Rightarrow collusion)
 - ▶ d = prob. that a cartel dies (collusion \Rightarrow competition)
- Buyers' prob. that firms are colluding is the steady-state prob.:

$$\kappa = \kappa(1 - d) + (1 - \kappa)f \Leftrightarrow \kappa = \frac{f}{d + f}$$

Equilibrium (Collusion)

- $E[\pi^{\text{coll}}]$ = expected collusive profit
- $E[\pi^{\text{comp}}]$ = expected competitive profit
- Expected present value of profits under collusion:

$$V^{\text{coll}} = E[\pi^{\text{coll}}] + (1-d)\delta V^{\text{coll}} + d\delta V^{\text{comp}}$$

- Expected present value of profits under competition:

$$V^{\text{comp}} = E[\pi^{\text{comp}}] + (1-f)\delta V^{\text{comp}} + f\delta V^{\text{coll}}$$

- Incremental value in the "collusion" state:

$$V^{\text{coll}} - V^{\text{comp}} = \frac{E[\pi^{\text{coll}}] - E[\pi^{\text{comp}}]}{1 - \delta(1 - d - f)}$$

Equilibrium (Collusion)

- $\hat{\pi}_t(\rho) \equiv$ expected profit for type t seller when buyers believe it is a low-cost type with prob. ρ .
- Incentive compatibility constraint for cost type $t \in \{L, H\}$:

$$\begin{aligned} & \left(\frac{1}{2}\right) \hat{\pi}_t \left(\frac{\kappa q}{\kappa + (1 - \kappa)(1 - q)} \right) + (1 - d)\delta V^{\text{coll}} + d\delta V^{\text{comp}} \\ \geq & \hat{\pi}_t(1) + \delta V^{\text{comp}} \end{aligned}$$

Equilibrium (Collusion)

Incremental profit from collusion: *Price-enhancing effect*

- For transactions that occur whether firms are colluding or competing, price is higher under collusion because the reserve price is higher.
- Effect occurs with both one-seller buyers and two-seller buyers.
- Consider buyers who negotiate with one seller
 - ▶ If seller's cost $< R_L(v) < R_K(v)$ then a transaction occurs under collusion or competition.
 - ▶ Low-cost seller receives higher reserve price $R_K(v)$ compared to $R_L(v)$.
- Sellers are better off, buyers are worse off.

Equilibrium (Collusion)

Incremental profit from collusion: *Business-shifting effect*

- Effect occurs with only one-seller buyers.
- In expectation, collusion shifts demand from when a seller is a low-cost type to when it is a high-cost type.
- Sellers and buyers could be worse off.

Equilibrium (Collusion)

Incremental profit from collusion: *Transaction-enhancing effect*

- Some transactions occur when firms are colluding but not when firms are competing.
- Effect occurs with both one-seller buyers and two-seller buyers.
- Consider buyers who negotiates with one seller.
 - ▶ If seller's cost lies in $(R_L(v), R_K(v))$ then the higher reserve price under collusion results in a transaction.
 - ▶ Seller earns $R_K(v) - c$ and buyer earns $v - R_K(v)$.
- Pareto improvement: sellers and buyers are better off.
- (Note: Because of this effect, collusion can increase total surplus.)

Equilibrium (Collusion)

Sufficient Conditions for Existence

Under some parametric assumptions on cost distributions, coordination on list prices is an equilibrium when:

- probability of low cost type is neither too low nor too high (so competitive list prices are informative)
- fraction of buyers who approach one seller is sufficiently high (so competitive list prices are informative)
- discount factor is sufficiently high (so collusion is stable)
- probability of cartel death is sufficiently low (so collusion is stable)
- probability of collusion is sufficiently low

Some Policy Conclusions

- Result

- ▶ If all buyers negotiate with one seller then an inclusion effect is present \Rightarrow list prices are informative \Rightarrow sellers can profitably coordinate on list prices.
- ▶ If all buyers negotiate with both sellers then an inclusion effect is absent \Rightarrow list prices are uninformative \Rightarrow sellers cannot profitably coordinate on list prices.

- Conjecture: Coordinating on list prices is more effective when the inclusion effect is stronger.

- Conjecture: Inclusion effect is stronger when a buyer negotiates with a smaller fraction of sellers which is more likely when

- ▶ expenditure is lower (relative to the cost of bargaining)
- ▶ there are more sellers.

Some Policy Conclusions

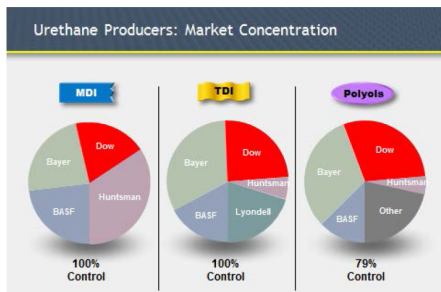
Turbine generators (1963-1975)

- Coordinating on list prices in this market would be ineffective.
 - ▶ Two sellers: General Electric (GE) and Westinghouse.
 - ▶ Turbine generator has a high absolute price.
 - ▶ Likely that a buyer would negotiate with both sellers \Rightarrow list prices are predicted to be uninformative.
- Method of collusion in practice
 - ▶ GE and Westinghouse coordinated on a policy of not negotiating \Rightarrow list prices became actual transaction prices.
 - ▶ GE acted as a price leader in list/transaction prices.

Some Policy Conclusions

Urethane (1999-2003)

- Five sellers
- Urethane purchases are probably routinely conducted and may not be a big ticket item.
- Inclusion effect may be significant \Rightarrow list prices are informative \Rightarrow coordination on list prices could be profitable.



Concluding Remarks

Summary

- Coordination on list prices can be an effective method of collusion even though
 - ▶ all buyers pay negotiated prices.
 - ▶ seller do not coordinate on final prices (they offer the same bids as under competition).
- Mechanism
 - ▶ Under competition, list prices are informative as to sellers' costs.
 - ▶ Buyers decide on the sellers with which to negotiate based on list prices because they are informative of sellers' costs.
 - ▶ Coordinating on high list prices influences sellers' beliefs so they bargain less aggressively and that raises final transaction prices.

Concluding Remarks

Future research directions

Suppose buyers can detect collusion over time?

- Model dynamic game between long-lived sellers and long-lived buyers
- Buyers use list prices and bids to update beliefs that sellers are colluding.
- Buyers lower reserve price when they assign a higher probability to collusion.
- Colluding sellers try to avoid detection and buyers try to detect collusion.
- *What does equilibrium look like?*

Concluding Remarks

Future research directions

In actual cases, why did sellers not coordinate on final prices?

- Coordinating on final prices may make detection more likely because similar final prices could make buyers more suspicious
- Additional incentive compatibility constraints that depend on a seller's realized cost
- *When do sellers prefer to coordinate on final prices and when on only list prices?*