

# Lectures on Collusive Practices

Joe Harrington

Penn - Wharton

CRESSE - July 1-2, 2015

# Defining Collusion

- **Collusion** is when some or all firms in a market coordinate to suppress competition. This coordination is typically done with the intent of raising price and earning higher profit.
- “Cartels are cancers on the open market economy ...” [Mario Monti, former European Commissioner for Competition, Sept 2000]
- “... negotiation between competitors may facilitate the supreme evil of antitrust: collusion.” [U.S. Supreme Court Justice Antonin Scalia, *Verizon Communications, Inc. v. Law Offices of Curtis V. Trinko LLP*, 2004]

# Defining Collusion

## Laws

- Section 1 of the Sherman Act (1890, U.S.): "Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations, is declared to be illegal."
- Article 101 of the Treaty of the European Communities (1999) - "The following shall be prohibited as incompatible with the common market: all agreements between undertakings, decisions by associations of undertakings and concerted practices which may affect trade between Member States and which have as their object or effect the prevention, restriction or distortion of competition within the common market," and include:
  - ▶ fixing selling prices or any other trading conditions
  - ▶ controlling production, markets, technical development, or investment
  - ▶ sharing markets or sources of supply

# Defining Collusion

**Note: Legal statements pertain to the U.S. but are of some relevance in many other jurisdictions (including the EU)**

- It is not unlawful for firms to
  - ▶ charge high prices
  - ▶ act in a parallel manner
  - ▶ use collusive pricing rules (e.g., price high but price low in retaliation to a rival firm not pricing high)
- It is unlawful for firms to have an *agreement* to suppress competition (that is, unreasonably restrain trade)
  - ▶ What is an agreement?
  - ▶ What is sufficient evidence to conclude that firms have an agreement?

# Defining Collusion

- U.S. Supreme Court has developed the doctrine that an *agreement* to restrain trade is unlawful and has defined an agreement as or as requiring
  - ▶ a "unity of purpose or a common design and understanding, or a meeting of minds" (*American Tobacco Co. v. United States*, 1946)
  - ▶ "a conscious commitment to a common scheme designed to achieve an unlawful objective" (*Monsanto Co. v. Spray-Rite Serv. Corp.*, 1984)
  - ▶ "mutual consent" (*Esco Corp. v. United States*, 1965)
- E.U. General Court has defined an agreement as or as requiring
  - ▶ "joint intention" (*ACF Chemiefarma*, 1970)
  - ▶ "concurrence of wills" (*Bayer v. Commission*, 2000)

# Defining Collusion

- An unlawful agreement requires that firms
  - ▶ have engaged in an exchange of assurances or
  - ▶ have expressed intent (to coordinate) and achieved necessary reliance (in order to coordinate)
- Concerted action (W. Page, *Loyola University Chicago Law Journal*, 2007)
  - ▶ "[Firms] need not have exchanged promises of assurances of their actions; it is enough that they have communicated their intent to act and their reliance on others to do so."
  - ▶ *Interstate* (1939) - "[A]cceptance by competitors, without previous agreement, of an invitation to participate in a plan, the necessary consequence of which, if carried out, is restraint of interstate commerce, is sufficient to establish an unlawful conspiracy under the Sherman Act."

# Defining Collusion

Governments (through the courts and administrative bodies) have recognized three forms of collusion:

- ① Explicit (or express) - unlawful
- ② Tacit - problematic
- ③ Conscious parallelism - lawful

## Defining Collusion

Explicit collusion - firms acquire mutual understanding through direct means requiring minimal inferences (other than perhaps veracity)

- Example: Managers of rival firms meet in a hotel room and engage in unambiguous communication

*Lysine Cartel, Meeting in Maui, March 10, 1994*



- "Cases that speak of 'express' agreements ordinarily involve 'direct,' readily observable proof that the defendants have exchanged assurances that they will pursue a common course of action." - W. Kovacic, *Antitrust Bulletin*, 1993

# Defining Collusion

Tacit collusion - firms acquire mutual understanding through means that, while indirect, involve distinct identifiable actions

- Example: *United States v. Foley* (1979)
  - ▶ Jack Foley hosted a dinner party where the guests were nine competing realtors.
  - ▶ Foley announced that his firm was raising its commission rate from 6 to 7%.
  - ▶ In the following months, all defendants adopted a 7% rate.
- "No formal agreement is necessary to constitute an unlawful conspiracy." *American Tobacco* (1946)
- European Court of Justice defines "concerted practices" as "a form of coordination between undertakings which, without having reached the stage where an agreement properly so-called has been concluded, knowingly substitutes practical cooperation between them for the risks of competition."

# Defining Collusion

Conscious parallelism - firms are "endowed" with mutual understanding

- A process "not in itself unlawful, by which firms in a concentrated market might in effect share monopoly power, setting their prices at a profit-maximizing, supracompetitive level by recognizing their shared economic interests." *Brooke Group Ltd. v. Brown & Williamson Tobacco Corp.* (1993)
- "Today pure market 'parallel behavior' without any attempt from the firms involved to communicate with each other or establish practices which help sustain collusion would probably not be judged by the Court of First Instance and the European Court of Justice as a concerted practice within the meaning of Article [101]." [M. Motta, *Competition Policy*, 2004]

# Facts about Cartels

## Cartel duration

TABLE 1  
CARTEL DURATION: CROSS-SECTION STUDIES

	Eckbo— Sample 1 <sup>a</sup>	Eckbo— Sample 2 <sup>a</sup>	Griffin/ Marquez <sup>b</sup>	Suslow	Posner	Dick	Gallo et al.	Jacquemin et al.	Levenstein & Suslow
Number of Cartels	23	29	54	71	989	125	1348	40	42
Sample	Int'l Cartels, 1819–1964	Int'l Cartels, 1819–1964	Int'l Cartels, 1888–1984	Int'l Cartels, 1920–1939	U.S. DOJ cases, 1890–1969 <sup>f</sup>	Webb- Pomerene Export Assocs., 1918–1965	U.S. DOJ cases, 1955–1997	Japanese export cartels, 1967–1972	Int'l Cartels, 1990s
Average Duration (years)	3.8 <sup>c</sup>	4.6 <sup>c</sup>	7.3	3.7 <sup>e</sup>	7.5	5.3 <sup>g</sup>	5.4	10	5
Standard Deviation of Duration	2.4	4.7	6.3	3.0				4.5	4.5
Duration Range (years)	1–18	0–18 <sup>d</sup>	1–29	1–13				1–19	0–20
% less than 5 years	60%	57%	43%	40%		39%		12.5%	
% 10 or more years	12%	18%	32%	37%		24%		37.5%	

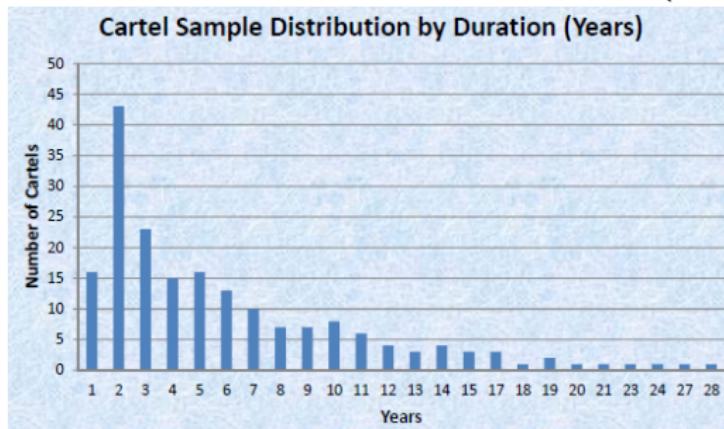
Levenstein and Suslow (*Journal of Economic Literature*, 2006)

# Facts about Cartels

## Cartel duration

Average duration of *discovered* cartels is 5-8 years (depending on the data set)

U.S. Department of Justice, Antitrust Division (1961 - 2012)

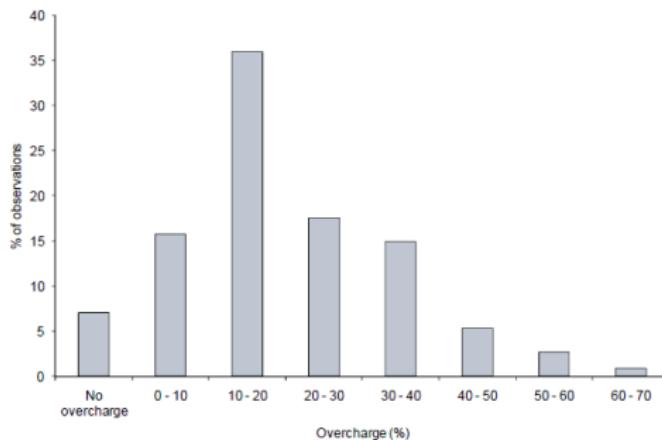


# Facts about Cartels

## Cartel overcharges

Overcharge = percentage increase in price due to collusion

**Figure 4.1** Distribution of cartel overcharges in empirical studies of past cartels: indicative results from new sample selected by Oxera, based on Connor and Lande (2008)



Source: Oxera analysis based on underlying Connor and Lande data described above and selection criteria applied by Oxera.

# Facts about Cartels

Organizational structure and managerial involvement

Data: 74 international cartels, European Commission, 1990-2009 (Ashton and Pressley, 2012)

# of Managerial Levels Participating in the Cartel	Frequency
1 level	3.6%
2 levels	39.3%
3 levels	12.5%
4 levels	5.4%
> 4 levels	1.8%

# Facts about Cartels

## Organizational structure and managerial involvement

Level	Frequency	Examples
Leader	46.6%	CEO, managing director, chairman, president
Senior managers	29.3%	Vice-president, head of sales and/or marketing
Senior middle managers	6.9%	Regional manager, divisional manager
Middle managers	3.4%	Product, project, key account production managers
Junior marketing & sales	13.8%	Sales representatives, assistant marketing mgrs

# Facts about Cartels

## Organizational structure and managerial involvement

- 11 vitamins and two carotenoids
- 18 manufacturers

Organizational Structure (Vitamins, 1990-99)

Level	Employees
Summit	Senior managers
Budget	Marketing heads
Global marketing	Operations managers
Regional marketing	Regional marketing heads

# Facts about Cartels

## Data issues

- Biased sample because we only observe *discovered* cartels.
- Suppose only the less effective cartels are caught.
  - ▶ Cartel duration has been underestimated.
  - ▶ Welfare losses have been underestimated.
- Suppose only the more effective cartels are caught because the less effective ones collapse before being discovered.
  - ▶ Cartel duration has been overestimated.
  - ▶ Welfare losses have been overestimated.
- Policy challenge: *How can we measure the efficacy of cartel enforcement policies, when we cannot measure the number of cartels in an economy?*

# Overview of Lectures

- ① Theory of collusion
- ② Coordinating practices
- ③ Identifying market conditions conducive to collusion
- ④ Imperfect monitoring
- ⑤ Firm asymmetries
- ⑥ Some underexplored collusive practices
- ⑦ Facilitating practices
- ⑧ Competition policy
- ⑨ Understanding cartel price paths
- ⑩ Detecting cartels

# Theory of Collusion

# Theory of Collusion

- Challenges faced by firms that want to collude.
- Challenge #1: Existence of a profitable and stable collusive agreement.
  - ▶ Market conditions must be consistent with the existence of a collusive agreement that is profitable (all colluding firms earn higher profit than under competition) and stable (each colluding firm chooses to abide by the collusive agreement).
  - ▶ Whenever collusion is an equilibrium, so is competition.
- Challenge #2: Achieving mutual understanding among firms concerning the collusive agreement
  - ▶ Explicit collusion - communicate using the spoken and written word.
  - ▶ Tacit collusion - how do you coordinate beliefs without talking?

# Theory of Collusion

- Role of economic theory
  - ▶ If firms achieve mutual understanding regarding a collusive agreement, then economic theory identifies market conditions whereby the collusive agreement will persist over time.
  - ▶ Economic theory does not address *how such a mutual understanding is achieved*.
  - ▶ Economic theory does not show when collusion *will* occur, only when collusion *can* occur.
- Some questions that the economic framework can address.
  - ① When is collusion feasible?
  - ② What factors facilitate collusion?
  - ③ What does collusion look like?
  - ④ How do you distinguish collusion from competition?

# Theory of Collusion

What problems must a cartel solve to be successful?

- ① Coordinating on a collusive agreement
  - ▶ Communication
  - ▶ Bargaining
- ② Sustaining a collusive agreement
  - ▶ Monitoring for compliance
  - ▶ Punishing for non-compliance
  - ▶ Controlling the expansion of non-cartel supply
- ③ Eluding detection by customers and the competition authority
- Example: international steel cartel agreement (1926)

International Combines in Modern Industry

Alfred Plummer, Pitman Publishing Corp.,  
New York, 1938.

## APPENDIX I

### INTERNATIONAL STEEL AGREEMENT

*30th September, 1926*

#### ARTICLE 1

EACH country shall pay 1 dollar monthly into a common fund for each ton of crude steel actually produced.

By the term "crude steel" is meant all the crude steel manufactured in the several countries by the Thomas, Bessemer, Siemens or Martin processes, by the electric crucible, or any other process. This sum shall be credited to the account of the country in question. The first time, it shall be paid two months after the present Agreement comes into effect in the form of drafts at three months; for subsequent months it shall be paid on the 25th of the month following in the form of a draft at three months.

Should the Government of one of the countries participating in the Agreement object to the transfer of all or any of the sums payable under the present Article, the actual payment might be replaced—

1. By the guarantee of a bank approved by the Managing Committee; or
2. By a cash payment into a blocked account at a bank situated in the country in question and approved by the Managing Committee.

#### ARTICLE 2

The administration of the common fund shall be provided for by a Managing Committee of four members appointed respectively by each of the countries Parties to the Agreement, i.e. Germany, Belgium, France, and Luxemburg. Each of these four countries shall also appoint two deputy members to replace the permanent member in the event of his being absent or unable to attend.

The chairmanship of the Managing Committee shall be held for one year by each of the countries concerned in rotation.

In a general way, and in addition to the special provisions laid down in the Articles following, the Managing Committee shall make the necessary arrangements for carrying out the

## 248 INTERNATIONAL COMBINES IN MODERN INDUSTRY

execution of the clauses of the present contract and for exercising the supervision which it entails. It shall also have full powers for the administration, handling, and custody of the moneys paid into the common fund or held by it. The number of votes of the Managing Committee shall be allotted in accordance with the quotas.

### ARTICLE 3

The Managing Committee shall fix the quota of each country for each quarter in accordance with the provisions of Article 4 not later than a fortnight before the beginning of that quarter, by applying coefficients—fixed once for all for each country—to the total tonnage representing the probable demand of the market.

### ARTICLE 4

The coefficients allotted to the different countries can only be modified by unanimous consent.

The total quarterly tonnage, and accordingly the quotas of each country, shall be fixed by a two-thirds majority of the votes, each country commanding the number of votes proportional to its participation, with the proviso that unanimity of all the countries but one shall constitute a sufficient majority even if this latter country represents more than a quarter of the votes.

The Saar shall never vote individually; its votes shall be divided between France and Germany in their ratios of one-third and two-thirds.

### ARTICLE 5

Every month each country's actual net production of crude steel during that month shall be ascertained, in relation to the figures indicated by the quotas.

### ARTICLE 6

If the quarterly production of a country exceeds the quota which was fixed for it, that country shall pay in respect of each ton in excess a fine of 4 dollars, which shall accrue to the common fund, in addition to the payment provided for in Article 1.

### ARTICLE 7

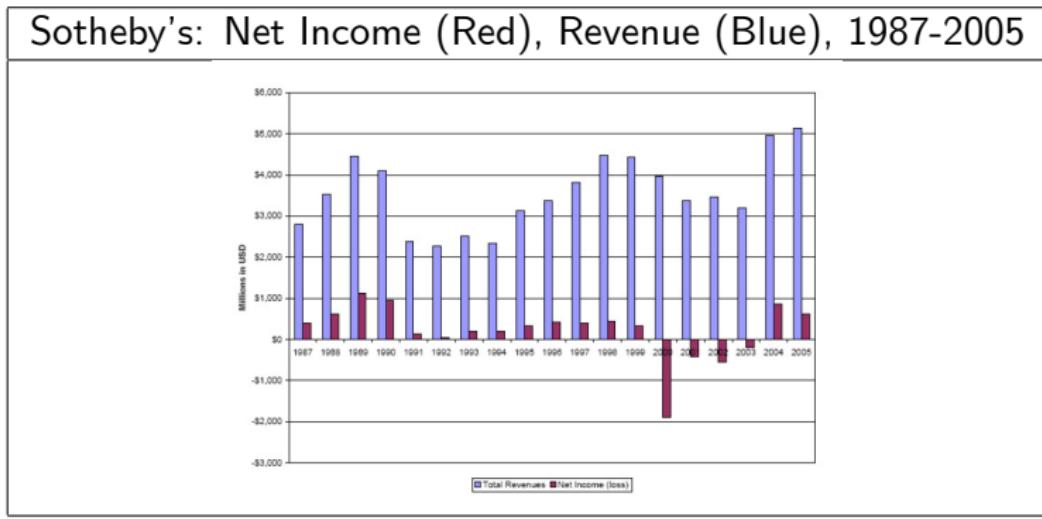
If the production of any country has been below the quota allotted to it, that country shall receive in compensation from the common fund the sum of 2 dollars per ton short.

The tonnage entitling to compensation may not, however,

# Theory of Collusion

## Fine arts auction houses cartel

- Auction houses sell fine art objects, antiques, etc. as the agent of the owner, in exchange for a percentage of the price it sells at auction.
- Companies: Christie's, Sotheby's.
- Cartel duration: April 1993 to February 2000.



# Theory of Collusion

Fine arts auction houses cartel

Meeting between Sir Anthony Tennant (Chairman, Christie's) and Alfred Taubman (Chairman, Sotheby's) at Taubman's London flat on April 30, 1993:



Tennant: "We're getting killed on our bottom line. I feel it's time to increase pricing."



Taubman: "I agree. But it's your turn to go first this time. We took the risk on the buyer's premium."

Source: Testimony of Dede Brooks (Chief Executive, Sotheby's) at the trial of Alfred Taubman

# Theory of Collusion

- "Price" is the commission rate or the percentage of the final bid price.

Commission Rates - 1995 (Christie's)

Annual Sales	Commission
Up to \$99,999	10%
\$100,000-\$249,999	9%
\$250,000-\$499,999	8%
\$500,000-\$999,999	6%
\$1,000,000-\$2,499,999	5%
\$2,500,000-\$4,999,999	4%
\$5,000,000 and above	2%

- Assume possible (constant) commission rates: 2%, 4%, 6%, 8%.

# Theory of Collusion

- Profit table (first number in a cell is Christie's profit)

		Sotheby's			
		2%	4%	6%	8%
Christie's	2%	-20,-20	60,0	140,-60	220,-200
	4%	0,60	100,100	220,60	140,-60
	6%	-60,140	60,220	180,180	320,80
	8%	-200,220	-60,300	80,320	230,230

- Christie's and Sotheby's anticipate interacting repeatedly over time.

# Theory of Collusion

- Non-collusive equilibrium: Both houses charge 4%.

		Sotheby's			
		2%	4%	6%	8%
Christie's	2%	-20,-20	60,0	140,-60	220,-200
	4%	0,60	100,100	220,60	300,-60
	6%	-60,140	60,220	180,180	320,80
	8%	-200,220	-60,300	80,320	230,230

# Theory of Collusion

- Non-collusive equilibrium: Both houses charge 4%.

		Sotheby's			
		2%	4%	6%	8%
Christie's	2%	-20,-20	60,0	140,-60	220,-200
	4%	0,60	100,100	220,60	300,-60
	6%	-60,140	60,220	180,180	320,80
	8%	-200,220	-60,300	80,320	230,230

# Theory of Collusion

- Non-collusive equilibrium: Both houses charge 4%.

		Sotheby's			
		2%	4%	6%	8%
Christie's	2%	-20,-20	60,0	140,-60	220,-200
	4%	0,60	100,100	220,60	300,-60
	6%	-60,140	60,220	180,180	320,80
	8%	-200,220	-60,300	80,320	230,230

- Basis for collusion

- Both auction houses are better off with a commission rate of 6% or 8%.
- They can agree that it is mutually beneficial to raise rates. But is such an agreement self-enforcing?

# Theory of Collusion

- A strategy for sustaining a collusive commission rate of 8%.
  - ▶ In the initial period, each auction house charges 8%.
  - ▶ In any future period,
    - ★ each charges 8%, if both auction houses charged 8% in all previous periods.
    - ★ each charges 4%, otherwise.
- Conditions ensuring stability of the collusive agreement.
  - ▶ Assume each auction house values next period's profit only 90% of this period's profit.
  - ▶ Collusive price of 8% yields a value to an auction house of

$$230 + 230 \times .9 + 230 \times .81 + 230 \times .73 + \dots = 2300$$

- ▶ Cheating yields a firm value of

$$320 + 100 \times .9 + 100 \times .81 + 100 \times .73 + \dots = 1220$$

- ▶ Stability is achieved because

$$\text{payoff to colluding} = 2300 > 1220 = \text{payoff to cheating}$$

# Theory of Collusion

- Reward-punishment scheme supports collusion.
- Cheating yields a current period gain of 90 ( $= 320 - 230$ ) and a future loss of 130 ( $= 230 - 100$ ) in all ensuing periods.
- If Christie's is "nice" and charges 8% then Sotheby's responds in kind by charging 8% in the next period.
- If Christie's is "nasty" and charges below 8% then Sotheby's responds aggressively by lowering its commission rate to 4% in the ensuing periods (in response to which Christie's can do no better than to charge 4% as well).

## Theory of Collusion

- Suppose the auction houses are more focused on near term profits (less patient).
- They attach lower weight to future profits: next period's profit is worth 40% of this period's profit.
- Collusive price of 8% yields a value to an auction house of

$$230 + 230 \times .4 + 230 \times .16 + \dots = 383$$

- Cheating yields a value of

$$320 + 100 \times .4 + 100 \times .16 + \dots = 387$$

- Stability is *not* achieved because

$$\text{payoff to colluding} = 383 < 387 = \text{payoff to cheating}$$

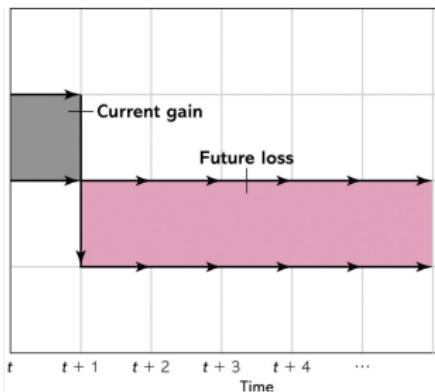
- A lower collusive price of 6% *can* be sustained.

$$\text{payoff to colluding} = 180 + 180 \times .4 + 180 \times .16 + \dots = 300$$

$$\text{payoff to cheating} = 220 + 100 \times .4 + 100 \times .16 + \dots = 287$$

# Theory of Collusion

- Cheating yields higher short-run profit but lower long-run profit.



- A colluding firm must attach sufficient weight to future profits to find it optimal not to cheat.
  - ▶ When firms are relatively patient (90% case), a commission rate of 8% can be sustained.
  - ▶ When firms are relatively impatient (40% case), only a commission rate of 6% can be sustained.

# Theory of Collusion

- One-period punishment: Revert to (4%, 4%)
- Each auction house values next period's profit 60% of this period's profit.
- In the initial period, each auction house charges 8%.
- In any future period,
  - ▶ each charges 8%, if both auction houses charged 8% or 4% in the previous period.
  - ▶ each charges 4%, otherwise.
- Conditions ensuring firms want to set the collusive rate.
  - ▶ Collusive price of 8% yields a value to an auction house of
$$230 + 230 \times .6 + 230 \times .36 + 230 \times .22 + \dots = 575$$
  - ▶ Cheating yields a firm value of
$$320 + 100 \times .6 + 230 \times .36 + 230 \times .22 + \dots = 587$$
  - ▶ Stability is not achieved because
$$\text{payoff to colluding} = 575 < 587 = \text{payoff to cheating}$$



## Theory of Collusion

- One-period punishment: Revert to (2%, 2%) - price war more intense than non-collusive outcome.
- In the initial period, each auction house charges 8%.
- In any future period,
  - ▶ each charges 8%, if both auction houses charged 8% or 2% in the previous period.
  - ▶ each charges 2%, otherwise.
- Conditions ensuring firms want to set the collusive rate.
  - ▶ Collusive price of 8% yields a value to an auction house of

$$230 + 230 \times .6 + 230 \times .36 + 230 \times .22 + \dots = 575$$

- ▶ Cheating yields a firm value of

$$320 - 20 \times .6 + 230 \times .36 + 230 \times .22 + \dots = 515$$

- ▶ Stability is achieved because

$$\text{payoff to colluding} = 575 > 515 = \text{payoff to cheating}$$

# Theory of Collusion

- Conditions ensuring firms want to participate in the price war.

- ▶ Collusive price of 2% yields a value to an auction house of

$$-20 + 230 \times .6 + 230 \times .36 + 230 \times .22 + \dots = 325$$

- ▶ Cheating yields a firm value of

$$0 - 20 \times .6 + 230 \times .36 + 230 \times .22 + \dots = 195$$

- ▶ Stability is achieved because

$$\text{payoff to punishing} = 325 > 195 = \text{payoff to cheating}$$

- A more severe punishment can sustain collusion, when reverting to the non-collusive outcome cannot.

# Theory of Collusion

What is collusion?

- From the economics perspective, collusion is defined by the
  - ▶ outcome: are prices suprarecompetitive?
  - ▶ mechanism: are prices sustained by the threat of a future punishment?
- Equilibrium requires mutual understanding among firms regarding their strategies but the economic definition does not address how that mutual understanding was achieved:
  - ▶ express communication? (explicit collusion)
  - ▶ non-express communication? (tacit collusion)

# Theory of Collusion

## What is collusion?

- From the legal perspective, collusion is defined by the "presence of an agreement" which means
  - ▶ the manner in which mutual understanding is achieved
  - ▶ the form of communication
- The law cares about the *process* by which firms arrived at that mechanism and outcome
  - ▶ "[A]ntitrust law clarified that ... an agreement describes a process that firms engage in, not merely the outcome that they reach. Not every parallel pricing outcome constitutes an agreement because not every such outcome was reached through the process to which the law objects: a negotiation that concludes when the firms convey mutual assurances that the understanding they reached will be carried out." - J. Baker, *Antitrust Bulletin*, 1993

# Theory of Collusion

Application: Simple analytics of deterrence

When is cartel formation deterred?

- $\pi^c$  is collusive profit
- $\pi^{dev}$  is deviation profit
- Assume non-collusive profit is zero
- $\alpha$  is the probability of being discovered and penalized
- $\gamma$  is the penalty multiple
- Penalty is proportional to the incremental profit from colluding:  
$$\gamma \times \pi^c$$

*How high must  $\gamma$  be so as to deter cartel formation?*

# Theory of Collusion

Application: Simple analytics of deterrence

Static participation approach: Cartel formation is deterred when collusion is unprofitable.

- Cartel formation is unprofitable if and only if:

$$\underbrace{(1 - \alpha) \times \pi^c}_{\text{Not caught}} + \underbrace{\alpha \times (\pi^c - \gamma \times \pi^c)}_{\text{Caught}} < 0$$

or

$$\gamma > \frac{1}{\alpha}.$$

- If  $\alpha = 0.15$  then deterrence occurs when  $\gamma > 6.67$ .
- (Highest feasible value of  $\gamma$  is 5 for the U.S. but 1-2 is typical in practice.)

# Theory of Collusion

Application: Simple analytics of deterrence

Dynamic incentive approach

- Cartel formation is deterred when collusion is unstable.
- A firm prefers to deviate when:

$$\underbrace{\pi^{dev} + \delta W - \alpha\gamma\pi^c}_{\text{Payoff from deviating}} > \underbrace{\pi^c + \alpha(\delta W - \gamma\pi^c) + (1-\alpha)\delta V}_{\text{Payoff from colluding}}$$

where  $V$  is the expected present value of colluding,  $W = 0$  is the expected present value of competing, and  $\delta$  is the discount factor.

- One can show:

$$V = \frac{\pi^c - \alpha\gamma\pi^c}{1 - \delta(1 - \alpha)}$$

# Theory of Collusion

Application: Simple analytics of deterrence

- Collusion is unstable if

$$\pi^{dev} - \alpha\gamma\pi^c > \pi^c - \alpha\gamma\pi^c + (1 - \alpha)\delta \left( \frac{\pi^c - \alpha\gamma\pi^c}{1 - \delta(1 - \alpha)} \right)$$

- Re-arranging yields

$$\gamma > \left( \frac{1}{\alpha} \right) \left( 1 - \frac{(\pi^{dev} - \pi^c)(1 - (1 - \alpha)\delta)}{\delta(1 - \alpha)\pi^c} \right)$$

- If  $\delta = 1$  (which makes collusion easiest to sustain), collusion is unstable when

$$\gamma > \left( \frac{1}{\alpha} \right) \left( 1 - \left( \frac{\alpha}{1 - \alpha} \right) \left( \frac{\pi^{dev} - \pi^c}{\pi^c} \right) \right).$$

- Takeaway: It takes lower penalties to destabilize a cartel than to make it unprofitable.

# Theory of Collusion

Application: Simple analytics of deterrence

Harrington (*Economics Letters*, 2014)

- Examines deterrence when penalty accumulates over time.
- $F_t$  is the penalty that a firm would have to pay if caught and convicted in period  $t$ . It evolves as follows:

$$F_{t+1} = (1 - \beta) F_t + f.$$

- ▶  $f$  is the amount of penalty assessed each period that the firms collude
  - ★ Example:  $f = \gamma \pi^c$  (U.S. customer damages)
  - ★ Example:  $f$  is some fraction of revenue (EU government fines)
- ▶  $0 < \beta < 1$  is the depreciation rate for the accumulated penalty.
- $F_0 = 0$  and the penalty rises over time and (if not caught) approaches  $f/\beta$ .
- Collusion becomes more difficult over time as the penalty from continuing to collude is rising.

# Theory of Collusion

## Application: Simple analytics of deterrence

- If  $\delta = 1$  then collusion is deterred when

$$\frac{f}{\pi^c} > \left( \frac{\beta}{\alpha} \right) \left[ 1 - \left( \frac{\alpha}{1-\alpha} \right) \left( \frac{\pi^{dev} - \pi^c}{\pi^c} \right) \right]$$

- Collusion is more likely to be unstable when

- ▶ per period penalty  $f$  is higher
- ▶ probability of being caught and convicted  $\alpha$  is higher
- ▶ depreciation rate on penalties  $\beta$  is lower

# Coordinating Practices

# Coordinating Practices

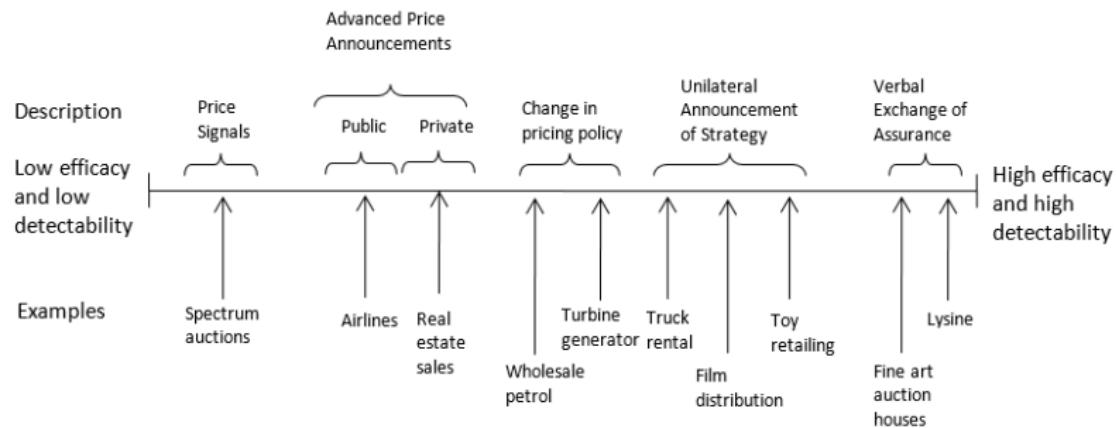
Object → Coordinating Practices → Mutual Understanding → Effect

- *Object* is when a firm assumes the objective of changing other firms' expectations to those consistent with collusion rather than competition.
- *Coordinating practices* serve to change firms' expectations; they facilitate the creation of mutual understanding among firms that they will collude.
- *Mutual understanding* is with respect to firms using collusive strategies.
- *Effect* is the product of mutual understanding as reflected in prices, quantities, etc.

# Coordinating Practices

- Suppose firms are of mind to collude, not compete. What might prevent them from achieving mutual understanding?
  - ▶ Miscommunication
  - ▶ Disagreement
- Failure of communication
  - ▶ Lack of clarity - When the medium is not a natural language, the receiving firm may not infer the intended content of the message from the sending firm.
  - ▶ Lack of veracity - Even when the intended content of a message is clear, it may not be believed.
- Failure of bargaining
  - ▶ Even if messages are correctly interpreted and believed, there may be disagreement as to the collusive arrangement.

# Coordinating Practices



# Coordinating Practices

## Unilateral announcement of a strategy

Firm announces a strategy that, if adopted, would produce collusive prices.

- Free-standing newspaper inserts (FSIs) are multi-page booklets inserted into newspapers and contain discount coupons for products sold by various firms.
- Two suppliers: Valassis Communications and News America Marketing.
- 2002-04: Valassis engaged in a price war in an announced attempt to achieve a 50% market share.

# Coordinating Practices

## Unilateral announcement of a strategy

July 2004 earnings call by Valassis' CEO

- Described a strategy to increase FSI prices:
  - ▶ abandoning its 50 percent market share goal
  - ▶ aggressively defending its existing customer base and market share
  - ▶ submitting price bids at levels substantially above current market prices for current News America customers
  - ▶ monitoring News America's response to its new business strategies.
- Proposed restoring the pre-price war price level of \$6.00 per FSI page per thousand booklets.
- If News America continued to compete for Valassis customers and market share, then the price war would resume.

# Coordinating Practices

## Change in pricing policy

### Turbine generators (US DOJ, 1975)

- Two suppliers: General Electric (GE) and Westinghouse.
- Practices (starting May 1963)
  - ▶ GE released a pricing book that permitted customers (and Westinghouse) to compute the book price of any GE generator.
  - ▶ GE announced a standard multiplier it would apply to the book price to generate a price for a customer.
  - ▶ Announced that it would not offer discounts.
- Outcome
  - ▶ GE acted as a price leader.
  - ▶ Firms had identical multipliers and book prices for the next 12 years.
- Coordinating practice: Posted pricing achieved mutual understanding regarding collusion.

# Coordinating Practices

## Change in pricing policy

Harrington (*Journal of Competition Law and Economics*, 2011)

- Adoption of posted pricing is not in a firm's interest if it expect firms to compete.
  - ▶ If GE posts price then Westinghouse can undercut the price and take a large share of business.
- Adoption of posted pricing is in a firm's interest if it expect firms to collude.
  - ▶ Posted pricing is a facilitating practice that makes coordination and monitoring easier
- Adoption of posted pricing produced mutual understanding of collusion.
  - ▶ GE's adoption of posted pricing was optimal *only if* it believed coordinated pricing would ensue.
  - ▶ Westinghouse's response of posted pricing was optimal *only if* it believed coordinated pricing would ensue.

# Coordinating Practices

## Advance price announcements

Airline Tariff Publishing Company (US DOJ, 1994)

- Airlines submitted fare changes to the Airline Tariff Publishing Company (ATPCO) which were then disseminated to airlines and consumers (through computer reservation systems).
- A fare change with a future first ticket date was an announcement of a future price change in that a consumer could not buy a ticket at that price until the first ticket date.
- If other airlines matched the announcement then it was enacted.
- If other airlines did not match then it was retracted.

# Coordinating Practices

## Price signals

Judge Richard Posner (*High Fructose Corn Syrup*, 7th Cir. 2002):

*Section 1 of the Sherman Act ... is broad enough ... to encompass ... an agreement made without any actual communication. ... If a firm raises price in the expectation that its competitors will do likewise, and they do, the firm's behavior can be conceptualized as the offer of a unilateral contract that the offerees accept by raising their prices.*

# Coordinating Practices

## Price signals

### Spectrum Auctions (Germany)

- German government auction of ten blocks of spectrum.
- Rule: Any bid must be at least 10% higher than the current bid.
- Mannesman's initial bids:
  - ▶ Blocks 1-5: 20 million DM/megahertz
  - ▶ Blocks 6-10: 18.18 million DM/megahertz
- As a bid of 20 is a 10% increase on 18.18, was Mannesman signaling to T-Mobil that each should win 5 blocks at 20 million?
- In the next round, T-Mobil bid 20 million on blocks 6-10. There were no subsequent bids.

# Coordinating Practices

Price signals: Focal point

Knittel and Stango (*American Economic Review*, 2003)

Credit cards (U.S., 1980s)

- Most credit card issuers faced a state-level interest rate ceiling.
- More than half of issuers set rates equal to their ceiling.
- Empirical model estimates whether or not the ceiling is binding.
- Empirical analysis finds a statistically significant proportion of issuers price at the ceiling even though it is not binding.
- But some firm must still take the lead and price at the ceiling.

# Identifying Market Conditions Conducive to Collusion

# Identifying Market Conditions Conducive to Collusion

What factors are relevant to collusion?

- Market concentration
- Product differentiation
- Entry conditions
- Demand volatility
- Firm asymmetries
- Excess capacity
- Price transparency and information exchange
- Buyer concentration
- and more

# Identifying Market Conditions Conducive to Collusion

How do these factors affect

- the incentive to cheat?
  - ▶ does it increase the short-run profit from cheating and thereby make collusion more difficult?
  - ▶ does it increase the future foregone profit from cheating and thereby make collusion less difficult?
- the ability to monitor compliance?
- the ability to elude detection?
- the ability to adjust the collusive outcome to changing market conditions?
- the ability to prevent non-cartel supply from expanding?
- the ease with which firms can agree on an outcome?

# Identifying Market Conditions Conducive to Collusion

## Market concentration

- Theory is unambiguous: more firms/lower market concentration makes collusion more difficult.
- When there are more firms, the short-run gain from cheating is greater.
  - ▶ With more cartel members, a firm's allocation of cartel supply is smaller.
  - ▶ The smaller is a firm's allocation, the larger is the incremental increase in sales from undercutting the collusive price.
- When there are more firms, the long-run loss from cheating is greater.
  - ▶ With more firms, the non-collusive outcome is more competitive.
- Generally, the rise in the gain from cheating is larger than the rise in the loss from cheating so, on net, the incentive to cheat is greater.
- Collusion is then more difficult with more firms, as reflected in
  - ▶ fewer environments in which a stable collusive equilibrium exists
  - ▶ the highest sustainable collusive price is lower.

# Identifying Market Conditions Conducive to Collusion

## Market concentration

- Empirical evidence is mixed.
- Levenstein and Suslow (*Journal of Economic Literature*, 2006):  
"There is no simple relationship between industry concentration and the likelihood of collusion. Most cartels in our case study sample were in relatively concentrated industries [and] most contemporary international cartels are in highly concentrated industries."
- Fraas and Greer (*Journal of Industrial Economics*, 1977)
  - ▶ 606 cartels, 1910-1972.
  - ▶ Median number of firms in an industry with a cartel is 8 (for manufacturing industries, it is 7).
  - ▶ Median number of firms for all industries is 18.

# Identifying Market Conditions Conducive to Collusion

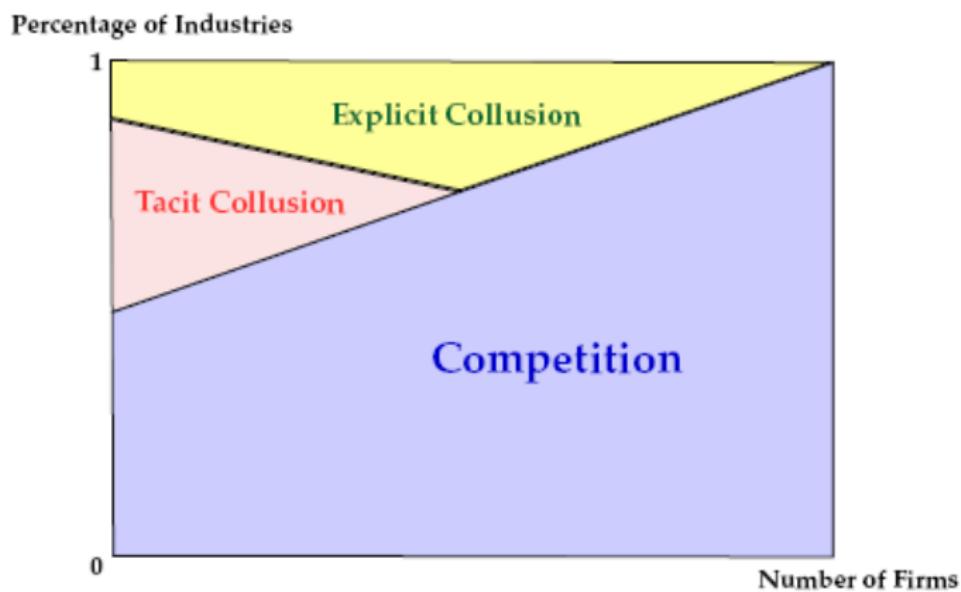
## Market concentration

Why might the empirical evidence be mixed?

- Data problem: Market concentration could be correlated with the coordinating practice which could be correlated with detecting collusion.
  - Suppose firms prefer to avoid express communication as a coordinating practice.
  - Suppose a market
    - ▶ with only a few firms can coordinate without express communication ("tacit collusion")
    - ▶ with more firms must use express communication ("explicit collusion").
  - Suppose we are more likely to detect explicit than tacit collusion.
- ⇒ Collusion may be more common with fewer firms and, at the same, it is more commonly observed when there are more firms

# Identifying Market Conditions Conducive to Collusion

Market concentration



# Identifying Market Conditions Conducive to Collusion

## Market concentration

- Experimental evidence - Fonseca and Normann (*European Economic Review*, 2012)
- Oligopoly model
  - ▶ Demand is fixed at 300 with a maximum reservation price of 100.
  - ▶ Cost is zero.
  - ▶ There are  $n$  ( $= 2, 4, 6, 8$ ) subjects and each subject chooses a price from  $\{0, 1, 2, \dots, 100\}$ .
  - ▶ Homogeneous products
    - ★ If  $m$  subjects have the lowest price  $p'$  then each has a payoff of  $(300/m) \times p'$ .
- Oligopoly solutions
  - ▶ Monopoly: All subjects price at 100.
  - ▶ Competition: At least two subjects price at zero.

# Identifying Market Conditions Conducive to Collusion

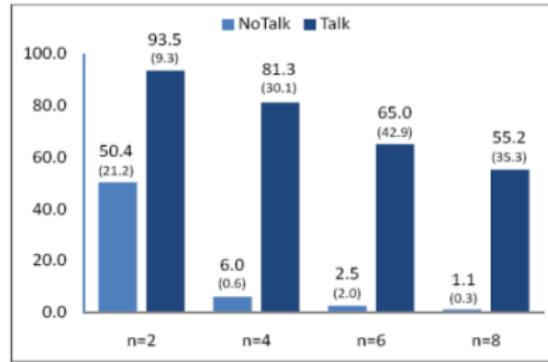
## Market concentration

- Horizon
  - ▶ Play occurs for 20 periods for sure.
  - ▶ Starting with period 21, the experiment continues with probability 5/6.
- Treatments
  - ▶ No Talk: In each round, subjects simultaneously choose prices.
  - ▶ Talk: Subjects communicate using an instant-messenger program for one minute, after which they simultaneously choose prices.
- Each market structure/communication treatment was run six times.

# Identifying Market Conditions Conducive to Collusion

## Market concentration

- Average price
  - ▶ declines with the number of subjects/firms (though no statistical difference among markets with 4, 6, or 8 subjects)
  - ▶ is higher with communication.
- Tacit collusion (price >> cost without communication) is common with 2 subjects and very rare with 4 or more subjects.
- Incremental value of communication is maximized with 4 subjects.



# Identifying Market Conditions Conducive to Collusion

## Market concentration

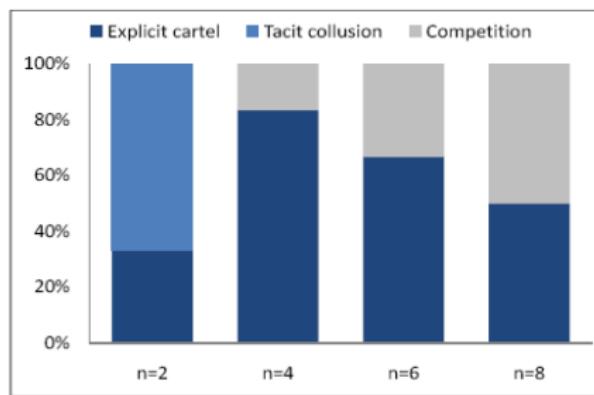


Figure 2: The share of industries for which talking pays (“Explicit cartel”) given a hypothetical expected cartel fine of 50. If the gain from talking is less than 50, the industry will either be tacitly collusive (price above marginal cost) or competitive.

# Identifying Market Conditions Conducive to Collusion

## Market concentration

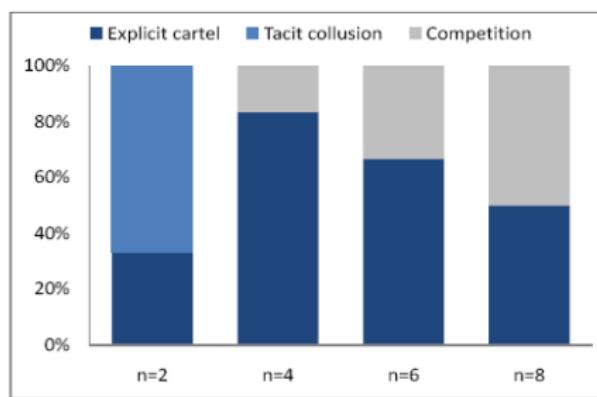


Figure 2: The share of industries for which talking pays ("Explicit cartel") given a hypothetical expected cartel fine of 50. If the gain from talking is less than 50, the industry will either be tacitly collusive (price above marginal cost) or competitive.

- Fonseca and Normann (2012): "Remarkably, Harrington [in his 2010 CRESSE Collusive Practices lecture] conjectures this very picture (qualitatively) will emerge in the field."

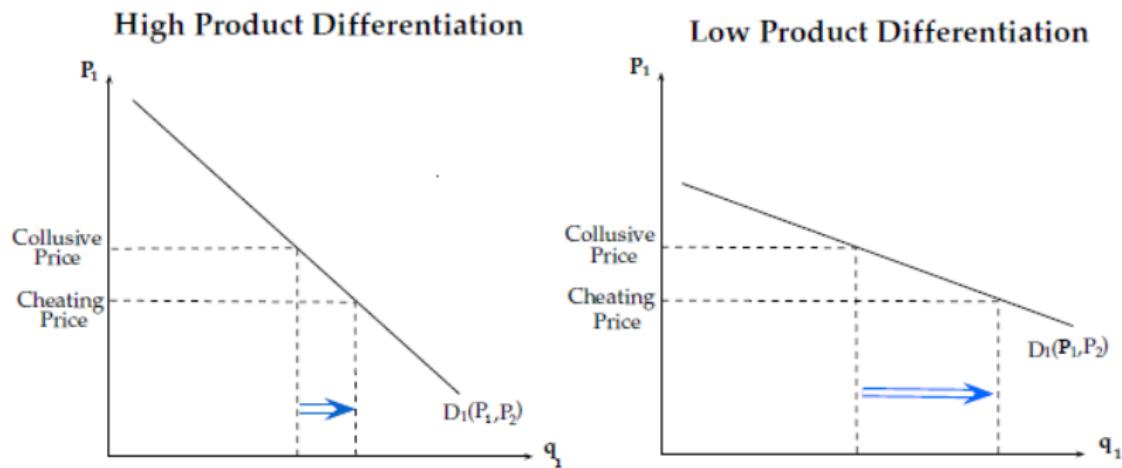
# Identifying Market Conditions Conducive to Collusion

## Product differentiation

- Theory is mixed.
- When products are more homogeneous, the short-run gain from cheating is greater.
  - ▶ A small price cut delivers a larger increase in market share and profit.  
[See figure on next slide.]
- When products are more homogeneous, the long-run loss from cheating is greater.
  - ▶ Because firm demand is more responsive to price, each firm has a tendency to price lower.
  - ▶ Non-collusive price is closer to cost.
- Net effect varies with how product differentiation is modelled.

# Identifying Market Conditions Conducive to Collusion

Product differentiation



# Identifying Market Conditions Conducive to Collusion

## Product differentiation

- Empirical evidence is unambiguous
  - ▶ High fraction of cartels involve products that are commodities.
  - ▶ Collusion when products are highly differentiated is rare.
- Harrington (2006): 14 out of the 23 cartels examined had products that were commodities and most of the other cartels involved highly similar products.
- Symeonidis (*Journal of Industrial Economics*, 2003): A comprehensive study of cartels in the U.K. in the 1950s found cartels to be more likely in "low-advertising industries" (low advertising is associated with low product differentiation).
- Dick (*Managerial and Decision Economics*, 1996)
  - ▶ Legal U.S. export cartels, 1920-1965.
  - ▶ Data: 250 exporting industries, half of which had export cartels.
  - ▶ An industry was less likely to register a cartel when it exported consumer goods, which tend to be more differentiated.

# Identifying Market Conditions Conducive to Collusion

## Price transparency

- Consider a practice which results in price information being more quickly and more widely distributed among sellers.

Information	Example
Past prices	Trade association reports average transaction price
Current prices	Online pricebot
Future prices	Advanced notice of price changes

- Does this make collusion easier?
- Suppose the price information is also distributed among consumers. Is there an efficiency benefit?
- What is the net effect of greater price transparency?

# Identifying Market Conditions Conducive to Collusion

Price transparency: Nasdaq

- Market is for a security such as Microsoft or Intel.
- Firms are market-makers who buy and sell shares.
- Price-cost margin is, approximately, the bid-ask spread.
- Collusive practice: Do not quote in odd-eighths.

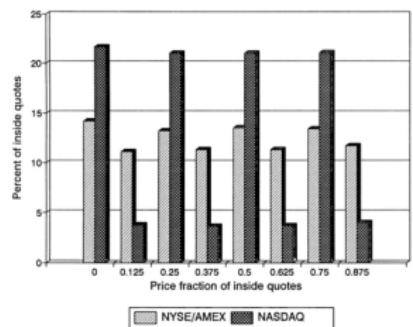
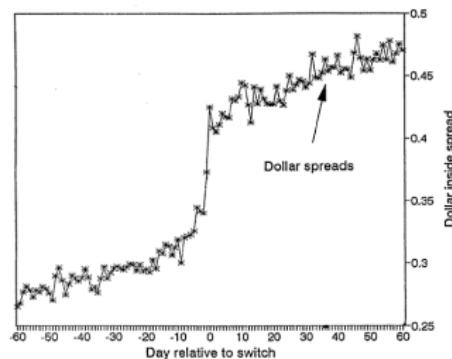


Figure 3. The distribution of price fractions across all inside quotes for 100 NASDAQ and 100 NYSE/AMEX securities of similar price and end-of-year market capitalization.



Bid-Ask spreads (Christie and Schultz, *Journal of Financial Economics*, 1999)

# Identifying Market Conditions Conducive to Collusion

Price transparency: Nasdaq

- $n$  firms sell homogeneous goods which are produced at a cost  $c$ .
- Compete by choosing price and consumers buy from the firm(s) with the lowest price.
- $D(p)$  is market demand when the transaction price is  $p$ .
- $0 < \delta < 1$  is a firm's discount factor (i.e., weight attached to next period's profit)
- Competitive solution: Unique symmetric static equilibrium is for all firms to price at  $c$ .

# Identifying Market Conditions Conducive to Collusion

Price transparency: Nasdaq

- Consider colluding at price  $p^*$  where  $c < p^* \leq$  monopoly price.
- Collusive strategy
  - ▶ Period 1: price at  $p^*$
  - ▶ Period  $t (\geq 2)$ :
    - ★ price at  $p^*$  if all firms have priced at  $p^*$  in all past periods
    - ★ price at  $c$  otherwise

# Identifying Market Conditions Conducive to Collusion

Price transparency: Nasdaq

Deriving condition for the collusive arrangement to be an equilibrium

- Firm's payoff if it colludes:

$$(p^* - c) \left( \frac{D(p^*)}{n} \right) + \delta \times (p^* - c) \left( \frac{D(p^*)}{n} \right)$$

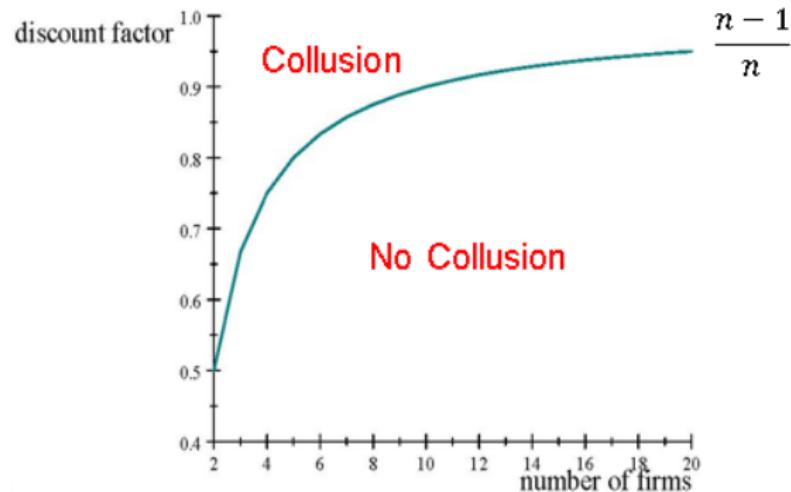
$$+ \delta^2 \times (p^* - c) \left( \frac{D(p^*)}{n} \right) + \dots = (p^* - c) \left( \frac{D(p^*)}{n} \right) \left( \frac{1}{1 - \delta} \right)$$

- If a firm deviates, it should price just below  $p^*$  and earn  $(p^* - c) D(p^*)$ .
- It is optimal to collude if and only if

$$(p^* - c) \left( \frac{D(p^*)}{n} \right) \left( \frac{1}{1 - \delta} \right) \geq (p^* - c) D(p^*) \Rightarrow \delta \geq \frac{n - 1}{n}$$

# Identifying Market Conditions Conducive to Collusion

Price transparency: Nasdaq



# Identifying Market Conditions Conducive to Collusion

Price transparency: Nasdaq

- Why was collusion so stable in Nasdaq, despite the fact that the market had as many as 60 firms?
- With  $n = 60$ , the equilibrium condition is  $\delta \geq 0.983$ .
- Shorter is the time until rival firms can respond to an episode of cheating, the closer is  $\delta$  to 1.
- In Nasdaq markets, the reaction time is probably in hours if not minutes. Thus, a deviation could be punished very quickly.
- Therefore, a high restriction on the discount factor is easy to satisfy, and collusion could then be stable even with many firms.

# Identifying Market Conditions Conducive to Collusion

Price transparency: Nasdaq

- Conditions conducive to collusion
  - ▶ Homogeneous service
  - ▶ High level of transparency allowed for monitoring of market-makers' bids and asks in real time.
  - ▶ Simplicity of collusive practice made coordination easy.
- Aftermath: In private litigation, Nasdaq market makers settled out of court for \$1.027 billion.

## Imperfect Monitoring

# Imperfect Monitoring

## Introduction

- A key feature to an effective collusive agreement is that non-compliance - low price or high quantity - is observed and punished.
- An anticipated punishment deters firms from cheating.
- In practice, monitoring of firms' behavior is difficult for many cartels.
  - ▶ When a firm's quantity choice is not easily observed by other firms.
  - ▶ When buyers are large, price is often negotiated in which case a firm's price is not observed by other firms.
- Objectives
  - ▶ Characterize collusion when monitoring is imperfect. What does collusion look like?
  - ▶ Expand the set of behavior that can be explained.
    - ★ With perfect monitoring, we can explain collusion but not price wars.
    - ★ With imperfect monitoring, we can explain price wars.

# Imperfect Monitoring: Price Model

- Porter (*Journal of Economic Theory*, 1983)
- Duopoly model (Cournot)
- Firm  $i$  chooses its quantity,  $q_i$  ( $i = 1, 2$ ).
- Inverse demand is  $110 - Q$  and is the price such that demand equals market supply of  $Q$ .
- Given firms' quantities, price is set to equate supply and demand:

$$P = 110 - (q_1 + q_2).$$

- A firm's cost function is  $20q$ .
- Firm 1's profit is

$$(110 - q_1 - q_2) q_1 - 20q_1.$$

# Imperfect Monitoring: Price

## Model

- Non-collusive equilibrium
  - ▶ Each firm produces 30.
  - ▶ Price is 50 ( $= 110 - 30 - 30$ )
  - ▶ Firm profit is 900.
- Joint profit maximum
  - ▶ Each firm produces 22.5.
  - ▶ Price is 65.
  - ▶ Firm profit is 1012.5.
- Informational assumptions
  - ▶ Assume each firm's quantity is not observed by its rival.
  - ▶ Market price is observed by both firms.

# Imperfect Monitoring: Price

## Collusive agreement

- Description
  - ▶ Each firm produces 22.5 as long as price is never lower than 65.
  - ▶ If price falls below 65 then firms stop colluding and each produces 30.

- Stability of the collusive agreement

- ▶ A firm that cheats will produce 33.75 and earn current profit of 1139.
- ▶ Cheating yields a short-run profit gain of 126.5.
- ▶ Cheating results in a future profit loss of 112.5 per period.
  - ★ When the firm cheats, the price is 53.75, which is below the collusive price of 65.
  - ★ This low price triggers a punishment - its rival raises future supply from 22.5 to 30.
  - ★ Future profit is reduced from 1012.5 to 900.
- ▶ A firm does not cheat if it sufficiently values future profit.

# Imperfect Monitoring: Price

## Collusion with stochastic demand

- Assume inverse demand is

$$P = 110 + x - (q_1 + q_2)$$

- ▶  $x$  is a "demand shock" that is randomly determined each period and unobserved by firms.
- ▶ Average value of  $x$  is 0.
- Re-evaluate the efficacy of the collusive agreement
  - ▶ Suppose price is below the collusive level of 65.
    - ★ Is it because a firm cheated by selling more than 22.5?
    - ★ Is it because there was a low demand shock that depressed price?
  - ▶ Incentive to cheat is stronger
    - ★ A firm can cheat a little bit - produce slightly above 22.5 - and is no longer assured of being caught.
    - ★ If the demand shock is big enough then price will remain above 65.
- Monitoring of compliance with the agreement is problematic.

# Imperfect Monitoring: Price

## Modified collusive agreement

- Collusive quantity of 25 for each firm.
- Key price levels
  - ▶ 60 is the (average) collusive price.
  - ▶ 55 is the "price war" trigger price.
  - ▶ 50 is the (average) non-collusive price.
- If the cartel was in the *cooperative phase* in the previous period and last period's price was
  - ▶ at least 55 then each firm produces the collusive quantity of 25 and the cartel remains in the cooperative phase.
  - ▶ less than 55 then each firm produces the non-collusive quantity of 30 and the cartel shifts to the punishment phase.
- If the cartel was in the *punishment phase* last period then
  - ▶ with probability 1/2, each firm produces 30 and the cartel remains in the punishment phase
  - ▶ with probability 1/2, each firm produces 25 and the cartel returns to the cooperative phase

# Imperfect Monitoring: Price

## Stability of the collusive agreement

- In response to a low price, there is a price war of random length, after which there is a return to the collusive outcome.
- Suppose the cartel is in the cooperative phase.
  - ▶ Firm 1 expects firm 2 to produce 25.
  - ▶ If firm 1 produces  $q$  then the probability of a price war starting next period is the probability that

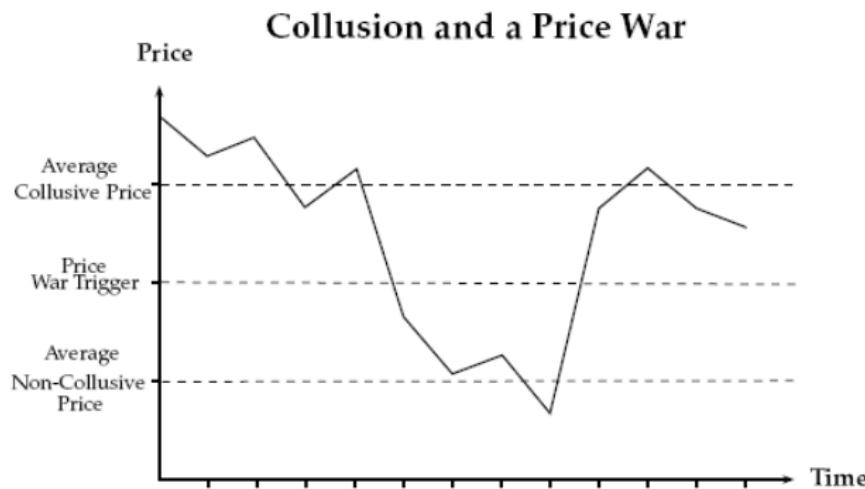
$$55 > 110 + x - (25 + q) \text{ or } q - 30 > x.$$

- ▶ The higher is firm 1's quantity, the more likely is  $x$  to take a value such that a price war is triggered.
- ▶ Trade-off between producing a little higher - and realizing a bigger market share and higher profits today - and increasing the probability of triggering a price war - and reducing future profit.

# Imperfect Monitoring: Price

## Theory of price wars

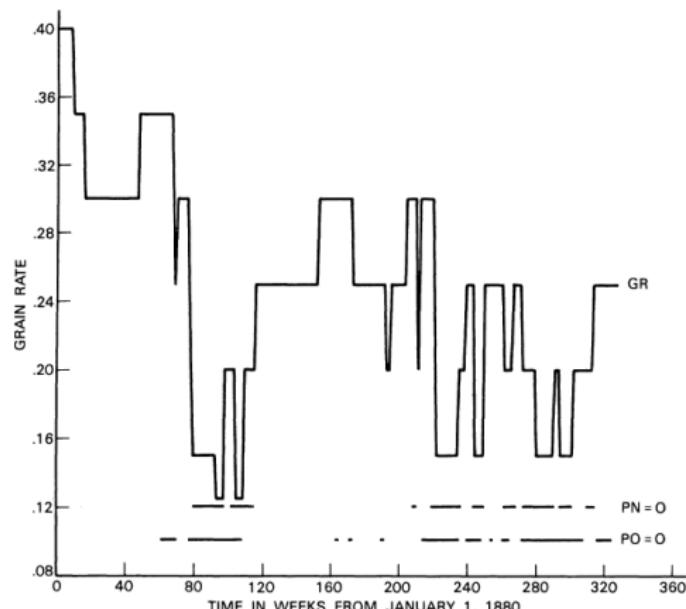
- A price war is a temporary reduction in price that is not due to changes in demand or cost.
- Price wars are a collusive phenomenon, not a competitive one.



# Imperfect Monitoring: Price

## Examples of price wars

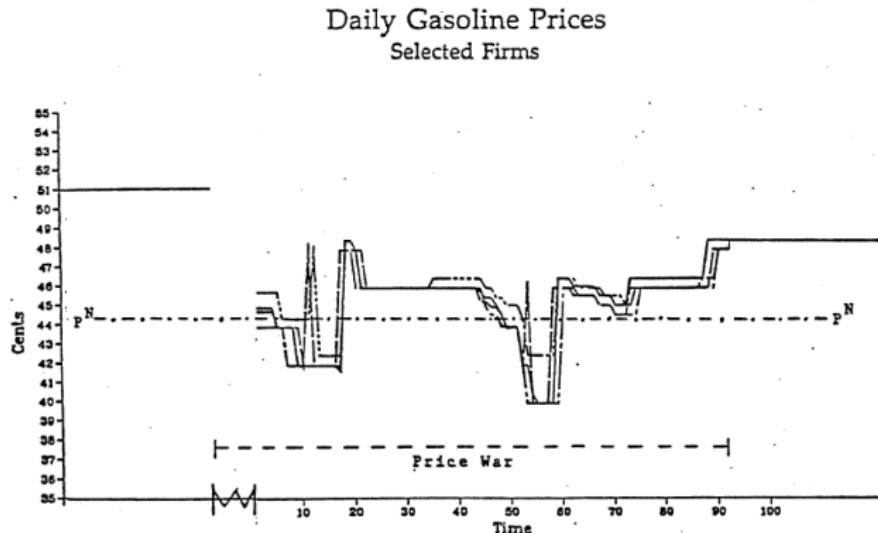
- Rail rate for transporting grain (U.S., 1880-86)
- Railroads formed the Joint Executive Committee (JEC) in 1879.
- JEC set the rail rate of eastbound freight shipments from Chicago to the Atlantic coast.



# Imperfect Monitoring: Price

Examples of price wars

Vancouver retail petrol market



# Imperfect Monitoring: Sales

Lysine (1992-95)

## Coordination

- Ajinomoto and Sewon preferred having exclusive geographic markets but the group ultimately decided on a market sharing arrangement.
- Wilson of ADM told the cartel that volume limitations did not mean dividing up the market by captive consumers. A "don't touch [each other's] customers policy" could create suspicions.

Market Allocation (tons)

Company	Global	Europe
Ajinomoto	73,500	34,000
ADM	48,000	5,000
Kyowa	37,000	8,000
Sewon	20,500	13,500
Cheil	6,000	5,000

# Imperfect Monitoring: Sales

Lysine (1992-95)

## Monitoring

- Kanji Mimoto of Ajinomoto was assigned the task of preparing monthly "scorecards" for the cartel.



Kanji Mimoto  
Ajinomoto



Terry Wilson  
Archer Daniels Midland

- Each company telephoned or mailed their sales volumes to Mimoto.
- Mimoto prepared a spreadsheet that was distributed at the quarterly maintenance meetings.

# Imperfect Monitoring: Sales

Lysine (1992-95)

- Enforcement

- ▶ "Guaranteed buy-ins" - A company that sold more than its quota would have to buy product from producers who were below quota.

- Cheating

- ▶ Cheil claims that it reported "misleading" sales information to the other companies.
  - ▶ Ajinomoto hid 3,500 tons of lysine from the cartel's auditors; for example, an internal memo read: "Hide 1,000 tons in Thailand internal business."

# Imperfect Monitoring: Sales

Citric acid cartel (1991-95)

- Structure of meetings

- ▶ Discuss the latest cartel sales reports.
- ▶ Discuss price levels and decide whether to raise prices.
- ▶ Share information about non-cartel competitors.
- ▶ Discuss "problems affecting the group" (cheating).

- Timing and frequency of meetings

- ▶ Meetings were usually set to coincide with those of the trade association.
- ▶ About 25 formal meetings plus a dozen or so bilateral meetings.

# Imperfect Monitoring: Sales

Citric acid cartel (1991-95)

- Prices

- ▶ Agreed to "floor" and "target" prices to be implemented.
- ▶ Five major consumers could be offered a discount of up to 3% off the list price.
- ▶ No discounts to all other customers.

- Quantities

- ▶ Sales quotas were allocated to each firm and fixed on a worldwide basis.
- ▶ Quotas were based on the average of the previous three years' sales (1988-90).

Allocation of Market Shares

Company	Market Share
Haarman & Reimer	32.0%
ADM	26.3%
Jungbunzlauer	23.0%
Hoffman LaRoche	13.7%
Cerestar Bioproducts	5.0%

# Imperfect Monitoring: Sales

## Citric acid cartel (1991-95)

- Monitoring of volume agreement
  - ▶ Monthly, each company's sales was reported to an executive of Hoffmann-La Roche.
  - ▶ Data was assembled and then reported back to the members by telephone.
  - ▶ Annual checking by independent Swiss auditors.
  - ▶ Actual production by each member adhered very closely to the cartel's planned production.
- Enforcement
  - ▶ Buy-back system: If a company went over its assigned quota in any one year, it would be obliged to purchase product from the companies with sales below their quota during the following year.
  - ▶ At the meeting on 14 November 1991 in Brussels, it was determined that Haarmann & Reimer needed to buy 7,000 tons of citric acid from ADM.

# Imperfect Monitoring: Sales

Summary of cartel case studies

- Demand is largely from industrial buyers.
- Price is set bilaterally between seller and buyer and is generally not public information.
- Collusive agreement is monitored in terms of sales compared to quotas.
- Source: Harrington (*How Do Cartels Operate?*, 2006)

# Imperfect Monitoring: Sales

Harrington and Skrzypacz (*RAND Journal of Economics*, 2007)

- Two firms make simultaneous price decisions in each period.
- A firm incurs a cost of  $c$  to produce one unit.
- Demand
  - ▶ Market demand is fixed.
  - ▶ A firm's demand (or market share) is stochastic.
  - ▶ A firm's expected demand is decreasing in its price and increasing in its rival's price.
- Information structure
  - ▶ Each firm's price is not observed by its rival.
  - ▶ Firms' sales are publicly observed.

# Imperfect Monitoring: Sales

## Collusion: Symmetric Punishments

**Result** The threat of a price war is ineffective at supporting collusion.

- Consider a strategy profile in which there is a "price war" if either firm has a market share exceeding some threshold,  $\hat{s}$ .
- If firm 1 undercuts the collusive price,
  - ▶ it *increases* the probability that firm 1's market share exceeds  $\hat{s}$  which makes a price war *more* likely.
  - ▶ it *decreases* the probability that firm 2's market share exceeds  $\hat{s}$  which makes a price war *less* likely.
- These offsetting effects cancel each other out so a firm's price does not impact the probability of a price war.
- A firm then cheats as there is no future profit loss  $\Rightarrow$  collusive agreement is not stable.

# Imperfect Monitoring: Sales

## Collusion : Asymmetric Punishments

- Two-tier punishment.
- Penalties for overproduction sustain higher prices.
  - ▶ A firm makes a payment of  $z$  to its rival for each unit it sells.
  - ▶ If a firm expects to transfer  $z$  euros to the other firm for each unit it sells, it will price higher because its marginal cost is effectively  $c + z$ .
  - ▶ Transfers can be consummated through inter-firm sales.
- Threat of collapse of collusion ("price war")
  - ▶ If firms do not honor the compensation scheme then collusion collapses.
  - ▶ Firms then find it optimal to make these transfers.
- If firms are sufficiently patient, this collusive agreement is an equilibrium.

# Imperfect Monitoring: Sales

Harrington and Skrzypacz (*American Economic Review*, 2011)

- Assume sales are not public information and firms must self-report (as in citric acid, lysine, vitamins)
- Stable collusion requires that firms find it optimal to
  - ① set the collusive price
  - ② truthfully report sales (which proves to be the binding condition)
  - ③ make transfers
- How is a firm induced to report it has high sales?
  - ▶ Price war is made more likely when the aggregate sales report is lower.
  - ▶ A firm that reports higher sales makes a higher transfer but then it reduces the chances of a price war.

# Imperfect Monitoring: Sales

**Challenge:** Can we extend this scheme to when firms' costs are private information?

Chan and Zhang (*Journal of Economic Theory*, 2015)

- Extensive form
  - ▶ Firm learns its cost (private information)
  - ▶ Firm submits cost report (cheap talk)
  - ▶ Firms chooses its price (private information)
  - ▶ Firm learns its sales (private information)
  - ▶ Firm submits sales report (cheap talk)
  - ▶ Firm makes transfers (based on cost and sales reports)

# Imperfect Monitoring: Sales

**Result** A transfer scheme is constructed such that if firms are sufficiently patient and firm demand is sufficiently stable then profits close to the joint maximum can be sustained in equilibrium.

- How the transfer scheme works:
  - ▶ A firm's transfer is decreasing in other firms' reported profits.
  - ▶ Reports are then truthful because they do not affect a firm's payoff  $\Rightarrow$  firms' profits are revealed
  - ▶ If a lower price reduces other firms' profits more than it raises a firm's own profit, it will not want to deviate.
- Very general: private cost shocks, many common demand functions, quantity choice
- Transfer scheme differs from that in Harrington and Skrzypacz (2011) in that a firm's transfer
  - ▶ does not depend on its own sales report (that is, transfer payment is not proportional to sales report)
  - ▶ is non-linear in firms' reports

# Imperfect Monitoring: Sales

Communication is a critical component of cartels

Frequency of Meetings  
(Source: European Commission Decisions)

Market	Monitoring	Allocation
Choline chloride	2-3 weeks	6 months
Zinc phosphate	monthly	3 months
Citric acid	monthly	6 months
Organic peroxides	3 months	3-6 months
Sorbates	6 months	6 months

# Imperfect Monitoring: Sales

- Private monitoring setting
  - ▶ Firms' prices and sales are private information.
  - ▶ Sales are stochastic due to unobserved demand shocks.
  - ▶ Consider equilibria with and without a communication (cheap talk) phase.
  - ▶ Cheap talk can be used to share sales data (Do firms have the incentive to provide accurate reports?)
- Questions
  - ▶ When is profit higher by communicating?
  - ▶ What types of communication schemes are effective?
  - ▶ What is the optimal frequency of information sharing (meetings)?

# Imperfect Monitoring: Sales

Spector (Working Paper, 2014)

- Firms learn their own sales at a high frequency (e.g., monthly)
  - ▶ If firms use these signals to provide incentives, there are inefficiencies due to the noise.
  - ▶ Punishment is quick but is used too much
- Firms learn all firms' actual sales at a low frequency (e.g., annually)
  - ▶ If firms use these signals to provide incentives, inefficiencies are reduced because of less noise.
  - ▶ Punishment is delayed.
- If firms share those private signals through cheap talk messages then they can have precise public signals at high frequency.
  - ▶ Messages are truthful because the truth will be revealed in the future and it can be harshly punished at no cost (perfect monitoring)

**Result** Firms can more effectively collude by sharing their private sales information.

# Firm Asymmetries

# Firm Asymmetries

## Overview

- ① Types of firm asymmetries
- ② What is the impact of firm asymmetries on the incentives to collude and the collusive outcome?
- ③ In practice, how does the collusive outcome depend on firm traits?

# Firm Asymmetries

## Types of firm asymmetries

- Cost
- Capacity
- Historical market share
- Product traits
  - ▶ Petrol - location of a station
- Product line
  - ▶ Petrol - ownership of multiple stations
  - ▶ Vitamins cartel
    - ★ 12 vitamin markets with 11 firms
    - ★ Hoffman LaRoche was in all 12 markets, BASF was in 10, Takeda was in 5, the other firms were in 3 or less

# Firm Asymmetries

## Ability to collude

- Impact on the set of feasible collusive outcomes
  - ▶ Cartel stability requires inducing compliance from the firm with the strongest propensity to cheat.
  - ▶ May require redistributing cartel profit.
  - ▶ May require having a firm remain outside of the cartel.
- Impact on the selected collusive outcome.
  - ▶ Lower cost firms want a lower collusive price.
  - ▶ Firms with more capacity want a bigger market share.
- How can cartel profit be "redistributed" to induce compliance by all firms?
  - ▶ Market allocation (e.g., sales quotas)
  - ▶ Firms charge different prices (with more sales and profit going to the lower priced firms)
  - ▶ Monetary transfers (e.g., inter-firm sales)

# Firm Asymmetries

Ability to collude: Different discount factors

- $\delta_i$  is the discount factor of firm  $i$  and is the weight given to future profit.
- $n$  firms with different discount factors:

$$0 < \delta_1 < \delta_2 < \cdots < \delta_n < 1.$$

Firm 1 is the "least cooperative" and firm  $n$  is the "most cooperative."

- Firms have homogeneous products and a common cost of  $c$ .
- Market demand at a price of  $p$  is  $100 - p$ .
- If all firms charge a price of  $p$  and firm  $i$  has market share  $s_i$  then its profit is

$$(p - c) \times (100 - p) \times s_i.$$

# Firm Asymmetries

Ability to collude: Different discount factors

- Collusive strategy of firm  $i$ :

- ▶ Price at  $\hat{p}$  and sell market share of  $\hat{s}_i$ .
- ▶ If any firm deviates from  $\hat{p}$  than all firms price at  $c$ .

- Collusive agreement is stable if, for all firms,

$$\begin{aligned} & (\hat{p} - c) (100 - \hat{p}) \hat{s}_i + \delta_i (\hat{p} - c) (100 - \hat{p}) \hat{s}_i \\ & + \delta_i^2 (\hat{p} - c) (100 - \hat{p}) \hat{s}_i + \dots \\ & \geq (\hat{p} - c) (100 - \hat{p}) \end{aligned}$$

$$\begin{aligned} \left( \frac{1}{1 - \delta_i} \right) (\hat{p} - c) \hat{s}_i (100 - \hat{p}) & \geq (\hat{p} - c) (100 - \hat{p}) \\ \hat{s}_i & \geq 1 - \delta_i \end{aligned}$$

- Each firm's market share must be sufficiently large, and it is must be larger when the firm is "less cooperative."

# Firm Asymmetries

Ability to collude: Different discount factors

- Suppose the cartel cannot control each firm's market share:  $\hat{s}_i = 1/n$ .

- Condition for cartel stability is

$$\frac{1}{n} \geq 1 - \delta_i \text{ or } \delta_i \geq \frac{n-1}{n} \text{ for all } i.$$

- The discount factor of all firms must be at least  $\frac{n-1}{n}$ .

- Suppose the cartel can control each firm's market share.

- Condition for cartel stability is

$$\left(\frac{1}{n}\right) (\delta_1 + \delta_2 + \dots + \delta_n) \geq \frac{n-1}{n}.$$

The average discount factor must be at least  $\frac{n-1}{n}$ .

- Firms that are more cooperative give up market share to firms that are less cooperative.

# Firm Asymmetries

Ability to collude: Different discount factors

- Example:  $n = 2$ ,  $\delta_1 = .4$ ,  $\delta_2 = .8$ .
- If firms could not reallocate market share then collusion is not sustainable because of firm 1.
- If firms can reallocate market share then collusion is sustainable as long as

$$s_1 \geq .6 \text{ and } s_2 \geq .2, \text{ or } .8 \geq s_1 \geq .6$$

- If firm 2 gives firm 1 an additional 10% of the market (so that  $s_1 = .6$ ) then collusion is sustainable.

# Firm Asymmetries

Ability to collude: Different discount factors

- Bargaining outcome
- Suppose

$$\left(\frac{1}{n}\right) (\delta_1 + \delta_2 + \cdots + \delta_n) > \frac{n-1}{n} > \delta_1.$$

- ▶ Average discount factor is sufficiently high.
- ▶ Some firms would cheat if their market share was  $1/n$ .
- A collusive outcome with equal market shares is not sustainable as the least cooperative firms will deviate.
- Nash Bargaining Solution is defined by some value for  $k$  such that
  - ▶  $s_i = 1 - \delta_i$  for  $i = 1, \dots, k$  [least cooperative firms each receive the minimum market share to induce them to collude]
  - ▶  $s_j = \left(\frac{1}{n-k}\right) [1 - (1 - \delta_1) - \cdots - (1 - \delta_k)]$  for  $j = k + 1, \dots, n$  [the most cooperative firms equally divide up the residual market share]

# Firm Asymmetries

Ability to collude: Different capacities

- Bos and Harrington (*RAND Journal of Economics*, 2010)
- $n$  firms produce identical products at a common and constant marginal cost.
- Each firm is endowed with a capacity which limits how much it can produce.
- Capacities differ across firms.
- Non-collusive outcome
  - ▶ Each firm prices at cost.
  - ▶ Firms have excess capacity.

# Firm Asymmetries

Ability to collude: Different capacities

- Cartel is composed of  $m$  firms, where  $2 \leq m \leq n$ .
- Pricing
  - ▶  $m$  colluding firms set the collusive price.
  - ▶  $n - m$  non-colluding firms (optimally) undercut the collusive price.
- Sales
  - ▶ A colluding firm's share of collusive supply equals its share of collusive capacity; each of them produces below its capacity.
  - ▶ Non-colluding firm has excess demand and produces at capacity.

# Firm Asymmetries

Ability to collude: Different capacities

- Each firm individually decides whether or not to join the cartel.
- Open membership
  - ▶ A non-colluding firm produces at capacity, while it produces below capacity as a colluding firm  $\Rightarrow$  lower supply benefits colluding firms.
  - ▶ Colluding firms always want to include another firm as then more capacity is controlled by the cartel.
- Trade-off faced by a firm in deciding whether to join the cartel.
  - ▶ More capacity is brought under the control of the cartel, which leads to a higher collusive price.
  - ▶ Collusion requires constraining supply as a firm produces below its capacity.
  - ▶ In sum, a firm realizes a higher price but lower sales by becoming a cartel member.

# Firm Asymmetries

Ability to collude: Different capacities

- Who colludes?

- ▶ Firms with large capacity join the cartel - rise in collusive price is large.
- ▶ Firms with small capacity do not join the cartel - rise in collusive price is small, reduction in supply is not.
- ▶ Firms with moderate capacity may or may not join the cartel.

- Firm asymmetries can then affect

- ▶ whether firms are able to collude
- ▶ the collusive outcome in the event they can collude
- ▶ which firms are members of the cartel.

# Firm Asymmetries

Ability to collude: Different capacities

- Many cartels are not all inclusive.
- Global citric acid cartel
  - ▶ Controlled 60% of global production
  - ▶ Controlled 67% of EU production
- Vitamin B1
  - ▶ Cartel excluded Chinese manufacturers.
  - ▶ Increase in Chinese supply caused the cartel's global market share to fall from 70% to 52% in the first 3 years.
- European industrial tubes cartel
  - ▶ Controlled 75-85% of total production.
  - ▶ Excluded at least two significant producers.

# Firm Asymmetries

## Practices: Market allocation

- Historical market share
  - ▶ Organic peroxides cartel set sales quotas for 1971 based on sales over 1969-70.
  - ▶ Citric acid cartel set sales quotas for 1991 based on sales over 1988-90.
- Caveat to historical market share: new capacity
  - ▶ Choline chloride cartel
    - ★ Chinook built a new plant and demanded an increase in its allocation.
    - ★ Unsatisfied with its new allocation, Chinook left the cartel.
  - ▶ Case of Archer Daniels Midland in the lysine cartel
    - ★ ADM upset a pre-existing cartel by entering the market with a large low cost production facility.
    - ★ ADM priced aggressively and grew its global market share to around 33%.
    - ★ ADM then approached the other suppliers and suggested forming a cartel with ADM's market share allocation equal to 33%.
    - ★ ADM settled on an allocation of 26%.

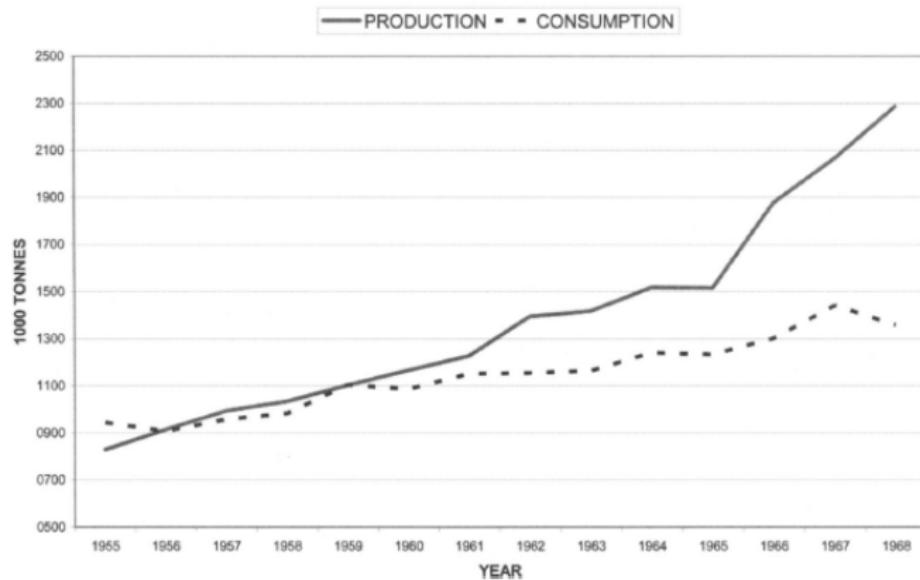
# Firm Asymmetries

## Practices: Market allocation

- Röller and Steen (*American Economic Review*, 2006)
- Norwegian cement industry: Three cement manufacturers cartelized over 1923-68.
- Collusive practices
  - ▶ Common sales office determined domestic cement supply to (presumably) maximize industry profit.
  - ▶ Domestic supply was allocated across the three manufacturers according to a member's share of capacity.
  - ▶ Any excess supply was sold in the world market.
- Over-investment in capacity
  - ▶ Each additional unit of capacity
    - ★ produced one more unit to be sold on the world market (assuming capacity > domestic demand)
    - ★ increased a firm's domestic sales by increasing its share of domestic demand
  - ▶ Production increasingly exceeded domestic demand.

# Firm Asymmetries

Practices: Market allocation



# Firm Asymmetries

Practices: Market allocation

- Procurement contracts
  - ▶ Road maintenance
  - ▶ School milk
- Allocation schemes
  - ▶ Bid rotation across time (when few contracts are up for bid simultaneously)
  - ▶ Allocation of contracts (when many contracts are up for bid simultaneously)
  - ▶ Monetary transfers

# Firm Asymmetries

Practices: Market allocation

- Efficient collusive mechanism

- ▶ Suppose cost differs across time and across firms.
- ▶ Cartel profit is maximized by having the firm with the lowest cost win the contract.
- ▶ Scheme has cartel members reveal their costs and then only the lowest cost firm bids for the contract (or the other firms submit higher bids to ensure they lose).

- Incentive problems

- ▶ If a firm is less efficient on average, it might not win enough contracts to find participation optimal. It might then deviate by undercutting the designated winner's bid.
- ▶ If side payments are not allowed then less efficient firms will need to win some of the time, which reduces cartel profit.
- ▶ If side payments are allowed then the most efficient firm always wins and "buys off" the other firms.

# Firm Asymmetries

Practices: Market allocation

Pesendorfer (*Review of Economic Studies*, 2000)

- School milk cartel
- Bidding procedure is a first price sealed bid auction with the lowest bidder winning the contract.
- Hundreds of contracts allow for many allocations to be implemented.
- Data: 1980-91 - Florida and Dallas-Fort Worth, Texas
- Legal evidence of side payments in Florida, but not in Texas.
- With side payments, the predicted variance of contracts for a firm is larger.
  - ▶ Variance of contracts for a firm in Florida exceeds that for Texas.
  - ▶ % of contracts won by the incumbent bidder
    - ★ 79% in Texas
    - ★ 41% in Florida

# Firm Asymmetries

Practices: Price

Clark and Houde (*American Economic Journal: Microeconomics*, 2013)

- Cartel among petrol stations in Victoriaville and Thetford Mines in Quebec province of Canada, 2005-06

Firm	Characteristic	Number of Stations	
		Thetford Mines	Victoriaville
Bilodeau-Shell	Cartel Organizer	4	4
Canadian Tire	Hardware store	0	1
Couche-Tard	Convenience store	2	3
Maxi	Grocery store	0	1
Petro-T	Wholesaler	2	1
Ultramar	Vertically integrated	3	2
Other	Independent	12	12
Total		23	25

# Firm Asymmetries

Practices: Price

Firm asymmetries:

- Network size: # of stations controlled by a firm.
- Station size - # of pumps, volume of petrol pumped
- Cost of petrol
  - ▶ Ultramar is vertically integrated with its own refinery.
  - ▶ Larger firms may have negotiated lower wholesale prices.
- Selling complementary products which may make petrol a loss-leader
  - ▶ Canadian Tire (hardware chain) and Loblaws (supermarket chain)
  - ▶ Couche-Tard (chain of convenience stores)

# Firm Asymmetries

## Practices: Price

Table 3: Summary statistics on the characteristics of stations in the three markets between 2001 and 2006

VARIABLES	Sherbrooke			Thetford-Mines			Victoriaville		
	Mean	S.D.	Max	Mean	S.D.	Max	Mean	S.D.	Max
Volume	6.53	3.51	19.74	4.27	1.85	8.96	5.83	4.03	21.35
Share	0.02	0.01	0.06	0.09	0.04	0.22	0.05	0.03	0.18
Nb. Pumps	10.39	6.94	32	6.48	3.06	12	8.07	4.19	18
Nb. Islands	2.40	1.15	6	1.96	1.01	5	1.97	0.88	6
Conv. Store	0.51	0.50	1	0.41	0.49	1	0.64	0.48	1
Self service	0.54	0.50	1	0.49	0.50	1	0.25	0.43	1
Carwash	0.22	0.41	1	0.10	0.30	1	0.16	0.36	1
24 Hours	0.31	0.46	1	0.08	0.27	1	0.21	0.40	1
Major brand	0.75	0.43	1	0.82	0.39	1	0.47	0.50	1

Volume is measured in thousands of liter per day. Conv. Store is an indicator variable equal to one if the station has a large convenience-store. Major brand is an indicator variable equal to one if the station sells branded gasoline (i.e. Esso, Petro-Canada, Shell, Irving, or Ultramar).

# Firm Asymmetries

## Practices: Price

- Possible effects of heterogeneity on collusion
  - ▶ Different preferences over price: Firms with lower cost and that sell complementary products want a lower collusive price.
  - ▶ Different incentives to cheat: A firm with fewer stations will gain more by undercutting price as there is less cannibalization of other stations.
- How to give a bigger share of cartel profits to firms with a stronger incentive to cheat?
  - ▶ Market allocation will not work as market share is a function of store amenities and locations, and not directly controlled by firms.
  - ▶ Price differences: allow less cooperative firms to charge a lower price
    - ★ Permanently lower price could be difficult to control as station demand is so elastic (estimated to be around -10 to -15).
    - ★ Periodic sales
    - ★ Delay in implementing price increases

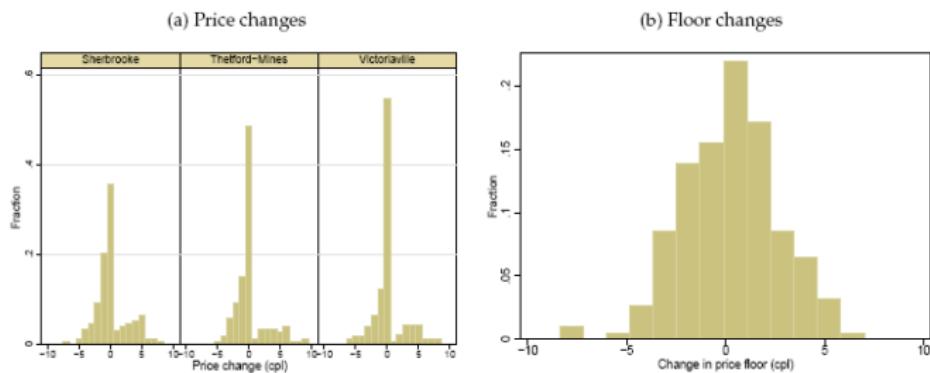
# Firm Asymmetries

## Practices: Price

### Price patterns ("rockets and feathers")

- Price increases are large and infrequent.
- Price decreases are small and more common.
- Long periods of no price change
- In response to rising cost, price is held fixed until, at some point, price is subject to a large increase.

Figure 2: Distribution of price and cost changes in the three markets



# Firm Asymmetries

## Practices: Price

Coordinated order of play for which price increases were enacted.

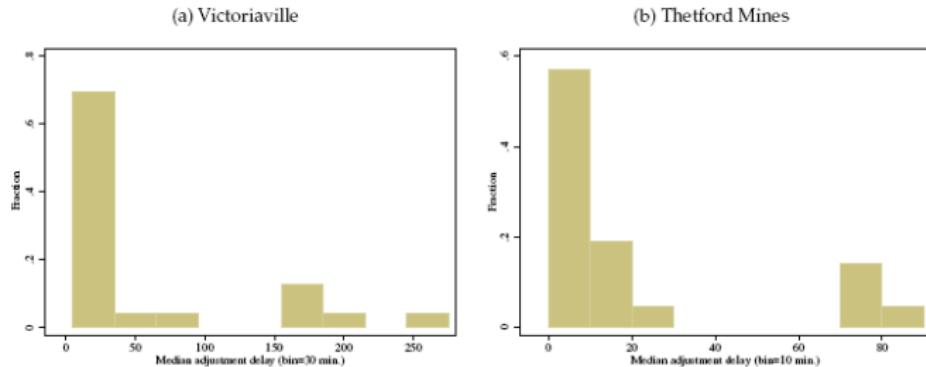
- Communication protocol
  - ▶ Price increases are initiated by the cartel leader.
  - ▶ Cartel leader contacts and negotiates with a subset of firms.
  - ▶ Once a price is agreed upon, the cartel leader communicates with the low-cost stations, who may negotiate a smaller price rise.
  - ▶ Communications go on for 1-2 hours prior to price being increased.
- Extent of communication
  - ▶ Implementation of a price increase required, on average, 65 phone calls.
  - ▶ Implementation of a price decrease required, on average, 27 phone calls. Many occurred after some station had already lowered price and served to inform other firms of the price decrease.

# Firm Asymmetries

## Practices: Price

- Cartel leader raises price.
- On average, 13 (30) minutes later a group of "follower" stations enacted it in Thetford Mines (Victoriaville).
- On average, 66 (145) minutes later low-cost stations enacted it in Thetford Mines (Victoriaville).

Figure 4: Distribution of median price adjustment delays during successful price increase episodes



# Firm Asymmetries

Practices: Price

Is this coordinated order of play a scheme to maintain cartel stability?

- Two hour delay is estimated to increase daily sales by 25-50%.
- How much additional profit this delivers depends on the frequency of price increases.
- Is the additional profit "commensurate" with the extent of firm heterogeneity?

# Some Underexplored Collusive Practices

# Some Underexplored Collusive Practices

- Practices

- ▶ Collusion in fuel surcharges but not total price
- ▶ Collusion in list prices, not transaction prices (without sales monitoring)
- ▶ Price signalling: Advance price announcements serve to coordinate on price
- ▶ Hub and spoke: Upstream (downstream) firm orchestrates collusion among downstream (upstream) firms

- Questions

- ▶ How does collusion work?
- ▶ What market conditions are necessary for it to work?

# Some Underexplored Collusive Practices

## Surcharges

Price-fixing has occurred or been suspected in several transportation markets in which firms coordinated on a common fuel surcharge

- Air freight (global), 2000-06
  - ▶ Lufthansa applied for leniency in the US and EU
  - ▶ Over 40 air cargo companies
  - ▶ Fine and damages (so far): 3.3B€
- Air passenger (inter-continental), 2004-06
  - ▶ Virgin Atlantic applied for leniency and reported that it was colluding with British Airways
- Rail freight (U.S. - Burlington Northern Santa Fe, Union Pacific, Norfolk Southern Corp., CSX)
  - ▶ On-going litigation; not yet determined whether they did collude on fuel surcharges

# Some Underexplored Collusive Practices

## Surcharges

- Air freight
  - ▶ Surcharge was per kilogram; independent of origin, destination, and distance
  - ▶ British Airways increased fuel surcharge from 4 cents/kilogram to 72 cents/kilogram
- Air passenger
  - ▶ Surcharge was per ticket
  - ▶ For a transatlantic round-trip, it rose from \$10/ticket in 2004 to \$110/ticket in 2006
- Rail freight
  - ▶ Surcharge was a % of the rail freight transport base rate.
  - ▶ During 2001-07, surcharges increased 55% more than the rise in fuel costs

# Some Underexplored Collusive Practices

## Surcharges

How can collusion in one component of price be effective? How was it monitored?

- Why couldn't an air cargo company reduce its base rate in order to get more business?
  - ▶ Could they monitor sales?
- Why couldn't BA and VA cut its base rate by 50% of the surcharge? With many flights and many pricing schemes, it would be difficult to detect.
  - ▶ Could they monitor it in terms of average fare?

# Some Underexplored Collusive Practices

## Surcharges

How can collusion be effective when firms coordinate on only one component of price?

- Bargaining (air cargo, rail freight)
  - ▶ A firm-specific fuel surcharge may not be credible to buyers.
  - ▶ A **common** fuel surcharge may credibly signal a component to cost that buyers accept as non-negotiable.
  - ▶ This could result in higher prices emerging through bargaining.
- Internal organization - collusion is typically among high-level executives, while final prices are set by lower-level employees.
  - ▶ Pricing complexity (passenger airline) - With complicated pricing formulas, could it be difficult to adjust prices to offset a surcharge?
  - ▶ Delegation - Is it difficult (or would it create suspicions) to instruct personnel not to treat a surcharge as "true" cost?

# Some Underexplored Collusive Practices

## List prices

Firms collude on list prices, offer discounts, and do not collude on final transaction prices.

- Possible cases
  - ▶ Banks and lending rates
  - ▶ Urethane
  - ▶ Bananas
  - ▶ Italian pasta
- *Lum v. Bank of America* (U.S., 2004)
  - ▶ Plaintiffs claimed that banks coordinated on a common prime rate for lending but admitted that the actual interest rate varied.
  - ▶ District Court dismissed the case (and 4th Cir. upheld) on the grounds that evidence of parallel movements in the base rate, but not the final rates, is insufficient evidence.

# Some Underexplored Collusive Practices

## List prices

*In re: Urethane Antitrust Litigation* (U.S., 10th Circuit Court, 2014)

- Plaintiffs' Response Brief: "The announcements stated that increases 'would apply to all [customers] regardless of what they were paying at the time' and typically to all products. For example, if one customer paid \$0.80 per pound and another paid \$0.90, an increase of \$0.06 per pound would raise the customers' prices to \$0.86 and \$0.96. ... As in virtually any market, purchasers could try to negotiate down from the increased price. But the increase formed the baseline for any negotiations."

# Some Underexplored Collusive Practices

## List prices

*In re: Urethane Antitrust Litigation* (U.S., 10th Circuit Court, 2014)

- Court: "The [district] court reasoned that the industry's standardized pricing structure - reflected in product price lists and parallel price-increase announcements - 'presumably establishe[d] an artificially inflated baseline' for negotiations. Consequently, any impact from a price-fixing conspiracy would have permeated all polyurethane transactions, causing market-wide impact despite individualized negotiations."
- Outcome
  - ▶ Four defendants settled for \$140 million.
  - ▶ Dow Chemical - 2013 jury guilty verdict with damages assessed at \$400 million for the cartel, trebled to \$1.2 billion, reduced to \$1.06B because of the \$140M paid by the other defendants. Upheld by Circuit Court. Dow is appealing to U.S. Supreme Court.

# Some Underexplored Collusive Practices

## List prices

Under what market conditions could collusion on higher list prices result in higher net prices?

- Are list prices cheap talk? Not if some buyers pay them.
- Are list prices informative of net prices?
  - ▶ Suppose list price is set for the year based on a firm's expected cost.
  - ▶ Suppose net price is set for a customer based on cost at that time.
  - ▶ List price is then a signal of a firm's cost and thus its net price.
- A firm that sets a lower list price
  - ▶ will induce a buyer to negotiate for a lower net price
  - ▶ but also attracts more buyer to negotiate with it.

# Some Underexplored Collusive Practices

## List prices

- If all firms raised their list prices
  - ▶ they can credibly commit to higher net prices (by signalling they have higher cost)
  - ▶ without being at a competitive disadvantage in attracting buyers to negotiate.
- Necessary conditions for collusion in list prices to work (according to this argument)
  - ▶ Buyers do not negotiate with all sellers.
  - ▶ There is adequate cost variability.

# Some Underexplored Collusive Practices

## Price signalling

- Advance price announcements may "reduce strategic uncertainty" and thereby promote coordination on higher prices
  - ▶ A firm announces a future price increase through some public medium
  - ▶ If rivals respond with similar announcements then proposed price increases are implemented.
  - ▶ If rivals do not respond in kind then the initial firm retracts the proposed price increase before any transactions occur
- Advance price announcements can have an efficiency benefit
  - ▶ Consumers may benefit from knowing what future prices might be
  - ▶ But these are only intentions and actual future prices could be different.
- Policy challenge: *How do we distinguish between announcements intended to inform consumers and announcements intended to coordinate with other firms?*

# Some Underexplored Collusive Practices

## Price signalling

- Australia - June 2012

- ▶ Instituted law prohibiting anti-competitive price signalling and information disclosures for the banking sector.
  - ▶ May be extended to other sectors of the economy.

- European Commission - December 2013

- ▶ Container liner shipping: Since 2009, these companies have made regular public announcements of price increase intentions through press releases
  - ▶ EC is concerned that "this practice may allow the companies to signal future price intentions to each other and may harm competition and customers by raising prices."

- Israel - August 2014

- ▶ Issued for public comment a proposed policy regarding "public statements that harm competition"

# Some Underexplored Collusive Practices

## Price signalling

*Coordinated Pretrial Proceedings in Petroleum Prods. Antitrust Litig.* (9th Cir., 1990)

- Plaintiffs were appealing a district court's summary judgment in favor of the defendants (oil companies).
- Defendants disseminated wholesale prices through press releases (in some cases in advance of the effective date) and posted prices at various locations that were accessible to rival firms.

# Some Underexplored Collusive Practices

## Price signalling

*Coordinated Pretrial Proceedings in Petroleum Prods. Antitrust Litig.* (9th Cir., 1990)

- Court concluded that: "The dealers were individually notified concerning any changes in the tankwagon prices or in the level of dealer discount. In light of this fact, it appears that the public dissemination of such information served little purpose other than to facilitate interdependent or collusive price coordination."
- Ruled in favor of the plaintiffs: "We believe that the evidence concerning the purpose and effect of price announcements, when considered together with the evidence concerning the parallel pattern of price restorations, is sufficient to support a reasonable and permissible inference of an agreement, whether express or tacit, to raise or stabilize prices."

# Some Underexplored Collusive Practices

## Price signalling

*Reserve Supply Corp. v. Owens-Corning Fiberglas Corp.* (7th Cir., 1992)

- Owens-Corning and CertainTeed's announced list price increases 30 to 60 days before their effective date.
- Plaintiff claimed
  - ▶ List prices have no independent value because no buyer pays list price.
  - ▶ List prices allow sellers to communicate and monitor the price activity of rivals by providing a common starting point for giving discounts.
- Defendants countered
  - ▶ The use of list prices to monitor pricing would not be possible because of the widespread use of discounts.
  - ▶ Announcing price increases 30-60 days in advance serves a legitimate purpose because their customers need to be able to take account of those increases in their bids.

# Some Underexplored Collusive Practices

## Price signalling

*Reserve Supply Corp. v. Owens-Corning Fiberglas Corp.* (7th Cir., 1992)

7th Circuit Court concluded:

- "These announcements did reduce the uncertainty inherent in raising prices by allowing competitors time to decide if they would follow suit. In that way they facilitated the parallel pricing that occurred in the market."
- "However, the record indicates that these announcements served an important purpose in the industry. Many of Owens-Corning's and CertainTeed's customers resold insulation to other customers or bid on building contracts well in advance of starting construction and, therefore, required sixty days or more advance notice of price increases."

# Some Underexplored Collusive Practices

## Price signalling

### Theoretical issues

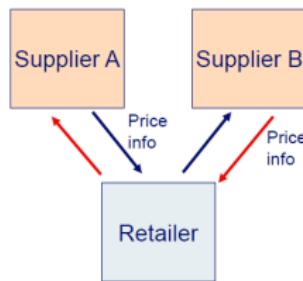
- Derive market conditions for which
  - ▶ public announcements will have little value to consumers so the efficiency benefit can be dismissed
  - ▶ collusive equilibria exist
- Multiple audience cheap talk model where a firm may be communicating with other firms and/or customers

# Some Underexplored Collusive Practices

## Hub and spoke

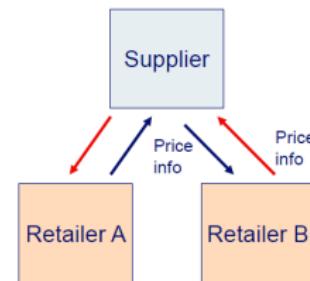
- Consider upstream firms (e.g., manufacturer) and downstream firms (e.g., retailers)
- Hub and spoke collusion is when competitors at one level collude by communicating and coordinating through a firm at another level. Competitors do not directly communicate.

Supplier to Retailer to Supplier



Toys "R" Us (FTC, 1998)

Retailer to Supplier to Retailer



Hasbro (OFT, 2003)

Source - M. Bennett, Office of Fair Trading, Dec 2010

# Some Underexplored Collusive Practices

## Hub and spoke

Toys "R" Us (U.S. Federal Trade Commission, 1998) - retailer as hub, manufacturers as spokes

- Toys R Us coordinated a boycott among manufacturers of certain toys to low-priced warehouse club stores.
- If a manufacturer sold a toy to Toys R Us than it could not sell it to clubs.
- Objective was for Toys R Us to have exclusivity over certain toys so that it would not be competing with the clubs.
- A manufacturer was concerned that other manufacturers may supply the discount retailers.
- Toys R Us entered into a vertical agreement with each manufacturer with assurances that other manufacturers would have the same contractual obligation: "We communicated to our vendors that we were communicating with all of our key suppliers, and we did that ... at Toy Fair 1992."

# Some Underexplored Collusive Practices

## Hub and spoke

Hasbro (UK Office of Fair Trading, 2003) - manufacturer as hub, retailers as spokes

- Toy manufacturer Hasbro organized a price-fixing agreement between retailers Argos and Littlewoods with respect to Hasbro's products.
- Starting in 1999, Hasbro introduced two initiatives:
  - ▶ "pricing initiative" - increase retail margins by persuading retailers to charge a recommended retail price (RRP)
  - ▶ "listing initiative" - offered rebates in return for the listing of certain Hasbro products where they were threatened to be delisted
- Monitoring: account managers were to undertake audits of toy retailers to ensure pricing at RRP.
- Coordination
  - ▶ Hasbro assured each retailer that the other retailers would go along
  - ▶ Information about retailers' pricing intentions went through Hasbro; no evidence of direct communication between retailers

# Some Underexplored Collusive Practices

## Hub and spoke

Hasbro (UK Office of Fair Trading, 2003)

- 73 The e-mail was copied to Hasbro's management including Mike Brighty, who was at that time a Sales Director alongside David Bottomley. Mike Brighty replied by e-mail on 19 May 2000:

'Ian ... This is a great initiative that you and Neil have instigated!!!!!!! However, a word to the wise, never ever put anything in writing, its highly illegal and it could bite you right in the arse!!!! suggest you phone Lesley and tell her to trash? Talk to Dave. Mike'

# Some Underexplored Collusive Practices

## Hub and spoke

- Suppose final product demand is  $100 - p$  where  $p$  is the price faced by consumers
- Unit cost of manufacturing is  $m$
- Unit cost of retailing is  $r$
- Monopolist that controlled manufacturing and retailing would choose the final product price to maximize:  $(100 - p)(p - m - r)$ .
  - ▶ Monopoly price is  $p^m = (1/2)(100 + m + r)$
  - ▶ Monopoly profit is

$$(100 - p^m)(p^m - m - r) = (1/4)(100 - m - r)^2$$

# Some Underexplored Collusive Practices

## Hub and spoke

- Suppose there are two retailers who consumers see as identical.
- Manufacturer charges a price of  $w$  per unit to retailers.
- Retailer 1 choose  $p_1$  to maximize  $(p_1 - w - r) D_1(p_1, p_2)$  where

$$D_1(p_1, p_2) = \begin{cases} 100 - p_1 & \text{if } p_1 < p_2 \\ (1/2)(100 - p_1) & \text{if } p_1 = p_2 \\ 0 & \text{if } p_1 > p_2 \end{cases}$$

- ▶ Same with retailer 2.
- Retailer competition results in perfect competition:  $p_1 = w + r = p_2$ .

# Some Underexplored Collusive Practices

## Hub and spoke

- Manufacturer chooses  $w$  to maximize

$$(100 - (w + r))(w - m)$$

- ▶ Manufacturer anticipates that final product price is  $w + r$  when it charges a price of  $w$  to retailers.
- ▶ Manufacturer price is  $w^m = (1/2)(100 + m - r)$
- ▶ Manufacturer profit is  $(100 - (w^m + r))(w^m - m)$   
 $= (1/4)(100 - m - r)^2$
- "One monopoly profit"
  - ▶ Manufacturer earns the same profit as when it also controlled retailing.
  - ▶ Extracts full monopoly profit by setting  $w = (1/2)(100 + m - r)$  and having the retailers compete so that

$$p = w + r = (1/2)(100 + m + r) = p^m$$

# Some Underexplored Collusive Practices

## Hub and spoke

- Takeaway

- ▶ In this setting, manufacturer has no incentive to participate in downstream collusion as it is already extracting the full surplus.
- ▶ Collusion raises retailer prices which lowers retail demand and thereby lowers manufacturer demand.
- ▶ If retailers are differentiated then  $\text{retailer price} > \text{cost}$  (double marginalization) which means the manufacturer does not extract the full surplus but downstream collusion again will not help.

- Challenges to a theory of hub and spoke collusion

- ① How can a manufacturer earn higher profit when downstream retailers collude?
- ② How can a manufacturer assist downstream retailers in colluding?

# Some Underexplored Collusive Practices

## Hub and spoke

Suppose there is bargaining between manufacturer and differentiated retailers (Note: this explanation is tentative)

- A retailer bargains aggressively for a lower wholesale price because
  - ▶ it lowers retailer's cost
  - ▶ it raises retailer's demand as it can then charge a lower price
  - ▶ it raises retailer's market share because it can price lower than competing retailers
- With downstream collusion, the third effect disappears which means the retailers have less bargaining power and the manufacturer can negotiate a higher price.
- Downstream collusion can then
  - ▶ raise total manufacturer-retailer profit by reducing retailer competition (surplus comes from consumers)
  - ▶ retailers can earn higher profit through higher price-cost markups
  - ▶ manufacturer can earn higher profit by charging a higher price

# Some Underexplored Collusive Practices

## Hub and spoke

Suppose there are two manufacturers (A and B) competing for shelf space with identical retailers (Note: this explanation is tentative)

- Retailers are indifferent between whose products are sold because all products yield a zero margin.
- Manufacturer A promotes downstream collusion and creates a margin for retailers which can increase demand for manufacturer A's products.
- Manufacturer A's profit rises because it takes some demand (and profit) from manufacturer B.
- Retailers' profits rise because they now earn a positive margin on manufacturer A's products.

# Facilitating Practices

# Facilitating Practices

- A *facilitating practice* is an activity that makes it easier for firms to collude which means it either helps them
  - ▶ coordinate on a collusive arrangement and/or outcome
  - ▶ stabilize a collusive arrangement by
    - ★ reducing the gains from a deviation
    - ★ monitoring for compliance
    - ★ punishing deviations
- As typically applied, it refers to practices that facilitate collusion *in the absence of an explicit agreement.*

# Facilitating Practices

- Some facilitating practices
  - ▶ advance notice of price changes
  - ▶ information exchange of current prices, of past prices and sales
  - ▶ base point pricing
  - ▶ posted pricing
  - ▶ resale price maintenance
  - ▶ most favored customer and meet the competition clauses
  - ▶ invitation to collude
  - ▶ product standardization
- Market conditions must be suitable for the existence of a profitable and stable collusive arrangement if a practice is to be facilitating
  - ▶ high concentration
  - ▶ low product differentiation
  - ▶ high entry barriers
  - ▶ excess capacity

# Facilitating Practices

- Facilitating practice may be "a factual predicate for the inference of an agreement" (P. Areeda and H. Hovenkamp, *Antitrust Law*, 2010)
  - ▶ *Todd v. Exxon Corp.* (2nd. Cir. 2001) - "Information exchange is an example of a facilitating practice that can help support an inference of a price-fixing agreement."
- Facilitating practice may be prohibited because of its anti-competitive tendencies
  - ▶ *Todd v. Exxon Corp.* (2nd. Cir. 2001) - The violation may "lie in the information exchange itself - as opposed to merely using the information exchange as evidence upon which to infer a price-fixing agreement. This exchange of information is not illegal per se, but can be found unlawful under a rule of reason."

# Facilitating Practices

## Prohibition

- A practice may be prohibited because it facilitates collusion.
- Evaluation is based on the rule of reason in balancing off anti-competitive effects with any efficiencies.
- Some examples
  - ▶ "Post and hold" laws
  - ▶ Information exchange, especially through trade associations
  - ▶ Resale price maintenance

# Facilitating Practices

## Prohibition

### Petrol stations (Brazil)

- Shortly after the deregulation of fuel retail prices, a regulation was enacted requiring retailers to post their prices on signs that are clearly visible by drivers from the road.
- Increased price transparency has
  - ▶ pro-competitive effects: consumer search is easier
  - ▶ anti-competitive effects: monitoring of compliance with a collusive price is easier



# Facilitating Practices

## Prohibition

### Petrol stations (Brazil)

- Cartel in Florianópolis
  - ▶ Established a committee to drive around the city looking at price signs in order to identify retailers who had not set the collusive price.
  - ▶ When non-compliance was detected, the president of the trade association of gasoline retailers would contact the defecting station owner and try to persuade him to comply.
- Increased price transparency that has the substantive benefit of reducing search costs for consumers should not be prohibited.



# Facilitating Practices

Prohibition: Information exchange through trade association

- What information might firms exchange through a trade association?
  - ▶ Facts and forecasts regarding demand and cost
  - ▶ Historical data: past prices, sales, investment, etc.
  - ▶ Current prices, capacities, etc.
  - ▶ Future plans: prices, investment, etc.
- Why would firms exchange information?
  - ▶ Allows them to make more informed decisions by having better information about demand and cost
  - ▶ Public announcement provides information to consumers which can increase demand
  - ▶ Facilitates collusion

# Facilitating Practices

Prohibition: Information exchange through trade association

Firms are better able to coordinate on a collusive outcome by

- exchanging future pricing intentions
- exchanging demand and cost data so that firms have a more common set of beliefs (which makes it more likely that, without express communication, they can settle on the same collusive price)
- current prices being more easily observable (enhances price leadership)

# Facilitating Practices

Prohibition: Information exchange through trade association

Firms are better able to monitor compliance with a collusive outcome when historical information (past prices and sales)

- is common to firms (so it is known when all should engage in a price war or some other punishment).
- is learned with shorter lag
  - ▶ as it reduces the time between a deviation and a punishment and thus makes cheating less profitable.
- is more accurate and disaggregated
  - ▶ as it is more effective at detecting non-compliance. (A customer allocation scheme can be implemented if it is public information as to which firm sells to a customer.)

# Facilitating Practices

Prohibition: Information exchange through trade association

- *American Column and Lumber Co. v. U.S. (1921)*
  - ▶ Supreme Court found trade association members' exchange of information on sales, production and inventories to be in violation of Section 1.
  - ▶ Focused on the exchange of price and output information, particularly, "suggestions as to both future prices and production."
  - ▶ "[G]enuine competitors do not make daily, weekly and monthly reports of the minutest details of their business to their rivals"
  - ▶ Hardwood prices had increased "to an unprecedented extent."
- *U.S. v. American Linseed Oil Co. (1923)*
  - ▶ Supreme Court struck down information exchange program concerning price lists, price variations and the names and addresses of buyers who received special prices.
  - ▶ The association kept the information confidential within the membership; customers did not benefit from the information exchange.

# Facilitating Practices

Prohibition: Information exchange through trade association

- *Maple Flooring Mfrs Ass'n v. U.S. (1925)*
  - ▶ Supreme Court upheld this information exchange program on the grounds that
    - ★ data was aggregated and involved past transactions
    - ★ data was publicly available and was actually read by buyers
    - ★ there was no uniformity in prices
    - ★ shared data had "a useful and legitimate purpose in enabling members to quote promptly a delivered price on their product."
  - ▶ Though detailed information on individual sales and monthly information on production and new orders was collected, only aggregated numbers were disseminated.

# Facilitating Practices

## Prohibition: Information exchange

- Information exchanges are not a *per se* violation because "such practices can in certain circumstances increase economic efficiency and render markets more, rather than less, competitive." *U.S. v. U.S. Gypsum Co.* (1978)
- *Antitrust Guidelines for Collaboration Among Competitors* (2000) issued by DOJ and FTC
  - ▶ Provides a framework for evaluating information exchanges and weighing the pro- and anti-competitive effects.
  - ▶ Assessment depends on the type of information shared and the way in which it is disseminated
  - ▶ More anti-competitive concerns are raised when information
    - ★ is more recent
    - ★ is about present and future business plans
    - ★ is of individual company data rather than aggregated

# Facilitating Practices

## Prohibition: "Post and Hold" laws

Wholesalers of alcohol are required to "post" their prices with a state authority for the coming period and they must "hold" these prices for the duration of the period.

### "Post and hold" law in New York

- Wine and spirits wholesalers must file by the fifth day of each month the prices they intend to charge for the next month.
- Within ten days (by the 15th), the State Liquor Authority (SLA) posts these prices online.
- Within three days (by the 18th), wholesalers can change their postings to meet lower prices.
- Prices posted on the 18th go into effect on the 1st of the next month for 30 days

# Facilitating Practices

Prohibition: "Post and Hold" laws

- Challenges to liquor stores colluding
  - ▶ coordination: firms coordinating on prices without express communication
  - ▶ monitoring: prices between wholesalers and retailers are not easily observed
- "Post and hold" law is a facilitating practice
  - ▶ coordination: a leader can set prices and other stores can match those prices
  - ▶ monitoring: any deviation is immediately detected when the SLA posts prices
  - ▶ punishment: immediate as firms can match any low price in the three days after the initial posting
- 9th Circuit Court found the "post and hold" law in the state of Washington to be a *per se* offense.

# Facilitating Practices: Prohibition

## Prohibition

### Procedures for Evaluating Information Exchange Practices

- ① Is the market suitable for collusion?
  - ▶ Are market conditions conducive to collusion?
  - ▶ Is there evidence of collusion?
  - ▶ Burden of proof is on the plaintiffs.
- ② How would the information exchange practices make a difference in the likelihood or extent of collusion?
  - ▶ What is the theory of collusion for this particular market?
  - ▶ How do the information exchange practices fit into that theory?
  - ▶ Is there an agreement among firms to share information?
  - ▶ Burden of proof is on the plaintiffs.
- ③ Are there efficiencies from the information exchange practices?
  - ▶ How do efficiencies compare with anti-competitive effects?
  - ▶ Burden of proof is on the defendants to establish the presence and magnitude of efficiencies.

# Facilitating Practices

## Evidentiary standards for an unlawful agreement

- *Monsanto Co. v. Spray-Rite Service Corp.* (1984)
  - ▶ "[T]here must be evidence that tends to exclude the possibility of independent action by the [parties]. That is, there must be direct or circumstantial evidence that reasonably tends to prove that [the parties] had a conscious commitment to a common scheme designed to achieve an unlawful objective."
- *Matsushita Electric Industrial Co., Ltd. v. Zenith Radio Corp* (1986)
  - ▶ "[C]onduct as consistent with permissible competition as with illegal conspiracy does not, standing alone, support an inference of antitrust conspiracy."
  - ▶ "To survive a motion for summary judgment or for a directed verdict, a plaintiff ... must present evidence that 'tends to exclude the possibility' that the alleged conspirators acted independently."

# Facilitating Practices

## Evidence

- A *facilitating practice* is an activity that makes collusion more likely or more effective, either by making coordination easier or making it easier to sustain a collusive agreement.
- A *plus factor* is the additional evidence - along with market conduct (such as parallel behavior) - required to prove that firms have an agreement to unreasonably restrain trade.
  - ▶ *Baby Food Antitrust Litig.* (1999) - "[P]lus factors refers to the additional facts or factors required to be proved as a prerequisite to finding that parallel action amounts to a conspiracy."
  - ▶ *Flat Glass Antitrust Litig* (2004) - "[E]xistence of these plus factors tends to ensure that courts punish 'concerted action' - an actual agreement - instead of the 'unilateral, independent conduct of competitors.'"

# Facilitating Practices

## Evidence

- A facilitating practice need not be a plus factor.
  - ▶ If a practice facilitates collusion but firms would independently implement it then it is generally not a plus factor.
  - ▶ If a practice facilitates collusion but has some pro-competitive benefits then it is generally not a plus factor.
  - ▶ *Holiday Wholesale Grocery Co. v. Philip Morris* (2002) - "Plaintiffs use the terms 'plus factors' and 'facilitating devices' interchangeably. This practice confuses the proper analysis because 'facilitating devices' are not necessarily sufficient under the law to constitute a 'plus factor'."
- "Facilitating practices can arise in the identification of an agreement by either: i) establishing that industry members have agreed to adopt the practice in question; or ii) introducing proof of practices to establish that the defendants conspired to fix prices." - W. Kovacic, *Antitrust Bulletin*, 1993

# Facilitating Practices

Evidence: Product standardization

*C-O-Two Fire Equip. Co. v. United States*  
(1952)

- 3rd Circuit Court not only inferred a price-fixing agreement but also an agreement to standardize fire extinguishers.
- Firms' products had identical size, red color, and appearance of components such that they were indistinguishable without their labels.



# Facilitating Practices

Evidence: Product standardization

*C-O-Two Fire Equip. Co. v. United States*  
(1952)

- Such standardization is not in a firm's interest but for collusion. Under competition, firms want to differentiate their products because
  - customers base their decisions more on price when non-price characteristics are more similar across products
  - less product differentiation intensifies price competition



# Facilitating Practices

Evidence: Posted pricing

- Common pricing policy in intermediate goods markets
  - ▶ Sellers publicly announce list prices
  - ▶ Sellers offer discounts off of those list prices, and the discounts are privately negotiated with individual customers
- Decision not to offer discounts off of list prices (posted pricing) can be a facilitating practice and plus factor because it can
  - ▶ communicate a desire to collude
  - ▶ provide a method for coordinating on price - price leadership with respect to list prices
  - ▶ makes monitoring easier
- Posted pricing can reduce consumer search costs and thus be pro-competitive

# Facilitating Practices

Evidence: Posted pricing

## Possible efficiencies

- Reducing buyers' search costs
  - ▶ benefits buyers: easier for a consumer to collect price information
  - ▶ may benefit sellers: more consumers are attracted to the market which raises demand.
- Reducing firms' selling costs
  - ▶ lowers training expenses and lower wages (as sales representatives need not be skilled in price negotiation)
  - ▶ more transactions per employee as each transaction takes less time since there is no negotiation over price

# Facilitating Practices

## Evidence: Posted pricing

These efficiencies may apply to many retail markets but not to some intermediate good markets (e.g., turbine generators)

- Customers will have the same information whether sellers post prices or negotiate because, given the expenditure associated with the product is large, they will get a price quote from both sellers.
- Savings in negotiation costs are small relative to the expenditure involved and thus are very unlikely to affect any welfare calculation.
- Sellers still need skilled sales representatives
- The "posted pricing" argument "exclude[s] the possibility of independent action" because the only reasonable inference from GE and Westinghouse adopting posted pricing is that they plan to coordinate pricing because their actions are consistent with their best interests *only if coordinated pricing ensues.*

# Facilitating Practices

Evidence: Sharing current price information

*U.S. v. Container Corporation of America (1969)*

- Background

- ▶ Cardboard cartons in southeastern U.S. with 6 firms having 60% of sales.
- ▶ Evidence of excess capacity and falling prices.

- Information sharing agreement

- ▶ Involved 18 companies supplying 90% of sales.
- ▶ No centralized information exchange.
- ▶ Companies informed each other about prices currently or last quoted to particular customers.
- ▶ Prices were subsequently matched by competitors.

# Facilitating Practices

Evidence: Sharing current price information

*U.S. v. Container Corporation of America (1969)*

- An agreement to exchange price information was inferred because, absent anticipation of reciprocity, such exchange would not occur.
  - ▶ "[A]ll that was present was a request by each defendant of its competitor for information as to the most recent price charged or quoted ... Each defendant on receiving that request usually furnished the data with the expectation that it would be furnished reciprocal information when it wanted it."
  - ▶ Absent collusion, it is rarely in a firm's best interests to share price information with a competitor, especially in markets for which there could be competitive bidding.
- Such a practice is not *per se* illegal
  - ▶ "I do not believe the agreement [to exchange prices] is so devoid of potential benefit or so inherently harmful that we are justified in condemning it without proof that it was entered into for the purpose of restraining price competition or that it actually had that effect."

# Facilitating Practices

Evidence: Sharing current price information

*U.S. v. Container Corporation of America (1969)*

- But a violation was found because it was shown that it had the effect of raising price.
  - ▶ "In this case, the probability that the exchange of specific price information led to an unlawful effect upon prices is buttressed by evidence in the record."
- Supreme Court concluded that the practices violated the Sherman Act.
  - ▶ "[T]he exchange of prices made it possible for individual defendants confidently to name a price equal to that which their competitors were asking. The obvious effect was to stabilize prices by joint arrangement ... I cannot see that we would be justified in reaching any conclusion other than that defendants' tacit agreement to exchange information about current prices to specific customers did in fact substantially limit the amount of price competition."

# Facilitating Practices

Evidence: Most favored customer clause

- A most favored customer clause is a contract provision in which a seller agrees to give the buyer the best terms it makes available to any other buyer.
- MFC clause creates the anti-competitive effect of making discounts to buyers less profitable
  - ▶ As any discount must be given to all customers, a seller is less inclined to give a discount to any buyer.
  - ▶ This enhances the seller's bargaining leverage as it makes it more credible that it will not concede to a buyer's demand for a discount.
  - ▶ This effect applies to a monopoly as well as an oligopoly.

# Facilitating Practices

Evidence: Most favored customer clause

*E.I. DuPont De Nemours & Co. v. FTC* (2nd Cir. 1984) - Ethyl

- Defendants were the four producers of lead anti-knock additives for gasoline
- Challenged practices were
  - ▶ quoting prices on a uniform delivered price basis
  - ▶ advance price announcements
  - ▶ most favored customer clause
- FTC administrative law judge and the full commission concluded that the conduct violated Section 5. It was overturned by the 2nd Circuit Court.

# Facilitating Practices

Evidence: Most favored customer clause

## *E.I. DuPont De Nemours & Co. vs. FTC (2nd Cir. 1984) - Ethyl*

- The MFC clause may be a facilitating practice but it was not viewed as a plus factor.
- 2nd Cir. noted that the practice had originally been implemented by the Ethyl Corp. when it was the monopoly supplier.
- Thus, the practice has a rationale unrelated to collusion.
- The practice could still be facilitating but its use does not "exclude the possibility of independent action."

# Competition Policy

# Competition Policy

## Introduction

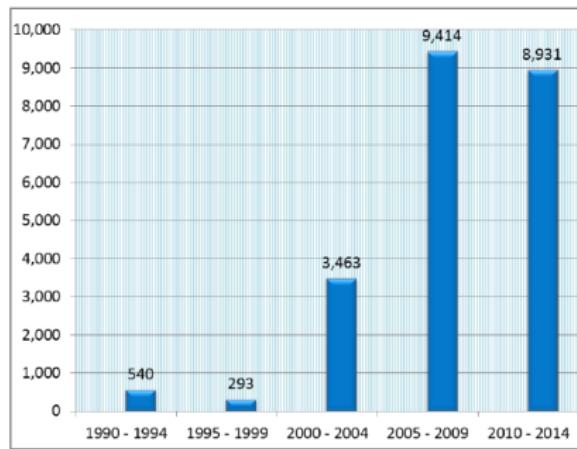
- Stages in fighting cartels
  - ① Discovery
  - ② Prosecution
  - ③ Penalization
- Developing evidence (discovery, prosecution)
  - ▶ Reports by customers, competitors
  - ▶ Whistleblowers
  - ▶ Leniency programs
  - ▶ Dawn raids
  - ▶ Economic analysis

# Competition Policy

## Introduction: Penalties

- Corporate
  - ▶ Government fines
  - ▶ Customer damages
- Individual
  - ▶ Government fines
  - ▶ Incarceration
  - ▶ Unemployment
- Ideally, penalties should be set so that collusion is unstable.
  - ▶ But what is the probability that a cartel ends up being caught and convicted?
  - ▶ Corporate bankruptcy limits the size of corporate penalties.
  - ▶ How is incarceration valued?

# Government Fines



- Maximum fine for a cartel: 1.47 billion € (TV and computer monitor tubes)
- Maximum fine for a firm: 715 million € (Saint Gobain - Car glass)

## Government Fines

- 2006 revision of European Commission guidelines for corporate fines
- Basic Amount =  $S \times a \times T + S \times b$ 
  - ▶  $S$  = value of the firm's sales in the last full business year of the firm's participation in the cartel
  - ▶  $a$  = percentage of the values of sales up to 30 percent ("gravity")
  - ▶  $T$  = number of year's of a firm's participation
  - ▶  $S \times b$  = fixed portion where  $b$  is 15-25 percent
- If a penalty is to deter cartel formation, it should be tied to the incremental profit from colluding. So why does the fine depend on revenue, not profit?
- Analysis of EC system of fines: Katsoulacos and Ulph (*Economic Journal*, 2013)
- Maximum fine for a firm: 715 million € (Saint Gobain - Car glass)

# Customer Damages

- What is the purpose of customer damages?
  - ▶ Compensation to harmed consumers.
  - ▶ Deterrence and desistance of cartels
    - ★ additional financial penalties to fines levied by the government.
    - ★ creates added incentives for customers to monitor, report, and investigate.
- Customer damages - U.S.
  - ▶ Treble damages
    - ★ Multiplier serves deterrence since the probability of being caught and paying penalties is well below one.
    - ★ In practice, settlements are closer to single damages.
  - ▶ Indirect purchasers cannot sue for damages except in some states.
  - ▶ Class action suits for when many customers each incur a small loss.

# Customer Damages

## Defining damages

- Customer damages - EU
  - ▶ Single damages.
  - ▶ Indirect purchaser suits are allowed.
    - ★ If an illegal overcharge is passed on to consumers who are not direct buyers then those consumers are harmed.
    - ★ Those harmed consumers can claim compensation.
- Comparison of US and EU
  - ▶ EU is focused on compensation.
  - ▶ US is primarily concerned with deterrence and desistance.
- Allowing indirect purchasers to sue weakens enforcement.
  - ▶ Direct purchasers have the best information when it comes to detecting collusion. Weakening their incentives will reduce the likelihood that they report and sue, thereby reducing enforcement.
  - ▶ Damage calculation becomes more difficult and could effectively reduce penalties.

# Customer Damages

## Defining damages

- Damages inflicted by firm  $i$  from colluding in period  $t$  are calculated to be

$$\left[ P_i^c(t) - P_i^{bf}(t) \right] Q_i^c(t)$$

- $P_i^c(t)$  is the observed (collusive) price charged by firm  $i$  in period  $t$ .
- $Q_i^c(t)$  is the number of units sold by firm  $i$  in period  $t$
- $P_i^{bf}(t)$  is the "but for" (or counterfactual) price for firm  $i$  in period  $t$ .
- $P_i^c(t) - P_i^{bf}(t)$  is the *overcharge*.

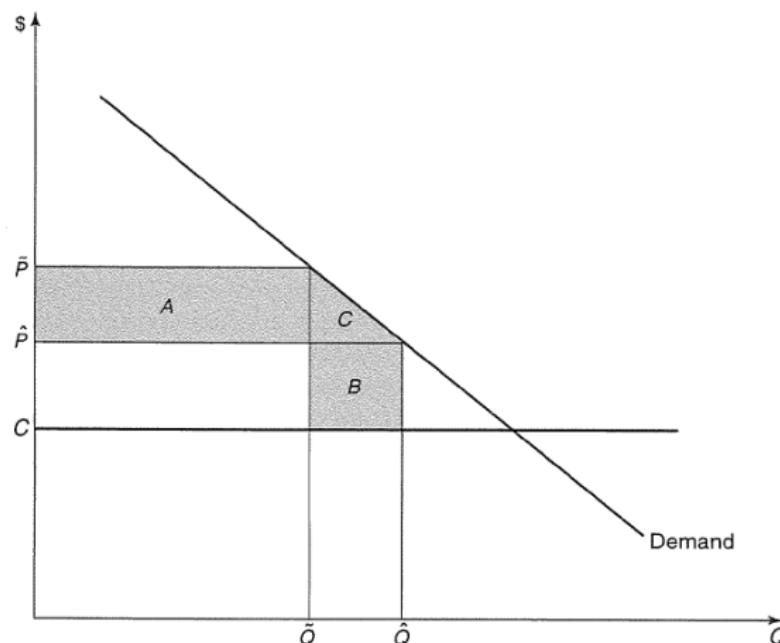
# Customer Damages

## Defining damages

- This method ignores the reduction in quantity due to a higher price.
- In the figure on the next slide:
  - ▶  $\tilde{P}$  is the collusive price,  $\hat{P}$  is the but for price,  $C$  is unit cost.
  - ▶ Overestimates profit gain to firms by rectangle B.
  - ▶ Underestimates loss to consumers by rectangle C.
- The discrepancy is less when market demand is more inelastic.
- Note: If a customer chooses not to buy at all because of the higher price, it cannot collect damages.

# Customer Damages

Defining damages



**Figure 5.13**  
Calculating Damages in a Price-Fixing Case

# Customer Damages

## Defining damages

- Primary challenges to calculating damages
  - ▶ Dating the cartel - identifying the time during which firms were colluding and thus damages were incurred.
  - ▶ Estimating the but for price.
- Dating the cartel
  - ▶ End of collusion - one may be confident that communications stopped, but did tacit collusion replace explicit collusion?
  - ▶ Start of collusion
    - ★ Evidence of meetings (memos, testimony, etc.) is evidence of collusion. Lack of evidence doesn't mean there wasn't collusion.
    - ★ Older evidence is more likely to have been destroyed or missing.
  - ▶ Methods used in "Detecting Cartels" are pertinent.
  - ▶ Official dates of the cartel by the competition authority are often the product of negotiation and thus are not definitive.

# Customer Damages

## Estimating the but for price

- Before and After approach - use price data from this market for periods in which these firms were not colluding:
  - ▶ non-collusive periods prior to the beginning of cartel activity
  - ▶ periods during the time of collusion in which collusion broke down
  - ▶ periods after the end of cartel activity.
- Yardstick approach - use price data from comparable markets (where collusion is not suspected)
  - ▶ Price for same product in other geographic markets.
  - ▶ Price for related products

# Customer Damages

## Estimating the but for price

### Market structure-based approach

- Specify a non-collusive model (e.g., Bertrand or Cournot)
- Estimate market demand and cost functions
- Using those estimates in the non-collusive model, project what prices would have been during the conspiracy period.
- Special case: cost-based approach
  - ▶ Estimate cost for the conspiracy period.
  - ▶ Assume the but for price is cost plus some fixed markup
- Two model approach
  - ▶ Specify models for both the counterfactual (non-collusive) and factual (collusive) scenarios.
  - ▶ Use the factual model and data for the conspiracy period to estimate market demand and cost functions.
  - ▶ Project but for prices.

# Damages

Before and After approach: Dummy variable version

Common approach is to control for demand and supply conditions by running a reduced-form regression:

$$P(t) = \alpha + \beta X(t) + \gamma v(t) + \varepsilon(t)$$

- $P(t)$  is the observed price.
- $X(t)$  is a collection of demand and cost factors.
  - ▶ Prices of substitutes (example: prices for beef, pork, and turkey for the processed chicken cartel)
  - ▶ Input prices - raw materials, labor, energy
  - ▶ Consumer disposable income, producer price index
- $v(t)$  is a dummy variable that equals one in those periods that firms were colluding.
- $\varepsilon(t)$  is the residual error.
- $\alpha$ ,  $\beta$ , and  $\gamma$  are parameters to be estimated.

# Damages

Before and After approach: Dummy variable version

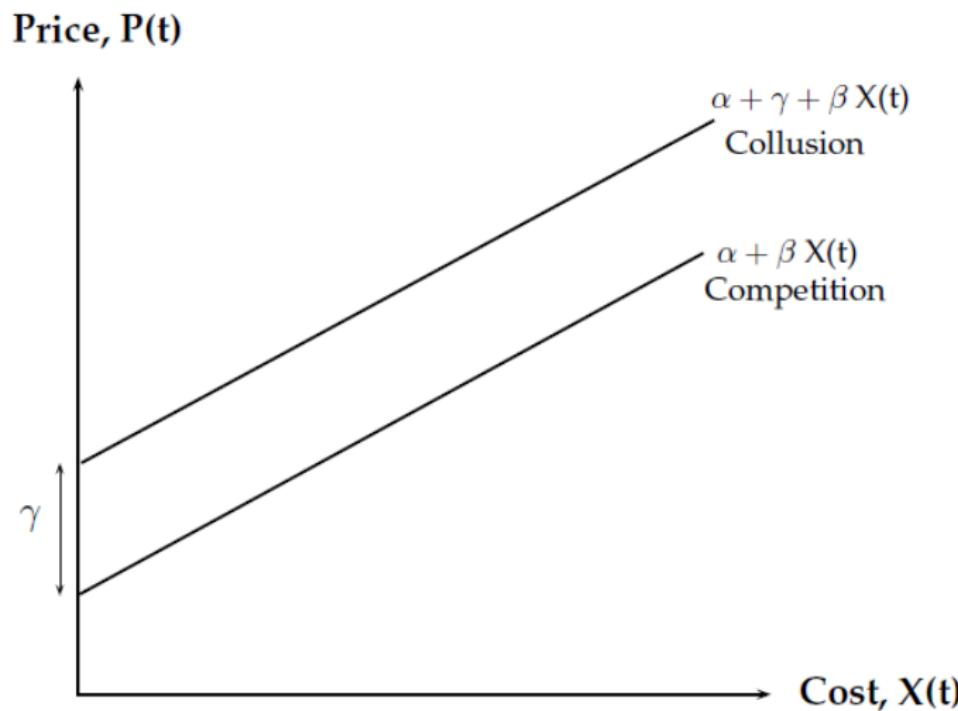
- Specification

- ▶ How price responds to demand and cost shifts is assumed to be the same under collusion and competition.
- ▶ Collusion just causes an upward shift in the price function.
- ▶ If  $\hat{\alpha}$  and  $\hat{\beta}$  are parameter estimates, the but for price for period  $t$  is then estimated to be:

$$P^{bf}(t) = \hat{\alpha} + \hat{\beta}X(t).$$

# Damages

Before and After approach: Dummy variable version



# Damages

Before and After approach: Forecasting version

Vitamins (Bernheim, 2002)

- Benchmark price model,

$$P(t) = \alpha P(t-1) + \beta X(t) + \varepsilon(t)$$

estimated the relationship between a vitamin's price and

- ▶ current demand and cost factors,  $X(t)$
- ▶ lagged price  $P(t-1)$  (takes account of gradual adjustment of price to a change in cost and demand)
- Demand factors
  - ▶ U.S. population, per capita income
  - ▶ demand drivers for animal nutrition products (pounds of slaughtered beef, chicken, etc.)
  - ▶ U.S. prices of potential vitamin complements and substitutes

# Damages

Before and After approach: Forecasting version

- Cost factors

- ▶ Raw materials (ammonia, hydrochloric acid, methanol, sugar, etc.)
- ▶ U.S. wage index for chemical industry workers
- ▶ U.S. dollar exchange rates (as companies were located abroad and sold in the U.S.)
- ▶ U.S. interest rates

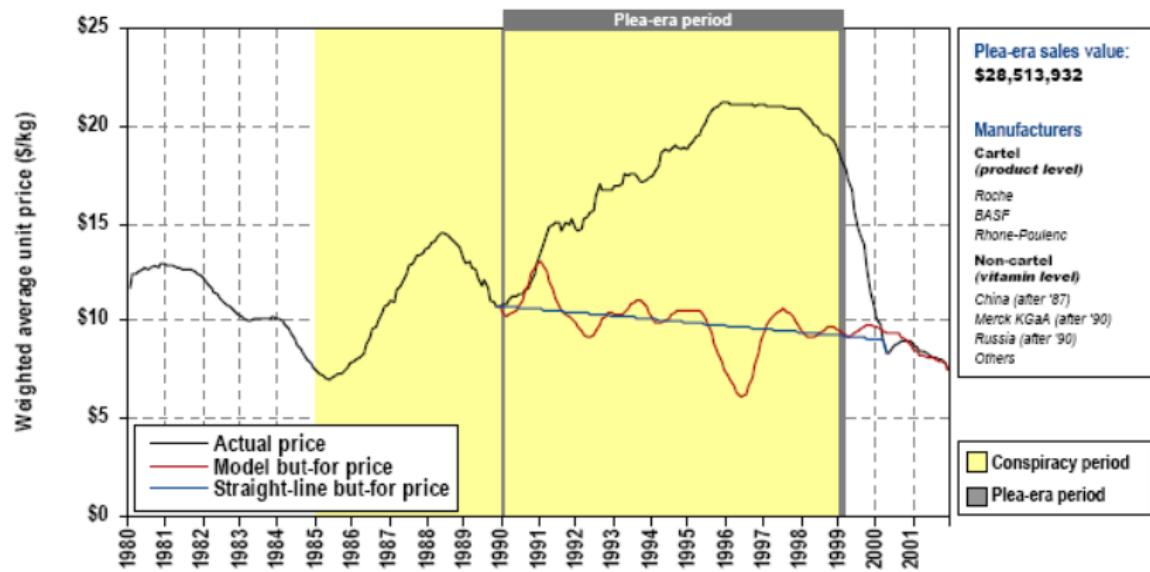
- Price data

- ▶ Pre- and/or post-cartel time periods.
- ▶ Monthly, 1980-2001

# Damages

Before and After approach: Forecasting version

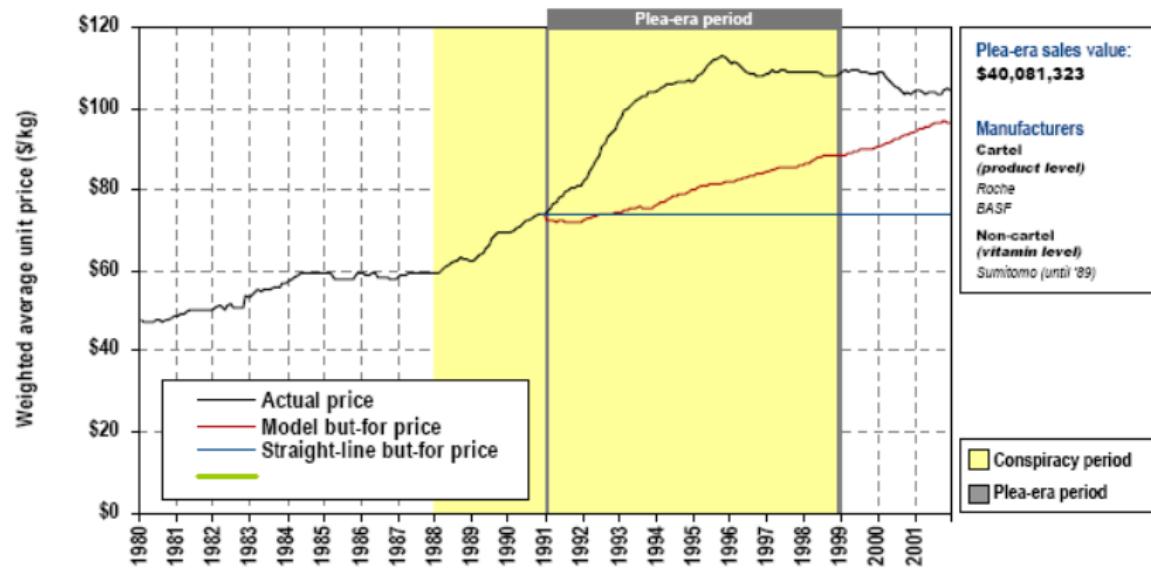
Figure 12-1: Vitamin E Acetate 50% Spray-Dried Feed Grade price and but-for price



# Damages

Before and After approach: Forecasting version

Figure 12-18: Beta Carotene 10% Cold Water Soluble USP price and but-for price



# Customer Damages

## Vitamins

Table 12A. Real Global Sanctions Relative to Real Overcharges, 1999-2005

Product Market	United States			Other Jurisdiction			World <sup>a</sup>
	Govt.	Private	Total <sup>a</sup>	Canada <sup>b</sup>	EU	Other	
<i>Percent of 2005 U.S. dollars</i>							
Beta carotene	37.9	85.9	123.8	82.3	27.2	0	54.7
Canthaxanthin	4.3	10.1	14.4	9.8	48.9	0	13.5
Biotin (vitamin H)	0	138.8	138.7	0	0	0	42.6
Choline chloride	1.3	22.4	23.6	27.9	22.2	0	13.4
Folic Acid (B9)	0	208.5	208.5	0	0	0	44.5
Vitamin A	23.4	72.8	96.2	69.6	16.5	1.9	39.5
Vitamin B1	0	131.0	131.0	0	0	0	42.0
Vitamin B2	51.0	99.4	150.3	90.0	59.1	0	74.4
Vitamin B3	46.3	62.2	108.5	86.7	0	0	39.7
Vitamin B5	30.9	75.4	106.3	89.4	57.4	0.3	66.1
Vitamin B6	0	84.8	84.8	0	0	0	15.8
Vitamin B12	0	5.1	5.6	202.4	0	0	2.7
Vitamin C	38.1	74.4	112.4	87.6	19.1	0.8	39.7
Vitamin D3	0	0	0	0	252.4	0	75.8
Vitamin E	26.6	67.0	93.6	59.5	13.4	1.2	42.8
Premixes	23.6	48.9	72.5	110.9	0	0	23.4
<b>Total</b>	<b>24.8</b>	<b>61.3</b>	<b>86.0</b>	<b>74.0</b>	<b>15.4</b>	<b>0.5</b>	<b>33.7</b>

Sources: Tables 14A and 17A

# Damages

Before and After approach: Comparison of dummy variable and forecasting versions

DV approach isolates the effect of collusion by controlling for other factors that impact price.

- Assumes relationship between price and cost and demand factors is stable over time and across conduct regimes.
- May have less accurate estimates because it presumes the relationship between price and cost and demand shifters is the same in the cartel and competitive periods
  - ▶ Collusive price tends to be less responsive to cost shocks than competitive price.
  - ▶ Can use Chow test to assess the maintained hypothesis in the DV approach
  - ▶ Also, can have dummy variables interact with cost and demand factors.

# Damages

Before and After approach: Comparison of dummy variable and forecasting versions

Forecasting approach isolates the effect of collusion by estimating the relationship between price and cost and demand factors under competition.

- Assumes relationship between price and cost and demand factors under competition is stable over time.
- May have less accurate estimates because it does not use all of the data.

# Damages

## Before and After approach: Critique

- Pre-cartel price data is old
  - ▶ Some studies find that around 20% of discovered cartels lasted more than ten years.
  - ▶ Estimates in the later years of the cartel may be inaccurate because of changes in unobserved market conditions.
- Pre-cartel price data may not be an appropriate benchmark.
  - ▶ Some cartels are preceded by a sharp price decline.
  - ▶ Firms may have cartelized in response to an *abnormally* intense bout of competition; e.g., a price war during tacit collusion.
  - ▶ But for explicit collusion, would the intensity of competition had remained at that level?
- Post-cartel price data may not be an appropriate benchmark.
  - ▶ Post-cartel prices may be above true but for prices because tacit collusion replaced explicit collusion.
  - ▶ Strategic pricing during litigation (see below).

# Customer Damages

## Difference-in-Differences approach

- Erutku and Hildebrand (2010)
- Cartel among petrol stations in Sherbrooke in Quebec province of Canada; 53 of 66 stations participated.
- Data: May 31, 2005 - May 22, 2007
  - ▶ Weekly retail prices - Sherbrooke, Quebec City, Montreal
  - ▶ Weekly wholesale prices (cost) - Quebec City, Montreal
  - ▶ 52 weeks before the Competition Bureau publicly announced its investigation and 52 weeks after it.

# Customer Damages

Difference-in-Differences approach

## Empirical model

$$P_{i,t} = \gamma_0 + \gamma_1 Sherbrooke_{i,t} + \gamma_2 Post_{i,t} + \gamma_3 Post_{i,t} \times Sherbrooke_{i,t} \\ + \beta_t w_{i,t} + \cdots + \beta_{t-n} w_{i,t-n} + \lambda Q_{i,t}$$

- $P_{i,t}$  = retail price in city  $i$  in period  $t$
- $Sherbrooke_{i,t} = 1 (0)$  if the city is Sherbrooke (Montreal or Quebec City)
- $Post_{i,t} = 1(0)$  if period  $t$  is after (before) the announcement
- $w_{i,t}$  = wholesale price (current and lagged  $n$  weeks)
- $Q_{i,t}$  = quarterly fixed effects

# Customer Damages

## Difference-in-Differences approach

- Interpretation of parameters

- ▶  $\gamma_1$  measures the average difference between retail prices in Sherbrooke and Montreal (or Quebec City)
- ▶  $\gamma_3$  measures the change in the Sherbrooke price (compared to the Montreal or Quebec City price) after the announcement.

- Difference-in-differences approach

- ▶ Before and After: Compares Sherbrooke prices during and after the conspiracy period
- ▶ Yardstick: Compares Sherbrooke prices with those of other markets - Montreal or Quebec City - for which there is no evidence of collusion.

# Customer Damages

## Difference-in-Differences approach

Empirical estimates: Control is Montreal

- Price in Sherbrooke
  - ▶ was 2.8 cents per litre higher over the entire time period, compared to Montreal
  - ▶ fell by 1.75 cpl in response to the announcement, compared to Montreal
- Average overcharge was  $2.7\% = 1.75/64$  (where 64 is average post-announcement price)
- Markups (58.8 is average post-announcement wholesale price)
  - ▶ Collusive:  $11.8\% = (65.75 - 58.8)/58.8$
  - ▶ Non-collusive:  $8.8\% = (64 - 58.8)/58.8$
  - ▶ Markup increased by  $= 34\% (.118 - .088)/.088$

# Customer Damages

## Difference-in-Differences approach

Table 6  
Differences-in-Differences Estimates on Retail Prices  $P_t$

	Montreal		Quebec City	
	Coefficient	t-Statistic	Coefficient	t-Statistic
Constant	1.35 (1.94)	.70	2.58 (1.95)	1.32
Sherbrooke <sub>t</sub>	2.80 (.57)	4.94**	-.32 (.58)	-.55
Post <sub>t</sub>	.21 (.56)	.37	-1.84 (.58)	-3.17**
Post <sub>t</sub> × Sherbrooke <sub>t</sub>	-1.75 (.80)	-2.19*	.26 (.82)	.31
Wholesale <sub>t</sub>	.73 (.05)	16.19**	.62 (.04)	15.08**
Wholesale <sub>t-1</sub>	.30 (.05)	5.87**	.35 (.04)	7.83**
Wholesale <sub>t-2</sub>	.01 (.04)	.31	.12 (.04)	2.81
$\rho$	.09 (.07)	1.25	.20 (.07)	2.68**

Note. Sherbrooke is the treatment city for both comparisons. Standard errors are in parentheses. Fixed quarterly effects are not reported. For the specification in which Montreal is the control city,  $R^2 = .91$  and the Durbin-Watson statistic (DW) = 2.00. For the specification in which Quebec City is the control city,  $R^2 = .92$ , DW = 2.03. N = 208.

\*Significant at the 5% level.

\*\*Significant at the 1% level.

# Customer Damages

## Difference-in-Differences approach

- Empirical estimates: Control is Quebec City
  - ▶ Prices in Sherbrooke were not statistically different from those in Quebec City.
  - ▶ Does this refute the yardstick approach for this case?
  - ▶ Or is this evidence of collusion in Quebec City?
- German wholesale paper (German Federal Court of Justice, 2007)
  - ▶ Dismissed the use of yardstick approach comparing cartelized market with other regional market on the concern that there was some evidence of cartels existing in all or most of the regional markets.

# Customer Damages

## Strategic post-cartel pricing

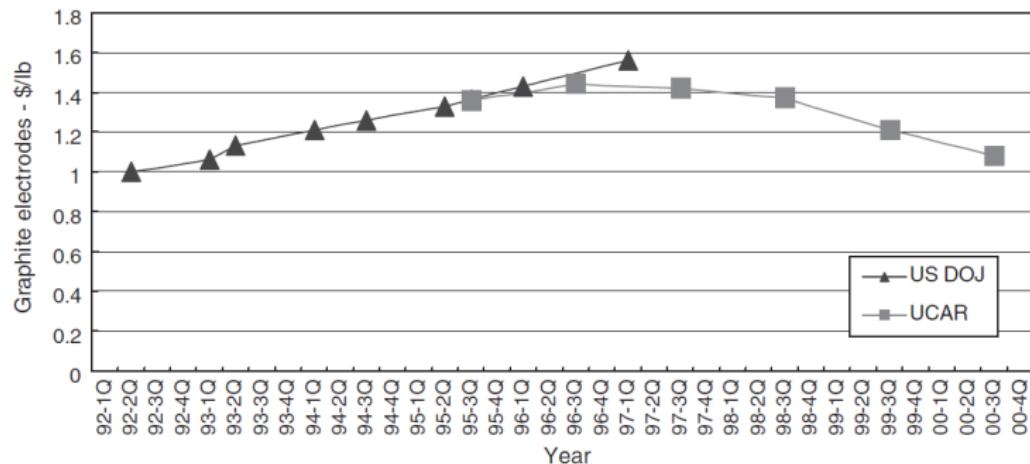
Harrington (*Journal of Industrial Economics*, 2004)

Graphite electrodes cartel

- Price-fixing conspiracy, 1992-97
- During the time of the cartel, price increased more than 50%.
- Post-cartel price path
  - ▶ No big price drop but instead a gradual decline over several years.
  - ▶ Two years after the cartel had ended, price was 20% above its pre-cartel level
  - ▶ Changes in input prices cannot explain why the post-cartel price exceeded the pre-cartel price.

# Customer Damages

## Strategic post-cartel pricing



Source: The US DOJ series is from court documents (United States of America v. Robert J. Hart, 10/19/99) and the UCAR series is from UCAR Annual Reports (1997, 1999, 2000).

# Customer Damages

## Strategic Post-Cartel Pricing

- But for price is determined according to the formula:

$$P^{bf} = \alpha P^{post} + (1 - \alpha) P^{pre}.$$

- $P^{pre}$  and  $P^{post}$  denote the average pre-cartel and post-cartel price, respectively.
- $\alpha$  is the weight given to post-cartel price data.
- Assume we have controlled for difference in demand and cost conditions across these regimes.

# Customer Damages

## Strategic Post-Cartel Pricing

- Determination of the post-cartel price.
- Each of the  $n$  colluding firms expects to pay damages equal to:

$$\theta \left( Q^c / n \right) [P^c - \alpha P^{post} - (1 - \alpha) P^{pre}]$$

- $P^c$  denotes price during the cartel regime.
- $Q^c$  denotes sales during the cartel regime.
- $\theta \geq 1$  is a multiplier applied to per period damages.
  - ▶  $\theta$  is bigger if there are treble not single damages.
  - ▶  $\theta$  is bigger if the cartel regime was longer.

# Customer Damages

## Strategic post-cartel pricing

- $\pi_1(p_1, \dots, p_n)$  denotes the profit of firm 1.
- Each of the  $n$  firms chooses the post-cartel price to maximize profit less expected penalties:

Choose  $p_1$  to maximize

$$\pi_1(p_1, \dots, p_n) - \theta(Q^c/n) [P^c - \alpha P^{post} - (1 - \alpha) P^{pre}]$$

where

$$P^{post} = \left(\frac{1}{n}\right)(p_1 + \dots + p_n)$$

is the average post-cartel price.

# Customer Damages

## Strategic post-cartel pricing

- Incentives

- ▶ A firm's price during the post-cartel regime forms part of the data set that is used to estimate the but for price.
- ▶ By pricing higher, a firm raises the estimated but for price and lowers estimated damages.

- Properties of the post-cartel price

- ▶ After the dissolution of the cartel, price is set above the (standard) non-collusive price. (Note: Firms are no longer colluding!)
- ▶ The estimated but for price is an overestimate of the true but for price.

- The upward bias in the estimated but for price is higher when

- ▶ the cartel was of longer duration (as then  $\theta$  is higher)
- ▶ there are fewer firms
  - ★ An individual firm's price has a bigger impact on the estimated but for price.
  - ★ A firm is more willing to sacrifice profit to reduce damages.

# Leniency Program

## Description

- A *leniency program* offers reduced penalties to corporations and/or individuals involved in collusion, in exchange for cooperating with enforcement authorities.
- U.S. Dept of Justice
  - ▶ 1993: Revised corporate and individual leniency program.
  - ▶ Three major revisions:
    - ★ amnesty is automatic if there is no pre-existing investigation
    - ★ amnesty may still be available even after an investigation has started
    - ★ all officers, directors, and employees who cooperate are protected from criminal prosecution.
  - ▶ Annual number of leniency applications increased 20-fold.
- European Commission - introduced leniency program in 1996, revised 2002.
- More than 50 jurisdictions have leniency programs

# Leniency Program

## Comparison of leniency programs

Before an Investigation	U.S.	EU	Japan
First firm	100%	100%	100%
Second firm	Plea	30-50%	50%
Third firm	Plea	20-30%	30%
Fourth or later firm	Plea	0-20%	0

After an Investigation	U.S.	EU	Japan
First firm	100%	30-100%	30%
Second firm	Plea	20-30%	30%
Third firm	Plea	0-20%	30%
Fourth or later firm	Plea	0-20%	0

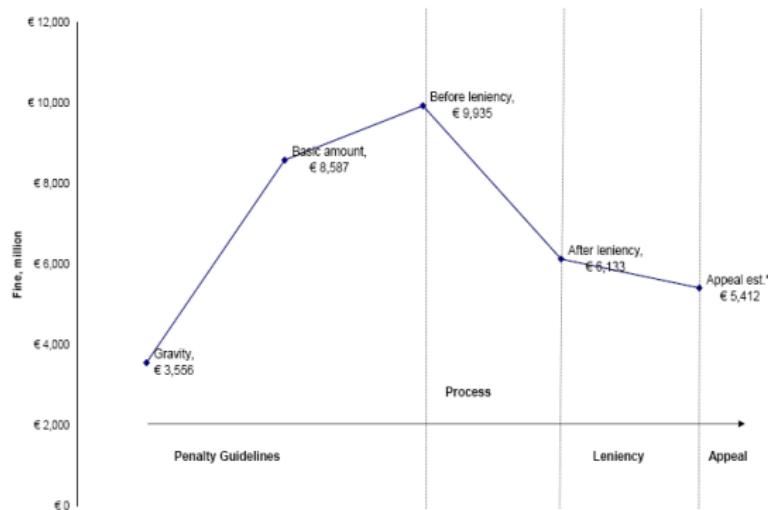
Plea - Reduced fine from plea bargaining (In the U.S., the second cartel member to plead guilty received a mean discount from the maximum recommended sentence of 75% - Connor, 2007.)

# Leniency Program

## Impact of leniency on fines, EC (1998-2007)

- EC provided partial or full leniency in 45 of 50 cartel cases.
- Leniency lowered average fines per cartel by almost 40% from 199 million to 123 million euros.

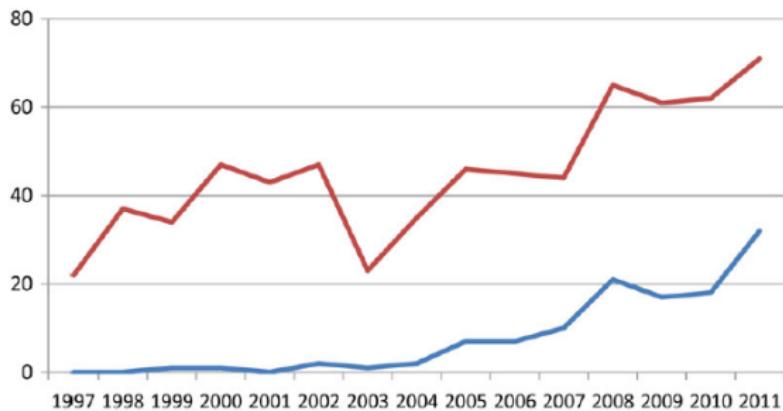
Figure 2: Aggregate fines at each step of fining process



# Leniency Program

Republic of Korea

- Red line: Number of convicted cartels
- Blue line: Number of convicted cartels with a firm awarded leniency



# Leniency Program

## Using leniency in the post-cartel environment

- Scenario

- ▶ Collusion has stopped.
- ▶ Does a firm apply for leniency?

- Model

- ▶  $f$  is the penalty avoided by receiving leniency (government fine)
- ▶  $d$  is the penalty not avoided by receiving leniency (customer damages)
- ▶  $\rho$  is the probability of a conviction when neither firm applies for leniency.
- ▶ Each auction house chooses the option that minimizes expected penalties.

		Sotheby's	
		Apply	Do not apply
Christie's	Apply	$d + \frac{f}{2}, d + \frac{f}{2}$	$d, d + f$
	Do not apply	$d + f, d$	$\rho(d + f), \rho(d + f)$

# Leniency Program

Using leniency in the post-cartel environment

Sotheby's

		Apply	Do not apply
Christie's	Apply	$d + \frac{f}{2}, d + \frac{f}{2}$	$d, d + f$
	Do not apply	$d + f, d$	$\rho(d + f), \rho(d + f)$

- Equilibria when the probability of being convicted is low:  
 $\rho(d + f) < d$  or  $\rho < \frac{d}{d+f}$ .
  - ▶ Equilibrium: Both apply for leniency.
  - ▶ Equilibrium: Both do not apply for leniency.
  - ▶ It is a coordination game. (Firms want to coordinate on "do not apply".)
- Equilibria when the probability of being convicted is high:  
 $\rho(d + f) > d$  or  $\rho > \frac{d}{d+f}$ .
  - ▶ Unique equilibrium: Both apply for leniency.
  - ▶ It is a Prisoners' Dilemma game. (Dominant strategy is "apply".)

# Leniency Program

## Using leniency in the post-cartel environment

An objective of competition policy is to turn a coordination game into a Prisoners' Dilemma by

- increasing the fraction of penalties avoided through leniency (decreasing  $\frac{d}{d+f}$ ).
  - ▶ Example: U.S. Antitrust Criminal Penalty Enforcement and Reform Act (2004) expanded leniency so that a firm receiving amnesty is only liable for single (not treble) customer damages.
- raising the probability of a conviction without use of the leniency program (increasing  $\rho$ ).
  - ▶ Example: whistleblower programs

# Leniency Program

## Whistleblower programs

- Korea Fair Trade Commission (2005) - Rewards of up to 1 billion Korean Won (approx. 800,000€)
- UK's Office of Fair Trading (2008) - Rewards of up to £100,000 (approx. 135,000€)
- Hungary (2010) - at least 1% of government fine up to a maximum of 50 million forints (approx. 160,000€)
- Creating a U.S. False Claims Act for Section 1 violations?
  - ▶ A non-government employee can file actions for fraud against federal government contractors.
  - ▶ Whistleblower is entitled to 15-25% of the government's total recovery.

# Leniency Program

## Whistleblower programs

- U.S. General Accountability Report (2011):

*DOJ Antitrust Division officials acknowledge that a whistleblower reward could increase ... the number of cartels detected. However, these officials maintain that the potential benefits would be outweighed by the ... disadvantages, most importantly the threat to witness credibility.*

- *Recommendation:* Allow a whistleblower's company to apply for leniency.
  - ▶ If it induces a leniency application then the whistleblower's credibility is substantiated.
  - ▶ Enhances an employee's incentive to report.

# Leniency Program

## Leniency to destabilize collusion

- Motta and Polo (*International Journal of Industrial Organization*, 2003), Harrington (*Journal of Industrial Economics*, 2008)
- Scenario
  - ▶ Firms are currently colluding.
  - ▶ Does a firm want to collude or cheat and, if it cheats, apply for leniency?
  - ▶ How does leniency affect the stability of the collusive agreement?
- Duopoly model:  $\pi^d > \pi^c > \pi^{nc} > \pi^x$ .

Duopoly model (profits)

Firm 2

Firm 1		Collude	Compete
	Collude	$\pi^c, \pi^c$	$\pi^x, \pi^d$
	Compete	$\pi^d, \pi^x$	$\pi^{nc}, \pi^{nc}$

# Leniency Program

Leniency to destabilize collusion

Sequence of moves in each period:

- ① Firms learn the value of  $\rho$  which is the likelihood of being discovered and convicted.
  - ▶  $\rho$  randomly changes over time.
- ② Each firm decides whether to *collude* or *compete*, and whether or not to apply for leniency.
- ③ Discovery of the cartel
  - ▶ Suppose at least one firm applied for leniency.
    - ★ Collusion stops, the firm receiving amnesty pays a reduced fine of  $\theta F$  (where  $0 \leq \theta < 1$ ), and the other firm pays a fine of  $F$ .
  - ▶ Suppose no firm applied for leniency.
    - ★ With probability  $\rho$ , the cartel is caught, collusion stops, and each firm pays a fine of  $F$ .
    - ★ With probability  $1 - \rho$ , collusion continues.

# Leniency Program

## Leniency to destabilize collusion

- If a firm colludes, its payoff is

$$\pi^c + \delta \times [(1 - \rho) \times V^c + \rho \times (V^{nc} - F)]$$

- ▶  $\pi^c$  is collusive profit.
  - ▶  $V^c$  is the value of future profits from continuing to collude.
  - ▶  $V^{nc}$  is the value of future profits when firms do not collude.
  - ▶  $\delta$  is the weight attached to future profit, where  $0 < \delta < 1$ .
  - If a firm cheats and does not apply for leniency, its payoff is
- $$\pi^d + \delta \times V^{nc} - \delta \times \rho \times F.$$
- ▶  $\pi^d$  is the profit from cheating.
  - If a firm cheats and applies for leniency, its payoff is

$$\pi^d + \delta \times V^{nc} - \delta \times \theta \times F.$$

# Leniency Program

Leniency to destabilize collusion

- It is optimal to collude when

$$\pi^c + \delta \times [(1 - \rho) \times V^c + \rho \times (V^{nc} - F)] \geq \pi^d + \delta \times V^{nc} - \delta \times \min \{\rho, \theta\} \times F.$$

- How does more leniency (lower  $\theta$ ) affect the condition for a stable collusive agreement?
- Deviator Amnesty Effect - leniency reduces penalties when a firm cheats.
  - ▶ When a firm cheats, leniency reduces the penalty when  $\theta < \rho$ .

# Leniency Program

## Leniency to destabilize collusion

- It is optimal to collude when

$$\pi^c + \delta \times [(1 - \rho) \times V^c + \rho \times (V^{nc} - F)] \geq$$

$$\pi^d + \delta \times V^{nc} - \delta \times \min \{\rho, \theta\} \times F.$$

- Cartel Amnesty Effect - leniency can either raise or lower future expected penalties.
  - ▶ In the event of cartel collapse (which occurs when  $\rho$  is sufficiently high), firms may apply for leniency.
  - ▶ Expected penalties can be higher (then  $V^c$  is lower) or lower (then  $V^c$  is higher).
  - ▶ If  $\rho > \theta$  then firms will apply but if  $\frac{n-1+\theta}{n} > \rho$  then expected penalties are higher.
- Generally, net effect is that *leniency makes collusion less stable*.

# Leniency Program

Measuring the effect of a leniency program: Experimental evidence

Bigoni, Fridolfsson, Le Coq, and Spagnolo (*RAND Journal of Economics*, 2010)

- Two subjects decide
  - ▶ whether to communicate
  - ▶ what price to set
  - ▶ whether to apply for leniency (if they communicated)
- Stage 1 (communication): Each subject decides whether to push a button to express a desire to communicate.
  - ▶ If both pressed the button then they communicate about prices through the simultaneous choice of a "minimum acceptable price".
  - ▶ Communication lasts for 30 seconds.
  - ▶ Communication makes them liable for penalties.

# Leniency Program

Measuring the effect of a leniency program: Experimental evidence

- Stage 2 (price and leniency): Subjects choose prices from  $\{0, 1, \dots, 12\}$  and, if they communicated, decide whether to apply for leniency.
- Stage 3 (leniency): Prices are revealed and, if they communicated and no one applied for leniency, they again decide whether to apply for leniency.
- Stage 4 (detection): If they communicated and no subject applied for leniency then a fine is levied with some probability.
- A firm with leniency pays no fine; the other firm pays the full fine.

# Leniency Program

Measuring the effect of a leniency program: Experimental evidence

- Competition solution: price = 3. Monopoly solution: price = 9
- Price is higher when subjects communicate (form a cartel).

Effect of communication on prices

Fine	Probability of Fine	Average Price	
		No communication	Communication
200	0.10	3.6	5.7
1000	0.02	3.5	7.2
300	0.20	3.2	6.1
1000	0.00	3.9	7.9

# Leniency Program

Measuring the effect of a leniency program: Experimental evidence

- Treatments: No Leniency Program, Leniency Program
- A leniency program reduced the likelihood of communication (cartel formation)

Effect of leniency program on the amount of communication

Fine	Probability of Fine	Rate of Communication	
		No leniency	Leniency
200	0.10	.590	.344
1000	0.02	.378	.251
300	0.20	.452	.436
1000	0.00	.538	.280

# Leniency Program

Measuring the effect of a leniency program: Experimental evidence

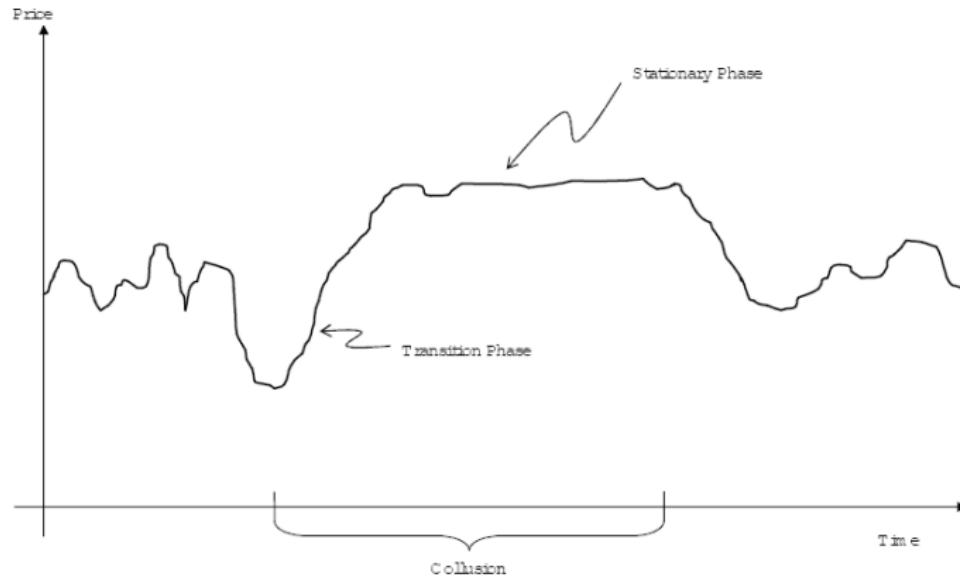
Fine	Probability of Fine	Expected Fine	Rate of Communication	Average Price
200	0.10	20	.344	5.7
1000	0.02	20	.251	7.2

- With a leniency program, higher fines (holding per period expected fine fixed)
  - reduce communication (cartel formation)
  - raise collusive price conditional on communication (forming a cartel)
- Higher fines are
  - reducing "trust" and shifting the equilibrium?
  - allowing for a more severe (credible?) punishment for undercutting price?

# Understanding Cartel Price Paths

# Properties of Cartel Price Paths

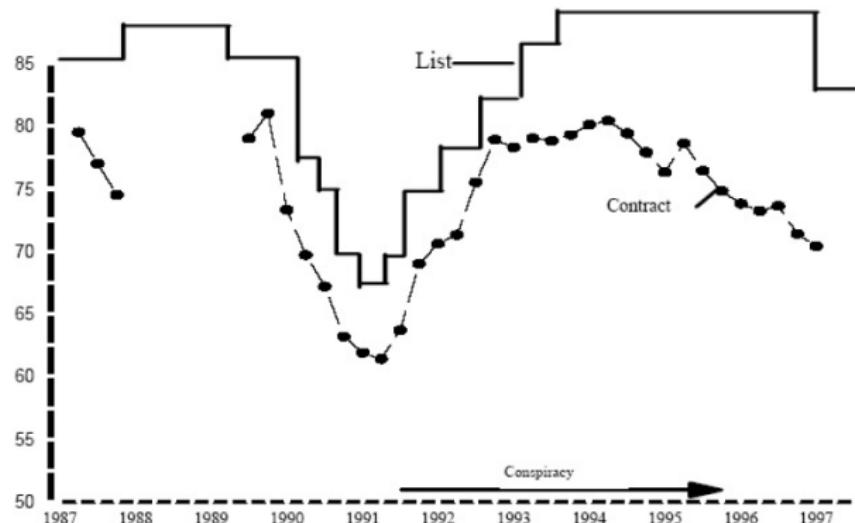
## Canonical Cartel Price Path



# Properties of Cartel Price Paths

## Citric Acid Cartel

- Transition phase in which price gradually rises.
- Cartel formation is preceded by price decline.



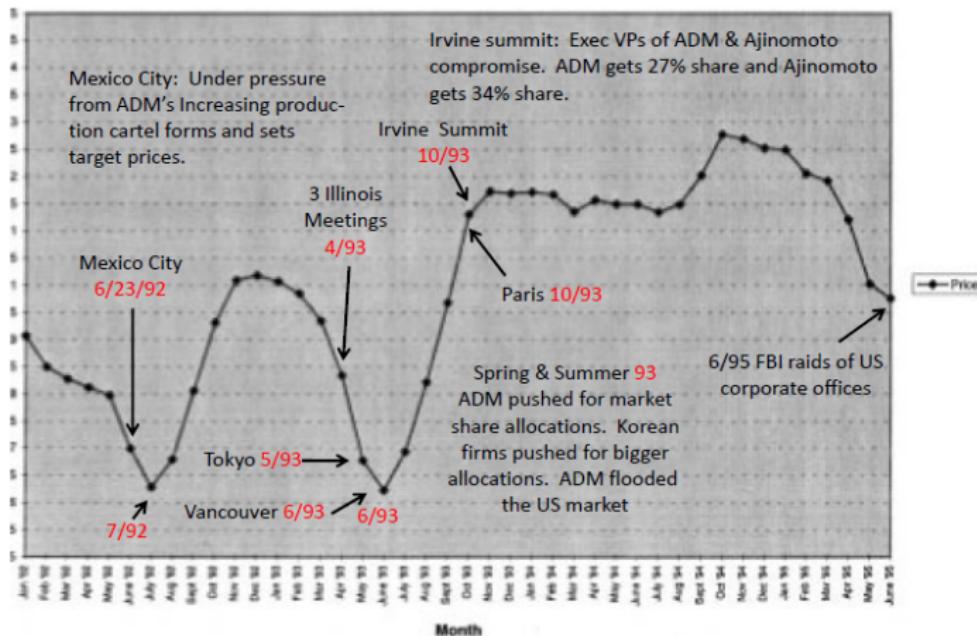
Connor (2001)

# Properties of Cartel Price Paths

## Lysine Cartel

- Transition phase in which price gradually rises.

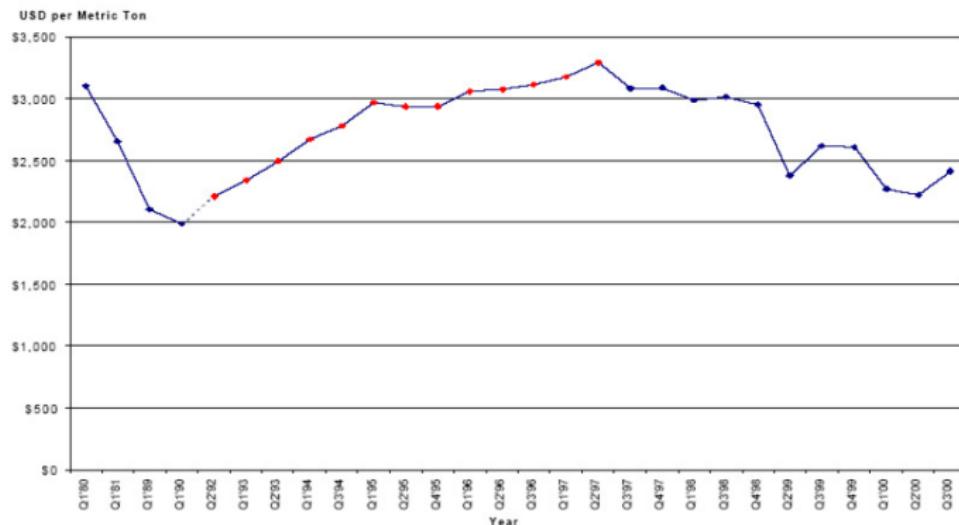
### Lysine Prices and the Conspiracy's History



# Properties of Cartel Price Paths

## Graphite Electrodes Cartel

- Transition phase in which price gradually rises.
- Cartel formation is preceded by price decline.



Levenstein and Suslow (2001)

# Properties of Cartel Price Paths

## Frozen Perch Cartel

- Low price variance

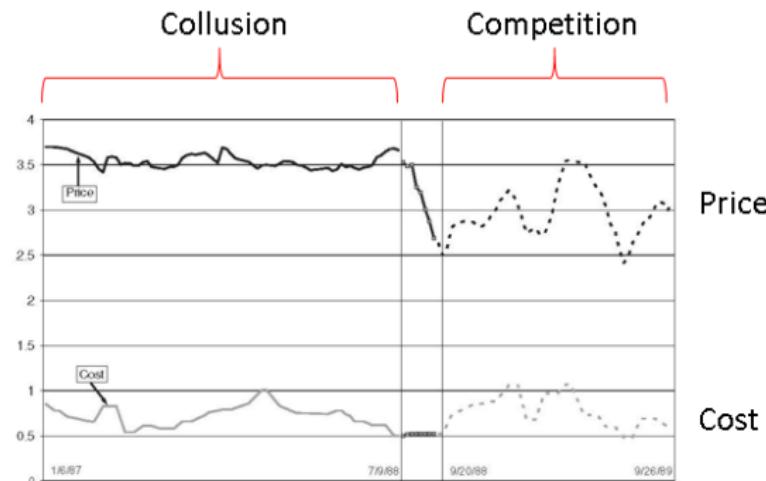


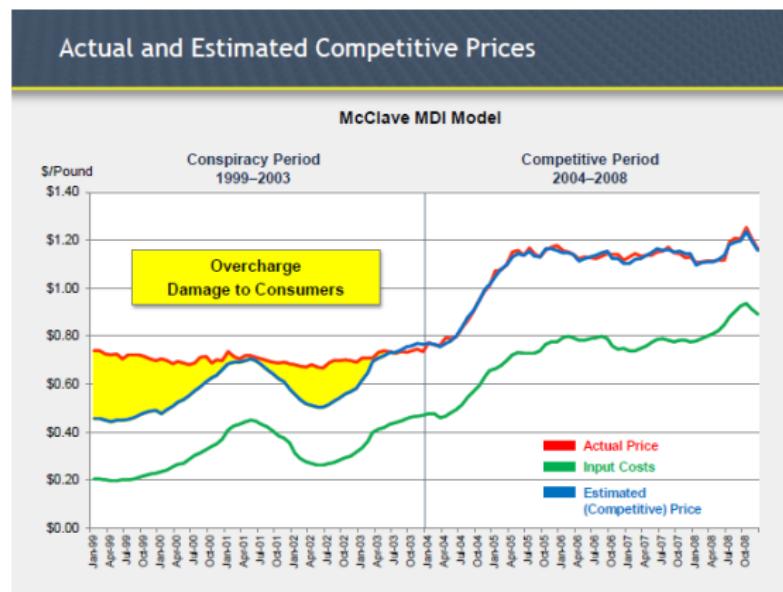
Fig. 1. Frozen perch prices and costs: 1/6/87–9/26/89.

Abrantes-Metz, Froeb, Geweke, and Taylor (2005)

# Properties of Cartel Price Paths

## Urethane Cartel

- Low price variance



Plaintiff's Response Brief (2014)

# Properties of Cartel Price Paths

## Summary (Tentative)

- ① Cartel formation is preceded by price decline.
- ② Transition phase in which price gradually rises.
- ③ Stationary phase in which price variance is low.

# Developing a Theory of Cartel Pricing that Fits the Facts

- Harrington and Chen (*International Journal of Industrial Organization*, 2006)
- Sources of price movements without a cartel
  - ▶ Common firm cost is stochastic (random walk)
  - ▶ Competitiveness of the non-collusive environment (measured by markup on cost) is stochastic (random walk)
    - ★ Interpretation: competition vs. tacit collusion

# Developing a Theory of Cartel Pricing that Fits the Facts

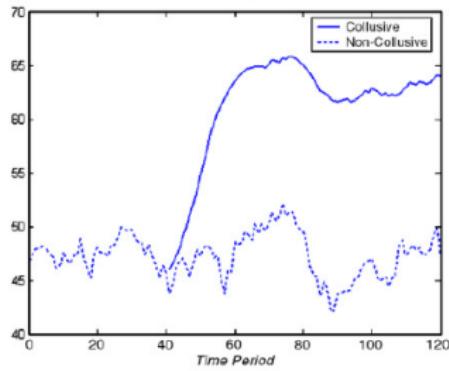
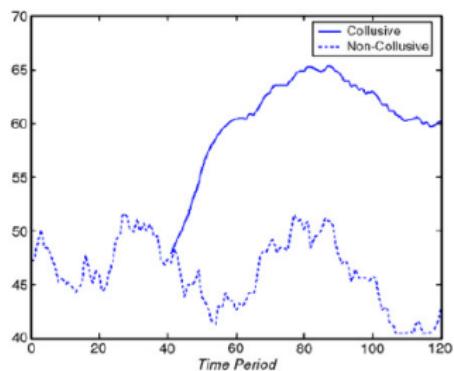
- Cartel formation
  - ▶ Firms form a cartel when the value to colluding exceeds the value to competing.
  - ▶ Timing of cartel formation depends on
    - ★ current competitiveness of the non-collusive environment.
    - ★ current cost.
- Cartel detection
  - ▶ Occurs when buyers become "suspicious".
  - ▶ Buyers are suspicious when recent price changes are "surprising" given past price changes.
- Cartel optimally chooses price in any period taking into account its impact on:
  - ▶ current profit
  - ▶ buyers' suspicions and the probability of being caught
  - ▶ accumulated penalty (in the event it is caught)

# Developing a Theory of Cartel Pricing that Fits the Facts

Sample collusive price paths

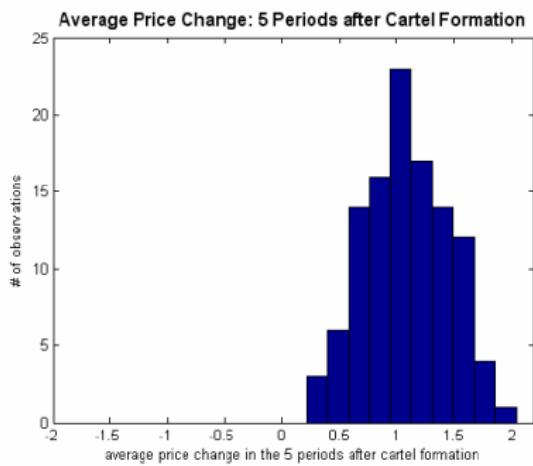
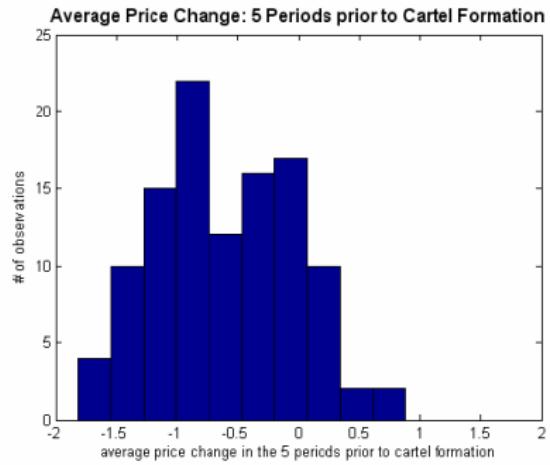
**Property:** Transition phase in which price gradually rises.

**Property:** Stationary phase in which price variance is low.

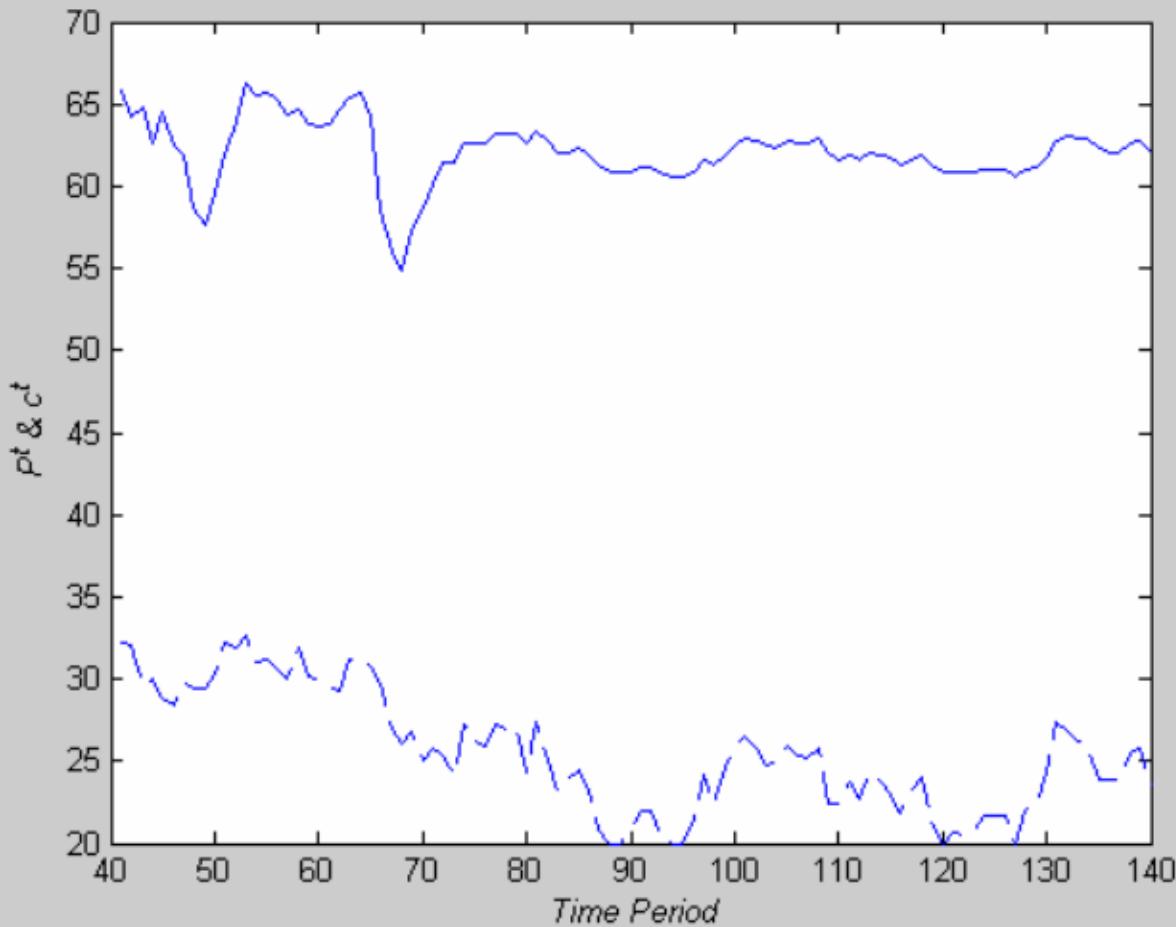


# Developing a Theory of Cartel Pricing that Fits the Facts

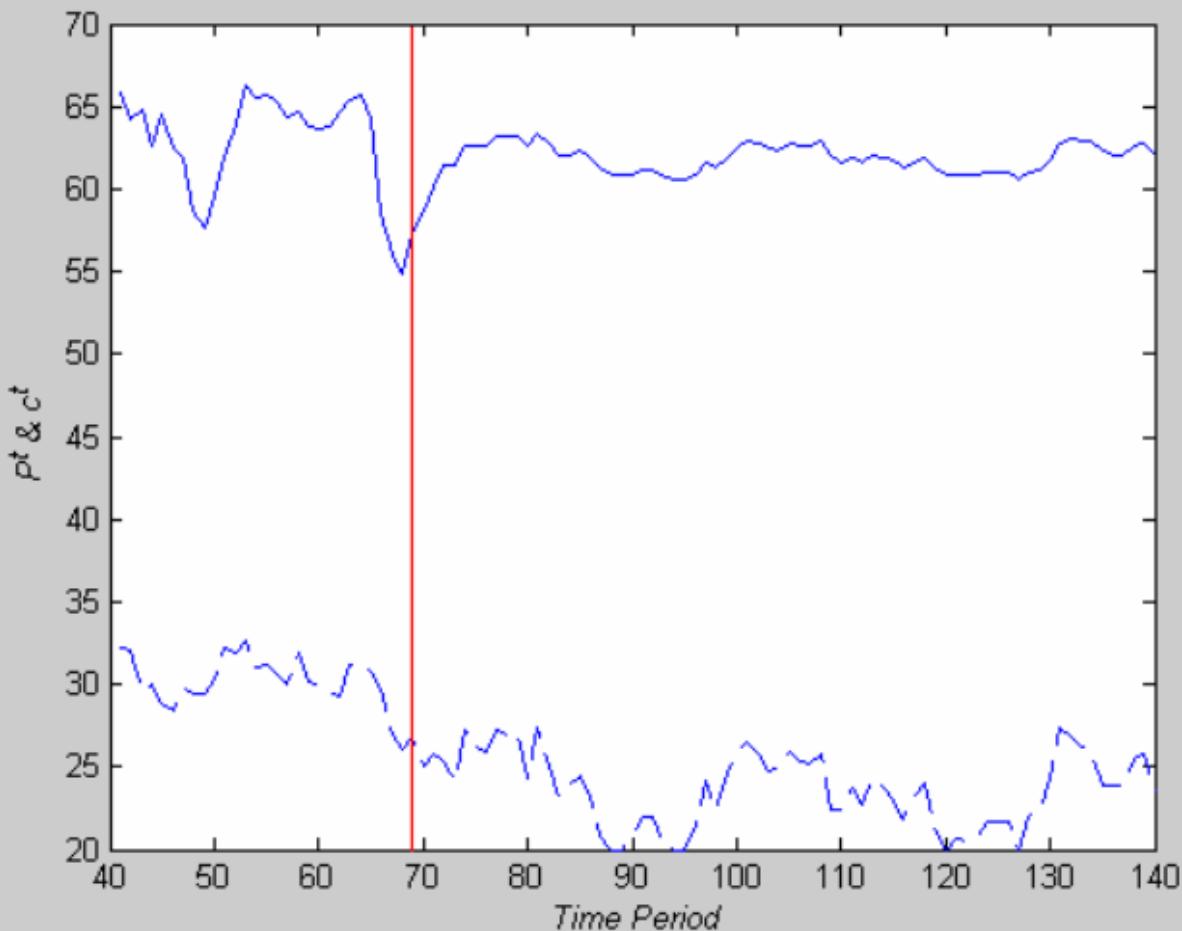
**Property:** Cartel formation is preceded by a price decrease (and followed by a price increase).



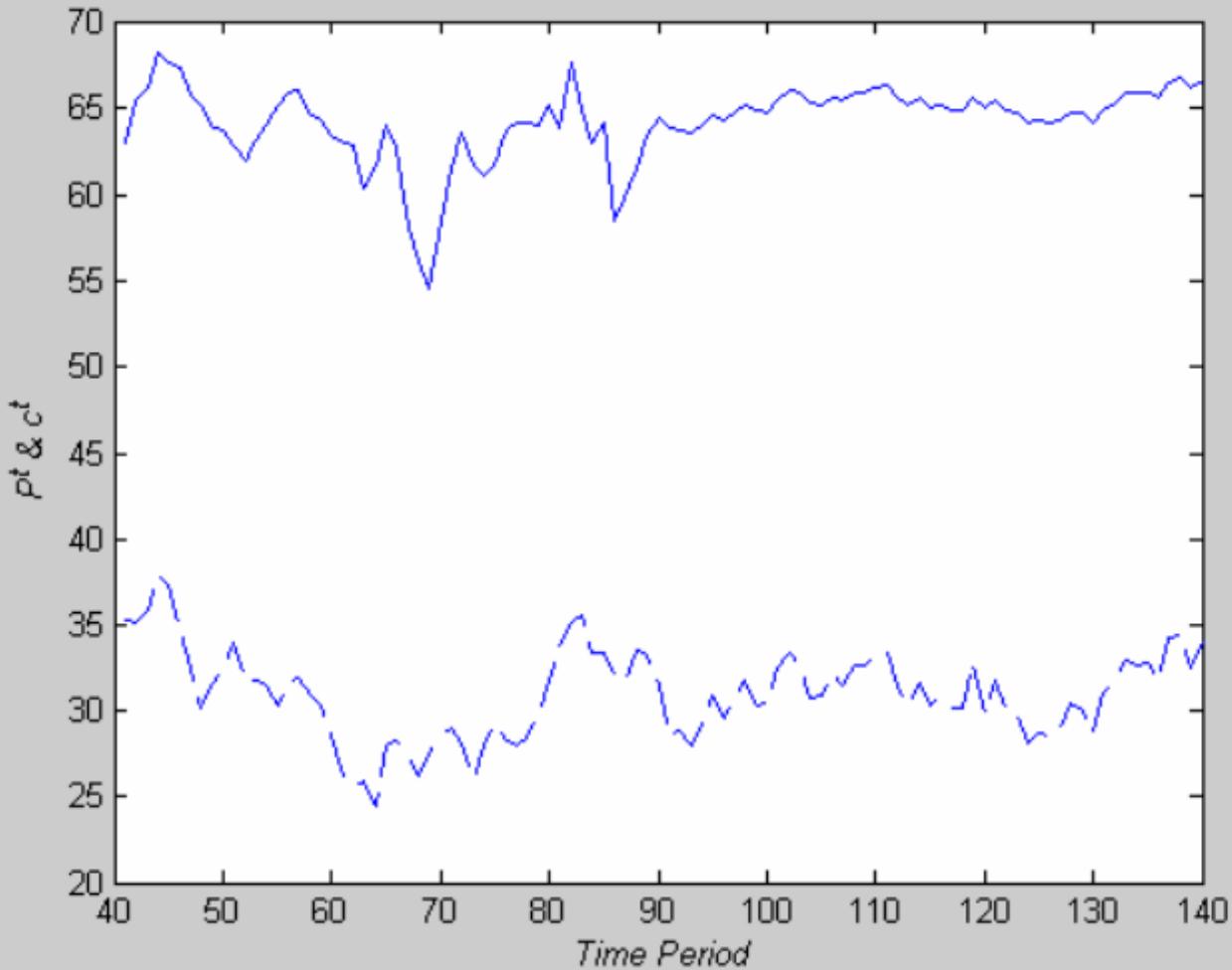
## Price and Cost Paths



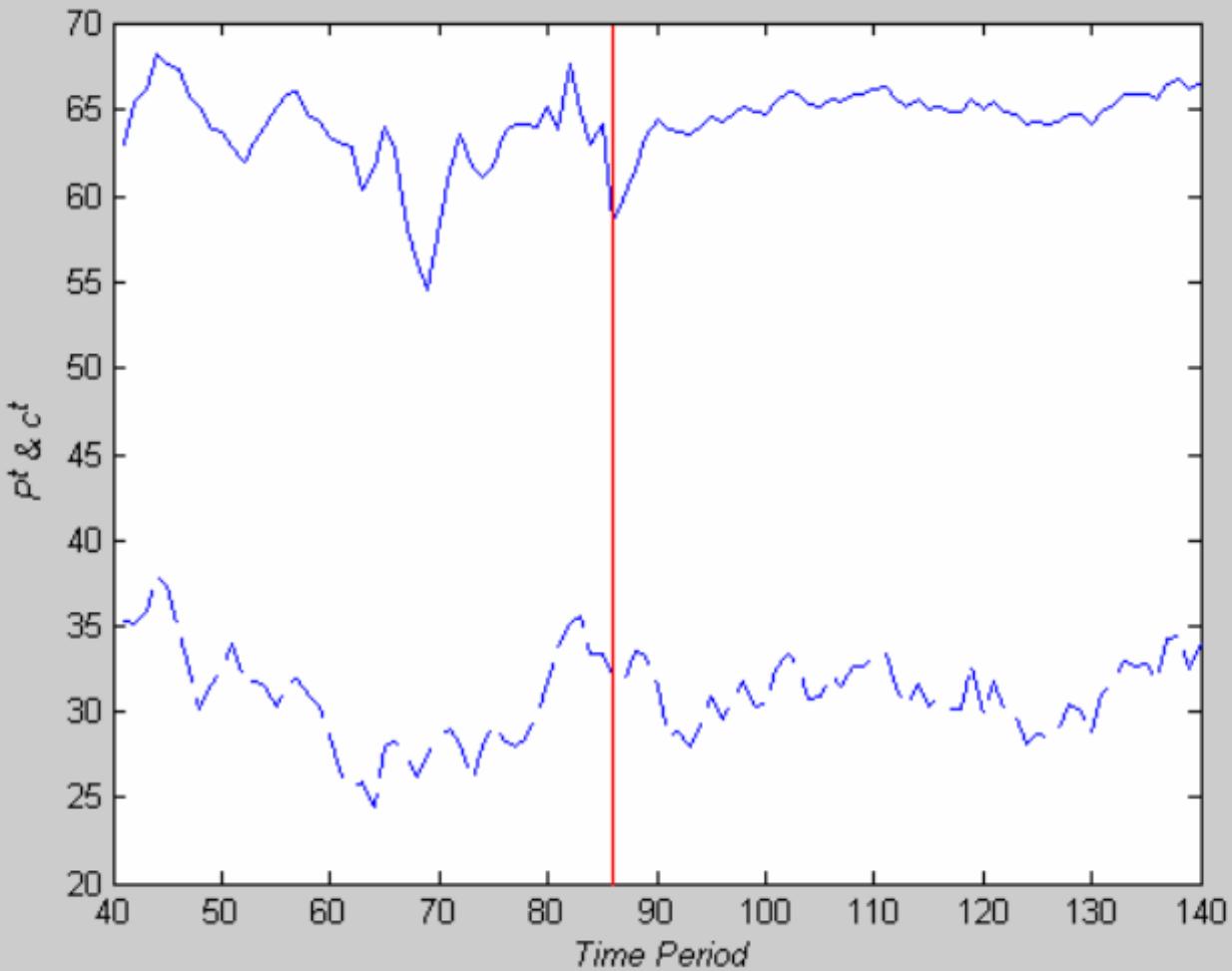
## Price and Cost Paths



## Price and Cost Paths



## Price and Cost Paths



# Detecting Cartels

# Detecting Cartels

## Overview

- Stages in the process
  - ① Screening - identifying markets where collusion is suspected.
  - ② Verification - systematically distinguishing between collusion and competition.
  - ③ Prosecution - developing economic evidence to determine guilt.
- Empirical methods for screening
  - ▶ Structural: Identifying industry traits conducive to collusion.
  - ▶ Behavioral: Identifying collusive behavioral patterns.
- Screening has been performed with some success in Brazil, Mexico, The Netherlands, South Africa.
- Deutsche Bahn has a cartel detection team comprising lawyers and economists.

# Detecting Cartels

## Structural approach to screening

- Structural approach identifies markets with traits conducive to the formation of a cartel.
- Factors conducive to cartel formation include:
  - ▶ fewer firms
  - ▶ more homogeneous products
  - ▶ less volatile demand, etc.
- Problem of too many false positives
  - ▶ Imagine the "ideal" market for collusion: two firms, homogeneous products, stable demand, etc.
  - ▶ In practice, only a small fraction of such markets probably have cartels.
  - ▶ The reason is that there are many omitted (unmeasured) factors that influence whether a cartel forms.

## Detecting Cartels

## Behavioral approach to screening

- Structural approach is based on data about the industry which makes it more likely that a cartel *will form*.
  - Behavioral approach uses data that may itself be evidence that a cartel *has formed*.
  - Questions to be addressed
    - ▶ What are current methods for identifying collusion?
    - ▶ How easily can a cartel beat a test for collusion?

# Detecting Cartels

Overview of behavioral empirical methods

- ① Is behavior inconsistent with competition?
- ② Is there a structural break (that is, statistically distinguishable change) in behavior?
- ③ Does the behavior of suspected colluding firms differ from that of competitive firms?
- ④ Does a collusive model fit the data better than a competitive model?
- Methods vary according to
  - ▶ the type of data that is required
  - ▶ the need for prior information about collusion
  - ▶ reduced form or structural estimation methods

# Is Behavior Inconsistent with Competition?

- Specify a class of competitive models and identify properties of equilibrium.
- Do these properties hold?
  - ▶ If “yes”, then there is no evidence of collusion.
  - ▶ If “no”, then this could be due to misspecification of
    - ★ cost and demand assumptions
    - ★ behavioral assumptions (collusion)
- Is the manner in which results differ from competition consistent with some model of collusion?

# Is Behavior Inconsistent with Competition?

Application: Procurement auctions for highway maintenance projects

- Bajari and Ye (*Review of Economics and Statistics*, 2003.)
- Key maintained hypothesis: After conditioning on publicly available information, bidders' costs are independent.
- Test: Is the unexplained part of one firm's bid independent of the unexplained part of another firm's bid?
- Implementation
  - ▶ Estimate a pricing equation for each firm.

$$BID_{i,t} = \beta_0 + \beta_1 DISTANCE_{i,t} + \beta_2 CAPACITY_{i,t} + \dots + \varepsilon_{i,t}$$

- ▶ Calculate the residuals of each firm's bid function,  $\varepsilon_{i,t}$ .
- ▶ Test the hypothesis that the coefficient of correlation for  $\varepsilon_{i,t}$  and  $\varepsilon_{j,t}$  is zero.

# Is Behavior Inconsistent with Competition?

Application: Procurement auctions for highway maintenance projects

- Testing for independence
  - ▶ Independence was rejected for four pairs of firms.
  - ▶ Only one of those four pairs (firms 2 and 4) bid against each other regularly.
- Suppose the test of independence fails.
  - ▶ Model is misspecified and collusion is one possible source of misspecification.
  - ▶ Is the failure of the test consistent with some model of collusion?
    - ★ Consider a collusive scheme in which cartel members, who are not designated to bid to win, submit phony bids.
- Suppose the test of independence doesn't fail.
  - ▶ Firms could still be colluding as the cartel members can pass the test by appropriately scaling their "competitive bids".
- Disadvantages
  - ▶ Doesn't test for collusion.
  - ▶ Omitted variables and misspecification are serious problems.

# Is There a Structural Break in Behavior?

- (Collusive) sources of structural breaks
  - ▶ Formation of a cartel.
  - ▶ Demise of a cartel.
- Approach: Find a breakpoint
  - ▶ Search without prior knowledge.
  - ▶ Candidate breakpoint: Events conducive to cartel formation.
  - ▶ Candidate breakpoint: Events that make collusion more effective.
- Example: Formation of a trade association
  - ▶ Trade associations are used as a cover for cartel meetings.
  - ▶ Amino Acid Manufacturers International Association was formed by members of the lysine cartel.

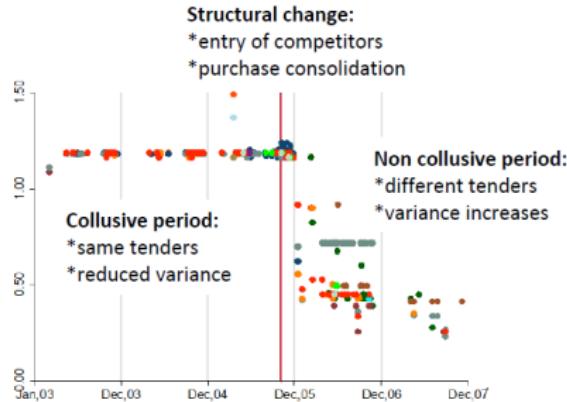
# Is There a Structural Break in Behavior?

- Test: Is there a break in the relationship among firms' prices around the time of the creation of the association?
- Oklahoma Highway Department only started receiving identical bids at procurement auctions some time after the Asphalt Refiners Association was formed.
- Warnings
  - ▶ One might expect structural change even if firms are not colluding.
    - ★ Trade association could lead to enhanced correlation of firms' prices because it promotes the exchange of information which then homogenizes firms' beliefs.
    - ★ Would it result in higher average prices?
  - ▶ Identify various implications of a trade association which are specific to collusion.

# Is There a Structural Break in Behavior?

- Mexico: Government procurement auctions for generic drugs

Figure 1. Medicine 1 average price 1



- Issues with a structural break test

- ▶ Doesn't test for collusion.
- ▶ There can be sources of structural change other than a switch from competition to collusion.

# Does the Behavior of Suspected Colluding Firms Differ from that of Unsuspected Firms?

- Approach
  - ▶ Estimate a model of (suspected) colluders' behavior.
  - ▶ Estimate a model of competitive firms' behavior.
  - ▶ Compare them.
- Common implementation
  - ▶ Estimate reduced form price equations - regressing price on cost and demand shifters - for colluding firms and non-colluding firms.
  - ▶ Test: Are the estimated coefficients statistically different?

# Does the Behavior of Suspected Colluding Firms Differ from that of Unsuspected Firms?

- Reality check
  - ▶ Do the non-colluding firms act in a manner consistent with a competitive model?
  - ▶ Do the colluding firms act in a manner consistent with some model of collusion?
- Sources of competitive benchmark.
  - ▶ Unsuspected firms in the same market.
  - ▶ Firms in a comparable market where collusion is not suspected.
  - ▶ Suspected firms during a time when they are not thought to have been colluding.
    - ★ Before cartel formation or after cartel collapse.
    - ★ Breakdown of collusion during the cartel regime.

# Does the Behavior of Suspected Colluding Firms Differ from that of Unsuspected Firms?

Procurement auctions for school milk

- Porter and Zona (*RAND Journal of Economics*, 1999)
- A market is a school district where each district awards an annual contract for the supply of school milk.
- Explaining bid submission
  - ▶ Estimated the decision of a firm to bid on a contract.
  - ▶ Under competition (after controlling for all public information), the decision to submit a bid should be independent across firms.
- Results
  - ▶ Independence was rejected: If one suspected firm submitted a bid, it was more likely the others did as well.
  - ▶ Collusive story: Non-designated winners submitted phony bids to give the appearance of competition.
  - ▶ (Smart but not smart enough: In an attempt to appear competitive, firms provided evidence that they were colluding!)

# Does the Behavior of Suspected Colluding Firms Differ from that of Unsuspected Firms?

Procurement auctions for school milk

- Explaining bid levels
  - ▶ Estimated the relationship between a firm's bid and cost and demand factors such as distance between district and plant, district enrollment, etc.
  - ▶ Test: Do the bids of suspected firms respond the same way as the bids of competitive (unsuspected) firms?
- Results
  - ▶ Competitive firms' bids were found to be increasing in the distance between the processing plant and the school district.
  - ▶ Bids of the three suspected colluding firms were
    - ★ less sensitive to distance compared to competitive firms
    - ★ and two of them had their bids *decreasing* in distance.

# Does the Behavior of Suspected Colluding Firms Differ from that of Unsuspected Firms?

Procurement auctions for school milk

- Reality check: Can we tell a coherent collusive story?
- Collusion will be effective only in those districts/markets for which non-colluding firms are neither numerous nor have a significant cost advantage (such as being the closest processors).
- Colluding firms may then be submitting higher bids in districts for which they have a distance advantage - so collusion works - and, in more distant markets, are forced by competition to submit lower bids (in spite of the higher transportation costs).

# Does the Behavior of Suspected Colluding Firms Differ from that of Unsuspected Firms?

## Issues

- Finding a competitive benchmark.
  - ▶ This may require prior information as to which firms may be colluding, in which markets there may be collusion, and over what time there may have been collusion.
  - ▶ It is not useful with all-inclusive cartels such as the vitamins cartel.
- Endogeneity of the competitive benchmark.
  - ▶ Why aren't some firms suspected of colluding? Will the empirical analysis pick up all relevant differences?
  - ▶ Why is there suspected collusion in one market and not in another comparable one? Suppose there is tacit collusion in the unsuspected market? The "competitive" benchmark is then not so competitive.

# Does a Collusive Model Fit the Data Better than a Competitive Model?

- Specify a model of collusion and a model of competition in which firms' prices depend on cost and demand shifters.
- Estimate the models and see which fits the data better.
- The competitive benchmark is estimated rather than identified ex ante.

# Does a Collusive Model Fit the Data Better than a Competitive Model?

Wheat auctions in India

Banerji and Meenakshi (*American Journal of Agricultural Economics*, 2004)

- Industry structure: three large buyers (with a total market share of about 45%).
- Competitive model
  - ▶ Auction is between three large buyers and many small buyers.
- Collusive model
  - ▶ Bid rotation in which the three buyers decide on the buyer to participate in a particular auction.
  - ▶ Auction is, effectively, between one large buyer and many small buyers.
- Result: Collusive model fits the data better than the competitive model.

# Does a Collusive Model Fit the Data Better than a Competitive Model?

Procurement auctions in Japan

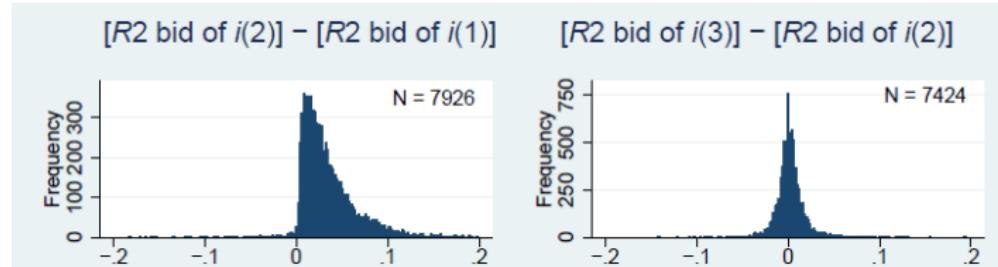
Kawai and Nakabayashi (Working Paper, 2014)

- Japanese procurement auctions for construction projects (2003-06) - \$14 billion/year (3% of GDP)
- First-price sealed bid auction in which the lowest bid wins the project
- If the lowest bid > secret reserve price then there is a second auction (30 minutes after the first auction)
- Consider those auctions which went to a second round and the difference between the lowest and next-lowest bids is very small (< 1% of reserve price)
  - ▶ Under competition, each bidder should have similar probabilities of winning in the second round
  - ▶ In practice, the lowest bidder from the first round submitted the lowest bid in 96.7% of auctions

# Does a Collusive Model Fit the Data Better than a Competitive Model?

Procurement auctions in Japan

- Compare the second round bids for the lowest and second lowest bidders in the first round, and the second lowest and third lowest bidders in the first round
  - ▶ Difference in the 2nd round bids of the third lowest and second lowest bidders from the 1st round is symmetric around zero.
  - ▶ Difference in the 2nd round bids of the lowest and 2nd lowest bidders from the first round is almost always positive.



- Pattern is consistent with a scheme in which there was a bidding ring which designated one member to submit the lowest bid in both

# Does a Collusive Model Fit the Data Better than a Competitive Model?

## Issues

- Advantages
  - ▶ Does not require prior information about who may or may not be colluding.
  - ▶ Applicable even if the cartel is all-inclusive (all firms and all markets) and data is only available during the cartel regime.
- Disadvantage - misspecification bias
  - ▶ Specified incorrect competitive model and that is why the collusive model out-performed.
  - ▶ Specified incorrect collusive model and that is why the competitive model out-performed.
  - ▶ Misspecification bias is apt to be a more serious concern for the collusive model as there are more collusive models than competitive models.

# Does a Collusive Model Fit the Data Better than a Competitive Model?

Procurement auctions for school milk

- Pesendorfer (*Review of Economic Studies*, 2000)
- Example of misspecification with respect to the collusive model.
- In the Florida school milk cartel, firms used side payments.
  - ▶ Market shares fluctuated over time because contracts could go to the most efficient firm with the other firms receiving transfers as compensation.
- In the Texas school milk cartel, there was no evidence of side payments.
  - ▶ Market shares were stable.

# Can a cartel beat these tests?

Some tests are easy to beat.

- Consider the test for independence of bids (Porter and Zona, 1993; Bajari and Ye, 2003).
- Firms' bids are independent under the competitive model and lack of independence is taken as evidence consistent with collusion.
- This test can be easily beat if cartel members scale up their "competitive bids" to maintain independence. (E.g., everyone bids 50% higher.)

# Can a cartel beat these tests?

Some tests are costly to beat.

- Consider the result that bids for school milk contracts are decreasing in distance (between the processor and the district).
  - ▶ An unconstrained cartel finds it optimal to bid high in nearby collusive markets but bid low in more distant competitive markets.
  - ▶ Cartel members could avoid failing this test by making their bids increasing in distance but it would lower profit.
  - ▶ In choosing their bids, a smart cartel would trade-off cartel profit with the probability of detection.
  - ▶ It may reduce the power of a test but not eliminate it.
- Identifying a structural break.
  - ▶ Collusion must imply a change in the price-generating process; in principle one should be able to pick up a break by monitoring the average price change.
  - ▶ A cartel can reduce the power of this test by manipulating price changes but it foregoes profit in doing so.

## General References

- Harrington, Joseph E. Jr., "How Do Cartels Operate?," *Foundations and Trends in Microeconomics*, Vol., Issue 1, July 2006.
- Harrington, Joseph E. Jr., "Detecting Cartels," in *Handbook of Antitrust Economics*, P. Buccirossi, ed., The MIT Press, 2008.
- Kaplow, Louis, *Competition Policy and Price Fixing*, Princeton University Press, 2013.
- Kaplow, Louis and Carl Shapiro, "Antitrust," in *Handbook of Law and Economics*, Vol. 2, A. M. Polinsky and S. Shavell, eds., Amsterdam: Elsevier, 2007.
- Levenstein, Margaret C. and Valerie Y. Suslow, "What Determines Cartel Success?," *Journal of Economic Literature*, 44 (2006), 43-95.

## General References

- Marshall, Robert C. and Leslie M. Marx, *The Economics of Collusion - Cartels and Bidding Rings*, MIT Press, 2012.
- Motta, Massimo, *Competition Policy: Theory and Practice*, Cambridge: Cambridge University Press, 2004.
- Porter, Robert H., "Detecting Collusion," *Review of Industrial Organization*, 26 (2005), 147-167.
- Viscusi, W. Kip, Joseph E. Harrington, Jr., and John M. Vernon, *Economics of Regulation and Antitrust*, 4th Edition, Cambridge, Mass.: The MIT Press, 2005.
- Whinston, Michael D., *Lectures on Antitrust Economics*, Cambridge, Mass.: The MIT Press, 2006.