# Module 4: Price Fixing

Market Organization & Public Policy (Ec 731) · George Georgiadis

- What is price fixing?
  - An agreement among firms, explicit or implicit, about setting prices or offering services.
  - In the US, the EU, as well as most developing countries, cartel agreements are illegal.
- Sherman Act (1890)
  - "Every contract in restraint of trade or commerce among the several states, or with foreign nations, is hereby declared illegal..."
  - "Every person who shall monopolize, or attempt to monopolize any part of the trade or commerce among the several states, or with foreign nations, shall be deemed guilty of a felony..."
- The Sherman Act helps prevent anticompetitive pricing in two ways:
  1. Any contract among competitors regarding the prices they will charge is unenforceable.
  2. Prohibits firms from talking and reaching an agreement about prices, outputs, or market division.
- Fines for violations of the Sherman act can be large!
  - Maximum fine is $10M, but the 1987 US Sentencing Guidelines allow for an alternative fine of either (i) twice the convicted firms' pecuniary gains, or (ii) twice the victims' losses.
  - Private parties who can prove that they incurred a loss due to price fixing, can recover damages.

- *e.g.*, Archer Daniels Midland agreed to pay $100M for its role in the lysine and citric acid price-fixing conspiracies.

- US antitrust laws make price fixing "per-se" illegal.
  - This means that to prove that a firm is guilty of price fixing, it suffices to prove that it met with some of its competitors, and agreed on the prices they will charge (without any inquiry into the actual anti-competitive effects of the agreement).
  - Even without communication, price fixing can be prosecuted (*tacit* collusion), but this is rare.

# Tacit Collusion

- Let us revisit the Bertrand competition game with $n = 2$ firms.
- *Setup:*
  - Time $t = 1, 2, ...$, and each firm discounts time at rate $\delta < 1$.
  - Demand curve $D(p)$ and production cost $c(q) = cq$.
  - Firm $i$'s demand in each period is given by

$$D_i(p_i, p_j) = \begin{cases} D(p_i) & \text{if} \quad p_i < p_j \\ \frac{1}{2}D(p_i) & \text{if} \quad p_i = p_j \\ 0 & \text{if} \quad p_i > p_j \end{cases}$$

- We showed that in the static game, there is a unique equilibrium, in which the firms charge $p_1^* = p_2^* = c$.
- Can we construct an equilibrium in which (both) firms set price $p = p_M$ ?
- Consider the following strategy:
  - In period 1, each firm $i$ sets price $p_{i,1} = p_M$ (*i.e.*, monopoly price), and expects to obtain profits $\pi = \frac{1}{2}D(p_M)(p_M - c) > 0$.
  - In every subsequent period $t$:
    - if $\pi_{i,s} = \pi_M$ for all $s \leq t - 1$, then firm $i$ sets price $p_{i,t} = p_M$.
    - otherwise, firm $i$ sets $p_{i,t} = c$.

- *Claim:* The above strategy constitutes a SPE if $\delta \geq \frac{1}{2}$.
- *Interpretation:*
  - Each firm sets price $p_M$ as long as the other firm has set price $p_M$ in all previous periods. Otherwise, it reverts to the competitive price $p^* = c$ forever after.
- *Trade-off:*
  - By setting $p < p_M$ in period $t$, a firm can obtain the entire market share, thus increasing its profit in that period.
  - But, starting the following period, it will obtain 0 profits forever after.
- *Claim:* The above strategy constitutes an equilibrium if and only if $\delta \geq \frac{1}{2}$.

*Proof.*

- First, suppose that each firm $i$ sets price $p_{i,t} = p_M$ for all $t$. Then it's expected discounted profit is given by
$$\sum_{s=t}^{\infty} \delta^{s-t} \pi = \frac{\pi}{1-\delta}$$
- What is the optimal deviation?
  - Clearly, the firm will charge $p < p_M$ and obtain the entire market share.
  - The firm solves $\max\{D(p)(p-c) : p < p_M\}$. Because $D(p)(p-c)$ is concave and maximized at $p = p_M$, it follows that the firm will set $p = p_M - \epsilon$, and obtain profit $\sim 2\pi$.
  - Under this deviation, the firm's expected discounted profit is $2\pi$ (because it obtains 0 profits starting in period $t+1$ and forever after).
- Therefore, a firm is better off not deviating (and maintaining tacit collusion) if $\frac{\pi}{1-\delta} \geq 2\pi$, or equivalently, if $\delta \geq \frac{1}{2}$.

□

- *Sloppy:* If prices are continuous, then the problem of determining the optimal deviation does not have a solution.
  - This problem is resolved if we assume that prices must be on a discrete grid (*e.g.*, the smallest denomination is 1 cent).

- *Intuition:* Firms find it optimal to maintain tacit collusion as long as they put enough weight on future profits (*i.e.*, if their discount rate is sufficiently high).

- Problems with implementing tacit collusion:
  - In practice, the relationship between demand and price is stochastic. Therefore, detecting deviations is difficult, and consequently a firm will have stronger incentives to deviate. (Sannikov and Skrzypacz, AER, 2007)
  - In a market with many firms, coordinating is difficult (it suffices for one "non-cooperative" firm to break the cartel).
  - Also, in this game, for any $p \in (c, p_M]$, there exists an equilibrium in which every firm charges price $p$ in every period. How to coordinate in a particular equilibrium?
  - Illegal!

# Prosecuting Price Fixing

- One of the earliest antitrust cases after the passage of the Sherman Act was the Trans-Missouri case.
  - 18 railroads had formed an association to set railroad rates.
  - The railroads argued that their agreement was not illegal, because absent the agreement, price competition would ultimately lead to monopoly and consequently to higher prices.

- Is there any merit to this argument? Maybe!
  - Let us revisit the Bertrand competition from earlier. Assume the demand function $D(p) = 2 - p$, production cost $c(q) = q$, and entry cost $F = \frac{1}{16}$.
    - With $n \geq 2$ firms, the equilibrium price is $p = 1$, and each firm's profit is $-\frac{1}{16}$.
  - Absent price fixing: only one firm will enter the market, and the price will be $p = \frac{3}{2}$ (*i.e.*, the monopoly price).
    - The monopolist's profit is then $\frac{1}{4} - \frac{1}{16} = \frac{3}{16}$ ;
    - consumers enjoy surplus $\int_{\frac{3}{2}}^{2}(2-p)dp = \frac{1}{8}$ ; and
    - aggregate surplus equals $\frac{5}{16}$.

- Suppose that there are two firms, and they agree to both set price $p_C = \frac{5}{4}$.
  - Each firm's profit is then $\frac{3}{32} - \frac{1}{16} = \frac{1}{32} > 0$ ;
  - consumers enjoy surplus $\frac{9}{32}$ $(> \frac{1}{8})$ ; and
  - aggregate surplus equals $\frac{11}{32}$ $(> \frac{5}{16})$.
- So both consumers, and the society as a whole are better off in this example when price fixing is allowed.

- The Supreme Court rejected this argument.
- While such an argument is theoretically plausible, it appears improbable. (Observe that the monopolist's profit is larger than the sum of the duopolists' profits.)
  - But this is a special example!
  - If for example $p_C = \frac{3}{2}$, then both consumer and aggregate surplus would be lower.
- Moreover, any sound policy should also consider the costs of administration.
  - In this case, it is costly to measure the social benefits and costs of price-fixing.
- Therefore, if we believe that in most cases price-fixing will not be socially beneficial, it makes sense to refuse to evaluate these claims, and hence have a "per se rule".

## A (simplified) Beckerian theory of Crime

- Each crime causes harm $h$, and receives punishment $p$.
- "Demand" for offenses is $O(p)$, where $O'(p) < 0$.
  - Surplus to offenders is $\int_p^\infty O(x)dx$.
- Prosecuting offenders and administering punishment costs $c(p)$ per offense, where $c'(p) > 0$.
- *Objective:* Choose the level of punishment $p$ to maximize

$$\int_p^\infty O(x)dx - [h + c(p)]\, O(p)$$

- First order condition:

$$\begin{aligned} -O(p) - [h + c(p)]\, O'(p) - c'(p)O(p) &= 0 \\ \implies [1 + c'(p)]\, O(p) &= -[h + c(p)]\, O'(p) \end{aligned}$$

$$\implies \underbrace{\epsilon_O}_{\text{elasticity of crime}} \quad \underbrace{\frac{h + c(p)}{p}}_{\text{ratio of harm to punishment}} = \underbrace{1 + c'(p)}_{\text{MC of punishment}}$$

  where $\epsilon_O = -\frac{pO'(p)}{O(p)}$ is the elasticity of crime (% change in crime caused by a 1% reduction in the punishment level).

- Enforcement should be greater if:
  - The deterrence effect of enforcement (elasticity) is large.
  - The marginal cost of punishment is low.
  - The harm created by the crime is large.

# Detecting Price Fixing

- To prosecute firms for price fixing, ideally, we would like direct evidence; *e.g.*, evidence of a meeting in which prices to be charged were agreed to.
  - What if such evidence is not available? Can we draw indirect inferences from other evidence?
- What kind of behaviors can we interpret as increasing the likelihood that price-fixing is taking place?
  - Useful for guiding enforcement efforts, or as evidence in court.
- Two types of evidence:
  1. Structural evidence: characteristics of the industry and its products that increase the desirability of price-fixing ; and
  2. Behavioral evidence: set of behaviors that are correlated with price-fixing.

**Structural Evidence (Hay and Keller, JLE 1974)**

- *Basic Idea:* $\mathbb{E}$ (gains from collusion) $-$ $\mathbb{E}$ (costs collusion)
- Analyzes 65 price-fixing cases brought by the DOJ between 1963 and 1972.
  - Ways of detection: Investigation into another case; complaint by a competitor, by a customer, by a state or federal agency, or by a current or former employee.
- *Main conclusion:* Price-fixing cases were heavily weighted towards highly concentrated markets.
  - In 42% of the cases, the 4 largest firms in the market had over 75% market share.
  - In 76% of the cases, the 4 largest firms in the market had over 50% market share.
- Possible problem: Sample selection bias.
  - We only observe the firms that were successfully detected. What about the firms that did commit price-fixing but were not detected?
  - If we assume that conspiracies involving more firms are more likely to be detected, then these figures may be downward biased.
- *Other findings:*
  - Most cases involve markets with homogeneous products (across firms).
  - In majority of cases, price-fixing was organized following a price war.

**Behavioral Evidence (Porter and Zona, RAND 1999)**

- School milk procurement auctions
- Focus on two features of bidder behavior:
  - Decision of whether to bid ; and
  - Decision of how much to bid conditional on bidding.
- Compare these decision between firms that were accused of collusive behavior and those that were not.
  - Collusion here means that firms agree to all make small bids.

- *Competitive firms*:
  - Likelihood of bidding *declines* (sharply) with the distance to the school district ;
  - Bid levels *increase* with the distance.
  - *Intuition:* Due to transportation costs, the procurement cost increases in the distance.
- *Anti-competitive firms*: Radically different behavior.
  - Bid levels *decrease* with the distance.
  - *Intuition:* Firms bid competitively when bidding in auctions that are far away, which are not covered by the cartel agreement.

**Collusion and Price Rigidity (Athey, Bagwell and Sanchirico, REStud 2004)**

- Consider a dynamic model, where in every period, each firm receives an i.i.d cost shock and sets its price.
  - Costs are private information; prices are public information.
  - Firms engage in Bertrand competition.
- *Basic Idea:*
  - In a competitive market, each firm should adapt its price in each period. The static NE is akin to a first-price auction.
  - In a collusive SPPE, the price path must deter high-cost firms from imitating low-cost firms. They show that the optimal collusive scheme involves a rigid price.
  - Intuitively, a rigid price has an efficiency loss due to firms not setting prices based on their actual cost, but it diminishes the informational cost.

# References

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