Collusion and Cartels

Allan Collard-Wexler
Duke

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Defining Collusion:

A secret agreement between two or more parties for a fraudulent, illegal, or deceitful purpose. These are “cooperative” outcomes in the sense that firms agree to act together.

Why do firms want to achieve a cooperative outcome?

They earn higher profits!

Some famous recent examples of collusion
(we’ll see more when we cover antitrust issues):

Lysine (mid-1990's)

From Wikipedia:

The lysine price-fixing conspiracy was an organized effort during the mid-1990s to raise the price of the animal feed additive lysine. It involved five companies that had commercialized high-tech fermentation technologies, including American company Archer Daniels Midland (ADM), Japanese companies Ajinomoto and Kyowa Hakko Kogyo, and Korean companies Sewon America Inc. and Cheil Jedang Ltd. A criminal investigation resulted in fines and three-year prison sentences for three executives of ADM who colluded with the other companies to fix prices. The foreign companies settled with the United States Department of Justice Antitrust Division in September through December 1996. Each firm and four executives from the Asian firms pled guilty as part of a plea bargain to aid in further investigation against ADM. The cartel had been able to raise lysine prices 70% within their first nine months of cooperation.

The investigation yielded $105 million in criminal fines, a record antitrust penalty at the time, including a $70 million fine against ADM. ADM was fined an additional $30 million for its participation in a separate conspiracy in the citric acid market and paid a total fine of $100 million. Three former high-ranking ADM executives were convicted in September 1998 after a ten-week jury trial. Buyers of lysine in the United States and Canada sued and recovered $80 to $100 million in damages from the five cartel members, and ADM paid $38 million to settle mismanagement suits by its shareholders.

The lysine cartel was the first successful prosecution of an international cartel by the U.S. Department of Justice in more than 40 years. Since then, the DoJ has discovered and prosecuted scores of international cartels.

Matt Damon Movie: The Informant

http://www.imdb.com/video/imdb/vi2750218777/

Vitamins Inc. (also mid-1990's)

From a NY Times article (October 10, 1999):

The scope of the conspiracy boggles the mind. For a full decade, top executives at some of the world's largest drug companies met secretly in hotel suites and at conferences. When Federal investigators were closing in, they moved to the homes of high-level European executives.

Working together in a coalition they brazenly called "Vitamins Inc.," they carved up world markets and carefully orchestrated price increases, in the process defrauding some of the world's biggest food companies, including Kellogg, Coca-Cola and Nestle.

It was, in the words of Joel I. Klein, head of the Justice Department's antitrust division, "the most pervasive and harmful criminal antitrust conspiracy ever uncovered."

In May, after the conspiracy collapsed, those involved agreed to pay nearly $1 billion to settle Federal antitrust charges, by far the largest criminal fines in American history. And further penalties could come in Europe and elsewhere. The companies involved have pleaded guilty to the Government's charges, but they have refused to discuss details of the case beyond what the authorities originally charged.

A Collusion Example

Let's play a game:

- I'm auctioning off $ 40.
- Write a bid (your payoff is thus 40-bid) on a piece of paper.
- Can't go over $40.00 (Duke policy prohibits me from harvesting money from students).
- Highest unique bid wins (if two people bid 35, the person who bids 34 wins).
- Talk as much as you want with each other.
- I will secretly send the payment, but announce it in class.

Self-enforcing Collusion:

Non-cooperative strategies that achieve cooperative results.

We extend the basic static Cournot game to an infinitely-repeated game.

Firms stand to gain the difference between the static Cournot outcome and the monopoly outcome (in total). Thus, we should be able to make each firm at least as well off under collusion as we can under non-cooperative Nash-in-quantities strategies in a one-shot game.

When we move to infinitely-repeated games, we find that collusive output levels constitute a subgame perfect equilibrium.

Steps:

1. non-cooperative (static Nash-in-quantities) strategies

2. collusive (cooperative) monopoly equilibrium

3. incentives to deviate from the cooperative outcome

Ex: One-shot game with

$$p = 1 - q_1 - q_2$$

1. find the best-response function and equilibrium profits for non-cooperative static Cournot. These are:

$$q_1(q_2) = \frac{(1 - q_2)}{2}$$

$$q_1 = q_2 = \frac{1}{3}$$

$$Q = \frac{2}{3}$$

$$p = \frac{1}{3}$$

$$\pi_i = \frac{1}{9}$$

2. find the best outcome under cooperative behavior. This will mean splitting the profits that result if we act like a monopolist.

Note that we have assumed: CRS, identical costs (= 0). In this case,

$$q_1 = q_2 = \frac{1}{4}$$

$$Q = \frac{1}{2}$$

$$p = \frac{1}{2}$$

$$\pi_i = \frac{1}{8}$$

(remember they split market shares 50-50).

3. Check deviations from the cooperative outcome
(Is it a Nash equilibrium?)

In the one-shot game, we should always deviate from the cooperative solution. (Just like the prisoner's dilemna.)

Look at F.O.C.:

Firm 1 plays collusive (cooperative) strategy ($q_1 = \frac{1}{4}$).
F.O.C. for firm 2 is:

$$\max \pi_2 \rightarrow (1 - \frac{1}{4} - q_2)q_2 = 0$$

This has solution $q_2^* = \frac{3}{8}$.

Firm 2 receives profits $\pi_2 = \frac{3}{8}^2 \approx 0.14$ given prices are $p = 1 - q_1 - q_2 = 1 - \frac{1}{4} - \frac{3}{8} = \frac{3}{8}$.

Two-Period Game

Firms will play for two periods.

- Period 1: Firms Compete in Quantities. Receive π^1.
- Period 2: Firms Compete in Quantities. Receive π^2.

Suppose I have the strategy "I will play $q = 1$ (keep your profits at zero) in the second period, if you don't play Monopoly in the first period." Will this work to sustain collusion?

- Collude:
  Payoffs are:
  $$\frac{1}{8} + \frac{1}{8} = \frac{1}{4} = 0.25$$
- Defect in Period 1, Revert to being punished by Cournot Eqm in period 2:
  $$\frac{9}{64} + 0 = \frac{9}{64} \approx 0.14$$

So I choose to cooperate with monopoly in the two periods, if, if I believe my opponents strategy.

Is Punishment in Period 2 Credible?

- In period 2, will I actually want to produce q_1?

- Moreover, would I play $q_1 = \frac{1}{4}$ in period 2, if we cooperate in period 1.

Infinitely Repeated Games (Supergames)

What happens when both firms live forever?

We need a discount factor (Tirole calls this δ).

Maximize discounted profits:

$$\Pi_i = \sum_{t=1}^{\infty} \delta^{t-1} \pi_i^t$$

And adopt “trigger strategies”. These say that in each period, I play cooperative as long as all players have always cooperated in the past. However, as soon as any player deviates in any period, I play noncooperative strategy forever. (Sometimes called ‘grim’ punishment.)

When is this strategy a subgame perfect equilibrium?

Tirole goes through the proof for this. The answer is: a trigger strategy is a subgame perfect equilibrium if δ is sufficiently large. I.e., we have to care about the future "enough." Otherwise, punishing in the future does not deter us from cheating today.

Result: with infinitely-repeated games, we get more equilibria!

Bertand Model

Suppose that we have a Bertrand Game with N competitors, with monopoly profits of π^M.
Trigger Strategies:

- Cooperate: Receive $\frac{\pi^M}{N}$ each period, forever.

$$\begin{aligned} & \frac{\pi^M}{N} + \delta \frac{\pi^M}{N} + \delta^2 \frac{\pi^M}{N} + \cdots \\ = & \frac{\pi^M}{N} \frac{1}{1-\delta} \end{aligned}$$

  (geometric series, remember...)
- Defect: Undercut p^M by a penny, and get the entire market. Receive π^M, then zero forever.

$$\begin{aligned} & \pi^M + \delta 0 + \delta^2 0 + \cdots \\ = & \pi^M \end{aligned}$$

When can we sustain cooperation?

$$\frac{\pi^M}{N}\frac{1}{1-\delta} \text{ vs. } \pi^M$$

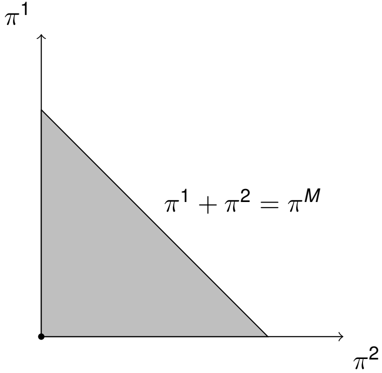
which happens when:

$$(1-\delta) > N$$

So, for instance, given $\delta = 0.5$, we can never sustain collusion at monopoly level using these trigger strategies...

Folk Theorem

A general theorem, the so-called “Folk” Theorem, is that any set of payoffs π^1 and π^2, such that $\pi^1 + \pi^2 \leq \pi^M$, can be sustained in an infinitely repeated game as $\delta \to \infty$.



Asymettric Costs

- Remember Stephen's discussion of Quebec gas retailers. These had different marginal costs, either due to owning a refinery, or having an onsite convenience store.
- Suppose two firms, marginal costs $\bar{c}$ and $\underline{c}$, where $\bar{c} < \underline{c}$.
- What it the condition to keep each firm inside the collusive agreement? (the so-called “Incentive Compatibility" Condition in Mechanism Design)
  - High Cost ($\bar{c}$):

$$(p^M - \bar{c})\frac{q^M}{2}\frac{1}{1-\delta} \geq (p^M - \bar{c})q^M$$

  - Low Cost ($\underline{c}$):

$$(p^M - \underline{c})\frac{q^M}{2}\frac{1}{1-\delta} \geq (p^M - \underline{c})q^M + (\bar{c} - \underline{c})Q(\bar{c})\frac{1}{1-\delta}$$

Asymettric Costs: Ctd.

- What is $(\bar{c} - \underline{c})Q(\bar{c})\frac{1}{1-\delta}$, Bertrand with a lower cost than my rival, forever.
- Which Incentive constraint is harder to satisfy? The incentive constraint for the low cost retailer.
- What can we do?
- Perhaps give the low cost retailer more market share, say instead of 50-50, 70-30. The IC conditions would become:
  - High Cost ($\bar{c}$):

$$(p^M - \bar{c})q^M \times 0.30\frac{1}{1-\delta} \geq (p^M - \bar{c})q^M$$

  - Low Cost ($\underline{c}$):

$$(p^M - \underline{c})q^M \times 0.70\frac{1}{1-\delta} \geq (p^M - \underline{c})q^M + (\bar{c} - \underline{c})Q(\bar{c})\frac{1}{1-\delta}$$

Concentration and Possibility of Collusion

- What is the relationship between collusion and the number of firms? Notice we need:

$$(1-\delta) \geq N$$

Information Lags, Infrequent Interaction

- What about the effect of frequent versus infrequent interaction?
- Think of δ as the number of periods that you can earn profits before other firms can respond.
- Higher likelihood of collusion when information is quickly disseminated, or when orders flow in regularly.
- The question of detecting defection in a cartel is the task of Green and Porter (1983).

Additional Factors

Two more issues may affect these results.

1. Entry. If firms enter, what happens to our ability to collude? (There is on-going research on this.) A basic result is that if firms enter faster than demand increases, it's harder to sustain collusion. Why? Future payoffs are smaller.
2. Exogenous shocks to demand. If demand is stochastic, we can have situations where the firms cannot tell whether one player cheated, or demand went down. (Green and Porter Model) We can also have business cycle effects. When demand is growing (before a boom) it's easy to sustain collusion. When demand is falling (beginning of a recession) it's hard. (Rotemberg and Saloner Paper)