Industrial Organization 03

Collusion

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Outline

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2. Why do cartels form?
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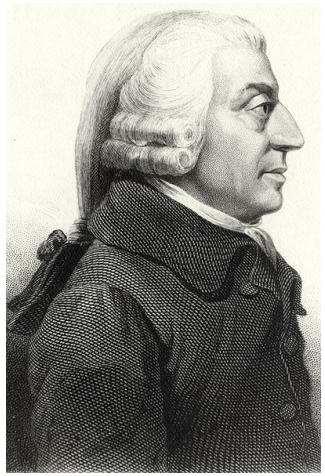
Introduction

Adam Smith (The Wealth of Nations, Book I, 1776)

People of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public, or some contrivance to raise prices.



Definition

Definition of collusion

We talk about collusion (or cartels) when firms in a market agree to make profits that are higher than the "normal" profits they would make in a competitive situation

→ "Normal" profits are those of the non-cooperative Nash equilibrium (Bertrand, Cournot...)

Collusion can be:

- *Explicit*: the firms explicitly agree on prices, but also on quantities, production capacities, investments in R&D, etc.
- *Tacit*: behavior that allows firms to earn profits above "normal" profits without an explicit agreement

Why do cartels form?

Firms in a market are tempted to collude to increase their market power (their profits)...

We consider that in the case of competition, firms "maximize their profit". Then, why does forming a cartel allow firms to increase their profits?

Because competition is like a prisoner's dilemma:

- A firm decides on its strategy (by setting prices, quantities, investments...) in order to maximize its profits...
- ... but it doesn't take into account the effect of its decision on the other firms
- In a cartel, firms take into account how their decisions affect the profits of the others

Various types of cartels

- Price fixing
- Quantity fixing (rare)
- Geographic market sharing
- etc. (other ideas?)

But...

- We can have *parallel behaviors* without collusion
- Some concerted practices are allowed under some conditions (e.g., research joint ventures)

Why are there not only cartels ?

Why don't all firms collude?

→ Because collusion is prohibited (competition policy). But this is not enough to prevent cartels!

→ Because firms in a cartel have incentives to "cheat", to "deviate" from the cooperative equilibrium

- Unilaterally break the collusive agreement and set a lower price (for example)... to capture a larger share of demand
- If each firm expects the others to cheat, collusion is not possible
- Punishment mechanisms are needed to deter the "cheaters"

Cartels and public policy

Cartels are socially inefficient:

- Loss of social welfare when price is higher than marginal cost: "deadweight loss" (welfare criterion)
- Transfer from consumers to producers (consumer surplus criterion)

Yet, in the 19th century, cartels were common and legal in the US (steel, sugar, oil...).

In France, since 1810, article 419 of the Code Pénal forbids price-fixing agreements with "*prices above or below of what would have been set by the free and natural competition*"...

... but in practice, the courts punish few cases ("good" cartels)

Cartels and public policy

At the end of the 19th century and the beginning of the 20th century, the American Congress passed two laws to fight against the high prices set by the "trusts":

- The Sherman Antitrust Act of 1890
- The Federal Trade Commission Act of 1914

These laws prohibit explicit agreements to reduce the intensity of competition

Sherman Act (1890):

> *Section 1. Every contract, combination in the form of trust or otherwise, in restraint of trade or commerce... is declared to be illegal. Section 2. Every person who shall monopolize, or attempt to monopolize, or combine or conspire with any person or persons, to monopolize any part of the trade or commerce... shall be deemed guilty of a felony...*

Cartels and public policy

In Europe, Article 101 of the Treaty on the Functioning of the European Union:

> *The following shall be prohibited...: (a) directly or indirectly fix purchase or selling prices... (b) limit or control production... (c) share markets or sources of supply...*

In France: article L.420-1 du code du commerce

The laws that prohibit cartels are entitled:

- Antitrust Law in the US
- Competition Policy in Europe

Cartels and public policy

Examples of **sanctions for collusion** (source: OCDE 2000):

Case	**Sanction**
Worldwide graphite electrode cartel (1992-1997)	$300 million and prison sentences in the US; €218 million in Europe
Worldwide vitamin cartel (1989-1999)	$1 billion and prison sentences in the US; €855 million in Europe
Worldwide lysine and citric acid cartel (1992-1995)	$200 million and sentences in the US
Cathode ray tube cartel (1996-2006)	€1.47 billion in Europe

Cartels and public policy

Enforcement:

- The prohibition of cartels is applied more or less strictly depending on the country (US more strict) and the time (stricter nowadays)
- The interpretation of what constitutes an anticompetitive agreement may also vary from country to country (ambiguities)
  - R&D agreements
  - Trade associations, information exchange...
- Leniency programs:
  - A company that participated in a cartel and provided information about the cartel may benefit from a partial or full reduction of sanctions
  - Introduced in the US in 1978 (revised in 1993), in Europe in 2002, in France in 2001

The stability of cartels

Whether collusion is **tacit** or **explicit**, it requires *repeated interactions* and a *punishment mecanism*:

- The setting of prices above competitive prices (for example) is supported by an agreement (tacit or explicit) that in case of deviation from the collusive agreement, the cheater will be "punished"
- The "punishment": a temporary price war or other actions aimed at reducing the deviating firm's profits
- The "punishment" should be sufficiently costly compared to the profits made by the deviating firm
- It is even more efficient if it is not costly to the firms imposing it
- Any "deviation" should be detected

An example of cartel

The diamond cartel:

- DeBeers Group, founded in 1870, dominates the global diamond market
- Controls trade rather than production: Central Selling Organization (CSO)
- More than 80% of the world's production passes through CSO

Benefits to producers of going through CSO:

- Expertise, publicity, price stability
- Fear of reprisal in case of "deviation"

A deviation:

- Zaire (now RD Congo) tried to deviate (in 1981)
- Two months later, a huge quantity of unidentified diamonds flooded the market: the price fell by almost 40%

A model of collusion

- Two firms, 1 and 2, sell identical goods (perfect substitutes)
- Same marginal cost of production, c

→ Same assumptions as in Bertrand competition

- But we consider a repeated game with infinite horizon ("supergame")
- At each time $t = 0, 1, ..., \infty$, the two firms set prices simultaneously and conditionally on the prices set previously
- δ denotes the discount factor (value of one euro today, which will be only obtained in the next period)
- p^m denotes the monopoly price, π^m the monopoly profit

The discount factor

δ is the discount factor (today's value of one euro, which will be received only in the next period). In general, $\delta < 1$

For example, an investor could invest 1 euro today in order to receive $1+r$ euro in the next period (r: rate of return per period). We would have:

$$\delta = \frac{1}{1+r}$$

When we apply the discount factor to future profits, we say that we are calculating the discounted value of future profits

→ For example, to evaluate the value of a project, we can calculate the "Net Present Value" (NPV) = discounted revenue - discounted costs

The collusion strategy

Let's consider the following strategy (called the "trigger strategy"):

Collusion period:

A firm sets the price $p = p^m$ (monopoly price) if the other firm has set p^m in the previous periods

Punishment period:

A firm sets $p = c$ after a deviation (i.e., if the other firm has set a price $p < p^m$ in the previous period) and for all subsequent periods

How do we determine whether the tacit collusion agreement is sustainable?

Comparison of the discounted value of future profits under collusion with the discounted value of future profits under deviation

Discounted profits in collusion

In each period, the firms set the monopoly price. Therefore, every period, the firms share the monopoly profit

The discounted value of future profits is:

$$\Pi = \frac{1}{2}\pi^m + \delta\frac{1}{2}\pi^m + \delta^2\frac{1}{2}\pi^m + ...$$

$$\Pi = \frac{1}{2}\pi^m \left(1 + \delta + \delta^2 + ...\right)$$

$$\Pi = \frac{1}{2}\pi^m \left(\frac{1}{1-\delta}\right)$$

Discounted profits in case of deviation

We look for the incentive to deviate from the collusive agreement (i.e., the net gain in case of deviation)

What is the "best" deviation strategy (price change)?

Best deviation

At any period, the best deviation consists in setting a price equal to $p^m - \epsilon$

So the deviating firm wins (at best)?

$$\widetilde{\Pi} = \pi^m + \delta \times 0 + \delta^2 \times 0 + ... = \pi^m$$

Sustainability of collusion

It is not in the interest of any firm to deviate if its profit in case of deviation is lower than its profit in case of collusion, i.e., if:

$$\widetilde{\Pi} < \Pi$$

or

$$\pi^m < \frac{1}{2}\pi^m\left(\frac{1}{1-\delta}\right)$$

so:

Result: stability of collusion

Collusion is sustainable (an equilibrium) if and only if

$$\delta > \frac{1}{2} \equiv \overline{\delta}$$

Sustainability of collusion

Collusion is sustainable if firms value future profits high enough

The "limit discount factor" $\overline{\delta}$ indicates the extent to which collusion is feasible:

- If a factor tends to decrease $\overline{\delta}$, we say that it *facilitates* collusion
- If a factor tends to increase $\overline{\delta}$, we say that it makes collusion *more difficult*

Remark: there are other equilibria to this repeated game (e.g., the Bertrand equilibrium of the one-period game is an equilibrium)

Collusion when the number of periods is finite?

Equilibrium of a price competition game repeated $T < \infty$ times

There is only one (subgame perfect) Nash equilibrium such as $p^\star = c$

Why?

- Backward induction reasoning
- The last period (Tth) corresponds to the one-period Bertrand game, so the unique equilibrium of this period is such that $p_T = c$
- In period $T-1$, firms expect the Bertrand equilibrium to prevail in the last Tth period
- So, they are in the same situation as in the last period and set $p_{T-1} = c$
- etc.

Market structure and collusion

Does a more concentrated market structure (fewer firms) facilitate collusion?

- Consider an oligopoly with n identical firms
- Marginal costs are assumed to be constant and equal to c
- Firms compete à la Bertrand
- The discounted value of future profits in case of collusion is

$$\Pi = \frac{1}{n}\pi^m\left(\frac{1}{1-\delta}\right)$$

- What is the deviation profit? It is still $\widetilde{\Pi} = \pi^m$
- So, the limit discount factor is

$$\delta > \left(1 - \frac{1}{n}\right) \equiv \overline{\delta}$$

Market structure and collusion

The threshold discount factor

$$\overline{\delta} \equiv \left(1 - \frac{1}{n}\right)$$

increases with n. So, we obtain the following result:

Relation between market structure and collusion

The smaller the number of firms, the easier it is to collude

For example, two firms with a discount factor of 0.6 can implement tacit collusion, but three firms cannot

Market structure and collusion

Empirical evidence supports this theoretical prediction:

- In the cartel cases handled with by the US Department of Justice (DOJ) between 1990 and 2003:
  - 77% involved anticompetitive agreements among 6 or fewer firms
  - only 13% involved anticompetitive agreements among 50 or more firms
- Of of the 111 cartels detected and sanctioned by the European Commission between 1969 and 2009 (Combe and Monnier, 2012):
  - Average of 7.7 participants and median of 5
  - 50% of cartels had fewer than 5 participants and 75% fewer than 10 participants
- Cartels often collapse upon entry

Entry barriers and collusion

Do entry barriers make collusion easier or harder?

Collusion is difficult to sustain if there are weak entry barriers:

- Entry of competitors (e.g., "hit and run" entry) reduces collusion profits
- The possibility of future entry by competitors weakens the "threat" of "punishment" in case of deviation

Consider the following model:

- Each period, there is a probability of entry μ from a competitor who sets the competitive price $p = c$
- With the probability $1 - \mu$, there is no entry and the two firms may try to collude
- A "hit and run" entry lasts only one period (so the possibility of entry is determined each period)

Entry barriers and collusion

In case of collusion, both firms receive:

$$\Pi = \frac{1}{2}\pi^m + (1-\mu)\,\delta\frac{1}{2}\pi^M + (1-\mu)\,\delta^2\frac{1}{2}\pi^m + ...$$

So, collusion is sustainable if:

$$\frac{1}{2}\pi^m + (1-\mu)\,\frac{1}{2}\pi^M\left(\frac{\delta}{1-\delta}\right) > \pi^m$$

or

$$\delta > \frac{1}{2-\mu} \equiv \overline{\delta}$$

Entry barriers and collusion

The threshold discount factor $\overline{\delta}$ increases with the probability of entry μ

So, we obtain the following result:

Relation between entry barriers and collusion

A higher probability of entry reduces the possibility of collusion

$\rightarrow$ A higher probability of entry (weaker entry barriers) reduces future collusion profits and thus reduces the "cost" of a deviation (punishment)

Frequency of interactions and collusion

Do frequent competitive interactions facilitate or hinder collusion?

Let's take the basic model:

- Two firms sell identical goods (perfect substitutes)
- Same marginal cost of production, c
- Firms compete every T periods: period 1, $T+1$, $2T+1$, etc.
- Collusion is sustainable if

$$\frac{1}{2}\pi^m\left(1+\delta^T+\delta^{2T}+...\right)>\pi^m$$

which is equivalent to

$$\delta>\frac{1}{2^{1/T}}\equiv\bar{\delta}$$

Relation between interaction frequency and collusion

More frequent interactions facilitate collusion

Multi-market contacts and collusion

Definition of multi-market contacts

When firms compete with the same rivals in different markets

- Two firms compete in two independent (but identical) markets: market 1 and market 2
- The two firms interact more frequently in market 1 (every period) than in the market 2 (every 2 periods)
- They collude in both markets and in case of a deviation, the "punishment" applies to both markets
- What is the threshold discount factor in both markets?
- Frequency of interactions: if $1/2 < \delta < 0,71 = 1/\sqrt{2}$, collusion is sustainable in market 1 but not in market 2

Multi-market contacts and collusion

Collusion is sustainable in both markets if the "gains" from deviation are lower than the "costs" of a deviation:

$$\frac{1}{2}\pi^m + \frac{1}{2}\pi^m \leq \frac{\pi^m}{2}\left(\delta + \delta^2 + ...\right) + \frac{\pi^m}{2}\left(\delta^2 + \delta^4 + ...\right)$$

or

$$4\delta^2 + \delta - 2 \geq 0$$

which holds if $\delta \geq 0,593$

For example, if $\delta \geq 0,6$, collusion is not sustainable in market 2, but it can be implemented in both markets

So, multi-market interactions enable collusion in markets where, due to their characteristics, it is a priori not sustainable

Multi-market contacts and collusion

Example from the airline sector (Ciliberto and Williams, 2014):

- Airlines compete on many, but not all, routes
- For example, in 2006 and 2008 in the US, the major airline companies had "contact" with a competitor on 40% of these routes

Multi-market contacts and collusion?

- Ciliberto and Williams (2014) show that the average multi-market contact rate has a significant positive impact on the price of a route (controlling for other explanatory factors for price)
- Airlines with high levels of multi-market contacts set prices that maximize their joint profits

Secret price cuts

Model of Green and Porter (1984):

- Market with two firms
- Each firm observes its price and its sales, but not its competitor's price and sales
- With a probability α, demand disappears: it falls to 0 ("demand shock")
- But if its demand is 0, a firm has no way of knowing whether this is due to bad luck ("demand shock") or because its competitor has deviated from the collusive agreement

In this context, perfect collusion (setting the monopoly price even after a demand shock) is not possible

Secret price cuts

However, collusion is still possible with this strategy:

- Collusion phase: first set the monopoly price and maintain it as long as each firm maintains its market share
- Punishment phase: when a firm's demand falls to zero, it enters a price war for a limited number of periods (T), after which it returns to the monopoly price p^M

Trade-off on the choice of T:

- The war price should be long enough to discourage "cheaters"
- But a price war can be triggered by a bad demand shock, not by a "deviation"
- So, firms have an incentive to limit the duration of the price war

Secret price cuts

Conclusion of Green and Porter model

If price cuts are difficult to observe, periodic price wars may be necessary to sustain an anticompetitive agreement

Remark: although there are periods of price wars in equilibrium, no firm cheats in equilibrium

When demand fluctuations can be observed

What would happen if firms could observe demand fluctuations?

- Let's assume that demand is cyclical (up and down)
- Demand shocks are independent from period to period
- If firms continue to collude, does their profit depend on the level of demand?
- *No*, because of the independence hypothesis
- Does the profit from deviating depend on the level of demand?
- *Yes*, deviating is more profitable when demand is high

Conclusion: It may be necessary to lower prices when demand is high → the prices move in a "counter-cyclical" manner

"If you find cheaper elsewhere..."

Some clauses can facilitate collusion!

"If you find cheaper elsewhere, we will refund the difference..."?

→ allows to detect deviations

The **"most favored customer clause"**

- What is the effect on incentives to deviate?
- If a firm lowers its price to capture demand in the short run, it should reimburse customers who previously paid the monopoly price

→ This type of clause reduces incentives to deviate and makes cartels more stable

Other factors

Cost asymmetries make collusion more difficult for two reasons:

- It is more difficult to agree on a common pricing strategy
- It is more difficult to "discipline" the most efficient firms

Growing markets:

- Collusion is easier to sustain because the gains from deviating are smaller than the costs as the market continues to grow

Take-aways (1)

- There are two forms of collusion: explicit collusion and tacit collusion
- A cartel allows firms to increase their profits, because the firms take into account how their decisions affect the profits of the others
- The possibility of collusion is realistic if we take into account the time dimension (repeated interactions between firms)
- Firms cannot always collude, because they have the possibility to cheat, which can lead to a punitive price war (Stigler's 1964 argument: sometimes, it can be more profitable to be outside a cartel!)
- Collusion is facilitated by: high weight of future profits, small number of firms, high barriers to entry, frequent market interactions, multi-market contacts, low uncertainty about demand

Take-aways (2)

Summary table: conditions for cartel formation (stability):

Market characteristics

– Small number of firms
– Multi-market contacts
– High barriers to entry
– Low demand variability
– Frequent interactions

Firm characteristics

– Homogeneous firms with respect to production costs
– Homogeneous firms with respect to the product offered