

Collusion

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Introduction

- **Collusion** is any form of **agreement** between competitors.
- Examples:
 - agreement on sales prices (*“prices”*),
 - quota allocations (*“outputs”*),
 - division of markets (*“markets”*),
 - etc.
- **Institutional arrangements** to sustain **collusion**:
 - **overt collusion**: cartels with a central office (secret if anti-trust laws exist) or some form of communication.
 - **tacit collusion**: firms never meet or communicate.

Introduction

- **Collusion** allows firms to exert **market power** they would not have otherwise by **artificially restricting competition** in a way to **reduce welfare** (typically by price increases).
- Accordingly, **collusion** is prohibited by **anti-trust laws**.
- Any anti-trust authority would certainly attack a **cartel**, or any **explicit agreement** on price-setting or market-sharing.
- However, there are **divergences** with regards to the required standard of proof and legal treatment of **tacit collusion**.

Agenda

- What Is Collusion?
- Factors Facilitating Collusion
- Modelling Collusion
- Policy Practice

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- **What Is Collusion?**
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Collusion in Economic Theory

- **Collusion** is a situation where firms' **prices are higher** than some **competitive benchmark**. (*"Collusion as a market outcome"*)
- **Competitive benchmark**: equilibrium price of a game where firms **meet only once** in the marketplace. (e.g. Bertrand in homogenous goods price games, Cournot in quantity games)
- Sometimes **collusion** is seen as a a situation where firms' prices are close enough to **monopoly prices**.
- In any case, **collusion** coincides with **high-enough price outcomes**, and **not with the specific form** through which that outcome is attained. (*"overt vs. tacit collusion"*)
- Yet, anti-trust authorities and judges should – from an economic viewpoint – consider as **illegal** only practices where firms **explicitly coordinate** their actions to achieve a **collusive outcome**.

Fragility of Collusion

- Even if **overt collusion** were to be legal, it would not be easy for firms to **achieve a collusive outcome**.
- In fact, **unilateral deviation** would increase a firm's profits.
- For instance, consider two fruit sellers in a street market.
- Pears per kilo cost EUR 1 and the monopoly price is EUR 2.
- Both pricing "collusively" at EUR 2 would give each seller approximately half of the buyers (identical quality of pears).
- However, a seller has a strong incentive to slightly undercut EUR 2 to get all buyers and to thus considerably increase profits.
- Any collusive situation naturally brings with it the **temptation to deviate** from it and to therefore **break collusion**.

Two Main Ingredients of Collusion

- In fact, **two elements** must exist for **collusion to arise**.
- **Firstly**, the colluders must be able to **detect** in a timely way the occurrence of a **deviation**. (*e.g. lower price than agreed*)
- Note that **detection** is **not always easy**: in many markets firms' prices and outputs are not directly observable.
- **Secondly**, there must be a **punishment** for the **deviator**. (*e.g. much lower prices by the rivals in the post deviation periods*)
- Generally the punishing firms also suffer due to lower profits: it is thus crucial that firms are **willing to participate** in the **punishment**.

Two Main Ingredients of Collusion

- Only if a firm knows that a **deviation** is quickly **detected** and **punished** by the other colluders, it refrains from deviating and the **collusive outcome** will arise.
- Thus, **collusion** can only be sustained if firms meet **repeatedly** in the marketplace. (*“Collusion never arises in one-shot games”*)
- Regarding the example, if the street market is small enough and if the sellers post the prices, detection of price cuts is immediate.
- Retaliation by the detecting seller can be immediate and a price war can ensue with severe losses to both sellers.
- Note that (cf. fruit seller example), if **detection** is **rapid** and **punishments** are **likely** as well as **credible**, then **collusion** can arise via purely **non-cooperative behaviour**: ***tacit collusion***.

Which Collusive Price?

- It is not always clear **which collusive price** be chosen.
- Folk theorem (Friedman, 1971): in repeated games with infinite horizon and large enough discount factor, firms can have **any profit between zero and the fully collusive profit** in equilibrium.
- This raises the issue of **coordination**.

Coordination: The Difference Between Tacit and Overt Collusion

- Under **tacit collusion** it is difficult for the firms to solve the problem of **coordination**.
- If firms **cannot directly communicate**, they can make **mistakes** and pick actions which are not jointly optimal yet hard to change.
- Using the market to **signal** intentions to coordinate on a different price might be very costly.
 - If a firm increases its price to **signal a higher price**, it loses market share in the adjustment period.
 - If a firm decreases its price to **signal a lower price**, this might be seen as a deviation and trigger a costly price war.

Coordination: The Difference Between Tacit and Overt Collusion

- Under **overt collusion** firms can talk and **coordinate** on their jointly preferred equilibrium without any costly experimentation.
- For instance, in case of **changing market conditions**, **communication** allows the firms to set a new collusive price without the risk of triggering a period of punishment.
- Also, **market-sharing** schemes (e.g. partitioning of the market in certain regions of certain customer types) are advantageous – whether achieved by overt collusion or historical accident.
- Indeed, **adjustments** to new demand or cost conditions can be made without triggering possible price wars.
- This might explain why such collusive **market-sharing** schemes have often been used.

Agenda

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Incentive Constraint for Collusion as the Basis

- The economic analysis of **collusion** is usually based on the so-called **incentive constraint for collusion (ICC)**: each firm compares the **immediate gain from a deviation** with the **profit it gives up in the future**, when rivals react.
- Only if the gain is lower than the foregone profit the firm colludes.
- Generally, **collusion** is **more likely** the **lower** the **deviation gain**, the **lower** the **expected profits** under **punishment**, and the **more weight** firms attach to the **future** (when deviation loss occurs).
- **Factors facilitating collusion** are discussed within the framework of the **ICC**:
 - If a given factor relaxes the **ICC** of the firms, then it facilitates collusion.
 - If it makes the **ICC** more binding, then it hinders collusion.
 - If the effect is ambiguous, then it does not have a clear impact on collusion.

Factors Facilitating Collusion

- From a practical viewpoint it is important to identify the **factors facilitating collusion**, so that **anti-trust authorities** can intervene to eliminate them whenever possible.
- Also in some cases (especially merger analysis), it has to be evaluated whether a **particular industry** is prone to a **collusive outcome** or not.
- The following **factors** are now discussed with the **ICC** in turn:
 1. Concentration
 2. Entry
 3. links among competitors
 4. Regularity and Frequency of Orders
 5. Buyer Power
 6. Price Elasticity of Demand
 7. Evolution of Demand
 8. Product Homogeneity
 9. Symmetry
 10. Multi-Market Contacts
 11. Inventories and Excess Capacities
 12. Price and Quantity Observability
 13. Coordination and Communication
 14. Most-Favoured-Nation Clause
 15. Meeting-Competition Clause
 16. Resale Price Maintenance

1. Concentration

- **Collusion** tends to be **more likely**, the **fewer firms** in the industry.
- Suppose that there are **many firms** of **identical size** and of **large capacity** in the same industry.
- In a **collusive situation**, each sets a **high price** and gets a **rather small share** of the total profits.
- However, a **deviating** firm setting a lower price than his rivals might get **all the market** for itself.
- Even with a **harsh punishment** (i.e. tiny stream of expected post-deviation profits), the **gains** can be so large in the deviation period **outweighing** the foregone **future collusive profits**.

1. Concentration

- For example, suppose that there are only **two firms**.
- At a **collusive equilibrium** each would get **half the market**.
- Thus, the **deviation gains** are **smaller** relative to the lower profits due to the punishment which follows.
- Besides, **concentration** helps firms' **coordination** on a collusive outcome, not only its enforcement: the **fewer firms** in the industry, the **easier** for them to **coordinate** their behaviour.

2. Entry

- The **easier entry** into an industry (*“the lower entry barriers”*), the **more difficult** to sustain **collusion**.
- **High prices** and profits **attract** new firms into an industry, and this tends to **disrupt the collusive outcome**: **two mechanisms**.
- **Firstly**, the entrant may **not want** to pursue a **collusive strategy** and acts aggressively: the incumbents have to **decrease prices** to keep customers thereby breaking the collusive equilibrium.
- **Anticipating** this forces incumbents to keep **prices low**.
- **Secondly**, the entrant and the incumbents **accommodate** with the entrant taking part in the (overt or tacit) **collusion**.
- As the **more firms** the **less likely** that **collusion** can be **sustained (concentration)**, **entry** might break the collusive outcome.

3. Links Among Competitors

- If a firm has a **participation** in a competitor (even without controlling it), the scope for **collusion** is enhanced.
- With a representative of a firm on the board of a rival firm, **coordination** of pricing and marketing policies is easier.
- Even without board representation (e.g. only shareholder), the **incentives to compete** in the marketplace might be reduced. (rival's profits affect the firm's own financial performance)
- Overall, it would therefore seem sensible **not to allow** a firm to have minority (a fortiori controlling) **shareholding** in a competitor.

4. Regularity and Frequency of Orders

- Regular orders facilitate collusion.
- Indeed, an unusually large order would give a strong temptation to deviate: unusually large profits vs. losing future collusive profits under typically small expected demand.
- High frequency of orders also helps collusion, as it allows for a timely punishment.
- Indeed, if orders arrive only with large time intervals, the temptation to deviate is higher, because the punishment will be started only much later, and will be discounted accordingly.

5. Buyer Power

- A **strong buyer** can use its **bargaining power** to stimulate **competition among sellers**. (e.g. threatening to redirect orders to others or potential entrants or to start own upstream production)
- By **concentrating orders** a powerful buyer can **break collusion**.
- By grouping orders into large and less frequent ones, a **strong (large) buyer** can induce suppliers to **deviate** from the **collusive strategy**. (**regularity and frequency of orders**)
- Also, a **strong buyer** might design **procurement auctions** so as to minimize the risk of collusive behaviour among suppliers.

6. Price Elasticity of Demand

- The effect of the **price elasticity** on **collusion** is **ambiguous**.
- If demand is very **elastic**, then **price cuts** imply a **large increase in demand** – both for the **deviation** and **punishment** periods.
- Thus, the price elasticity generally affects both sides of the **ICC** and its **net effect** on the sustainability of **collusion** is **ambiguous**.
- **However**, elasticity affects the **level of the maximum collusive price** (*“the lower the elasticity the higher the monopoly price”*).
- Hence, there is **less** reason to **worry** about possible collusion if the **price elasticity is high**.

7. Evolution of Demand

- **Demand stability** may help sustain **collusion**, as it increases the degree of **observability** in the market.
- In an **unstable market** with **frequent demand shocks** or **large uncertainty** it might be harder to decipher whether poor sales are due to **demand variability** or to **price undercutting by rivals**.
- Accordingly, **collusion** might be more **difficult** to sustain.
- By contrast, in a **stable market** it would be easier to **spot deviations** and **punish** them, rendering **collusion** easier.

8. Product Homogeneity

- Practitioners, authorities and judges often maintain that **collusion** is easier with **homogenous than differentiated products**.
- Economic theory is less clear-cut and more **ambiguous** here.
- With **differentiated products** it is **harder to punish** a deviant firm, since even strong rival price cuts would leave it with a positive demand.
- This effect tends to **discourage collusion**, as only the fear of punishment keeps firms from deviating.
- Yet, for precisely the same reasons a **deviation** is also **less profitable**: a deviator cannot expect large market shares from rivals even with substantial price cuts.
- This effect tends to **facilitate collusion**.

9. Symmetry

- **Symmetry** can concern different dimensions (e.g. market shares, costs, technological knowledge, product varieties)
- There are many informal arguments for the idea that **symmetry** helps **collusion**: e.g. it is intuitive that agents in a similar position would find it easier to arrive at an agreement suiting them all.
- Generally, a more **equal distribution** of assets **relaxes** the **ICC** of both the small and the large firm and would help **collusion**.
- For instance, a **high-capacity firm** has a higher incentive to **deviate** and the smaller firms have **difficulties to punish** due to their **capacity constraints**.

10. Multi-Market Contacts

- **Multi-market contacts** mean that the same firms meet in **more than one market**: the effect on **collusion** is **ambiguous**.
- Some argue that when firms **co-exist** in several markets, then it is **more costly** for them to **deviate** from a collusive outcome, since **punishment** would obtain in **all the markets**.
- Yet, if a firm is active in **many markets**, it can also **deviate** in **all of them** at the same time, which increases its **incentive to deviate**.

11. Inventories and Excess Capacities

- The effect of **large inventories** and **excess capacities** on **collusion** is **ambiguous**.
- Suppose that **all firms** in an industry are endowed with **excess capacity / inventories** relative to expected demand.
- On the one hand **large excess capacity / inventories** imply that there is a **stronger incentive to deviate**.
(“a price reduction would help fill capacity / reduce inventories”)
- On the other hand if **rivals** are also endowed with **large excess capacities / inventories**, the **punishment may be stronger**.
- Thus **both sides** of the **ICC** are affected in a similar way, rendering the final effect on **collusion** **ambiguous**.

12. Price and Quantity Observability

- Being able to **detect deviations** is important for **collusion**.
- Stigler (1964): **collusion breaks down** due to **secret price cuts**.
- Green and Porter (1984): if actual prices (or price discounts) are **not observable**, then **collusion** is more **difficult to sustain**.
- Intuitively, in the case of **unobservability** of rival prices and market demand, a firm does not know if **fewer customers** are due to a **negative demand shock** or to a **rival price cut**.
- Thus, **observability** of prices and quantities helps firms to **collude**: it allows to identify **deviations** and target **punishment**.
- **Competition policy** should pay special attention to **practices** that help firms **monitor** each other's behaviour. (*e.g. information exchange agreements on prices, quantities, capacities, costs*)

13. Coordination and Communication

- When firms **repeatedly** meet in the marketplace, the **discount factor** is **large enough**, any price between **marginal cost** and the **fully collusive price** might be sustained. (*"Folk-Theorem"*)
- This raises the issue of **which price** is likely as the outcome.
- **Habit** (e.g. "status quo"), **history**, or **particular events** might provide firms with a **focal point** on which to coordinate.
- Example: a regulator fixes a certain price cap for an industry.
- **Announcement** of future prices or production plans **might** help **collusion**: firms may better coordinate on a particular equilibrium.
- Whereas **private announcements** should be forbidden (*"Pure coordination purpose to avoid price instability or wars"*), **public announcements** also exhibit welfare-enhancing effects. (*"transparency for consumers stronger than collusive effects"*)

14. Most-Favoured-Nation Clause

- A **most-favoured-nation clause (MFN)** engages a seller to apply to a buyer the **same conditions** he offers to other buyers.
- The effect of **MFN** clauses on **collusion** is **ambiguous**.
- This clause makes it **harder to deviate** from a collusive outcome (*“smaller additional profit as price reductions also for existing customers”*).
- Yet **punishments** are also **more costly** (*“no selective punishment possible only targeted to rival customers”*).

15. Meeting-Competition Clause

- A **meeting-competition clause (MC)** states that if the buyer receives a **better price** from another seller, the price is **matched**.
- **MC** clauses are **facilitating collusion**.
- This clause makes firms immediately **aware of deviations** (*"timely detection"*).
- Also, they **reduce** the incentive to **deviate** (*"price decreases can only attract new buyers, but not steal existing buyers from rivals due to MC"*).

16. Resale Price Maintenance

- **Resale Price maintenance (RPM)** is a **vertical agreement** whereby a manufacturer imposes upon its retailer(s) the **price** at which the good should be sold in the **final market**.
- **RPM** might **facilitate collusion** among manufacturers.
- With **fluctuating retail prices** (*e.g. due to changing costs of retailing*) and **not easily observable wholesale prices** by each cartel member, cartel stability would suffer.
- Members would have **difficulties distinguishing changes in retail prices** caused by **cost changes** from **cheating** on the cartel.
- **RPM** can enhance cartel stability here by **eliminating the retail price variation**.

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The Shadow of the Future

- Note that in a **finitely (or certain horizon) repeated game**, the **collusive outcome** can **never** obtain at equilibrium.
- In the last stage all firms would deviate as if playing a one-shot game: by **backward induction** deviation obtains at every stage.
- Hence, consider n firms playing an **infinitely repeated game** (*or a finitely repeated game with uncertain ending*).
- Let π_i^{col} and V_i^{col} denote current profits and present discounted profits of firm i , if all firms (always) choose the collusive action.
- Let π_i^{dev} denote current profits of firm i , if i deviates and the others collude.
- Let V_i^{pun} denote present discounted profits of firm i , if i 's opponents always choose the punishment action. (*"punishment phase"*)

Discount Factor and Interest Rate

- Denote with $\delta \in [0; 1]$ the **discount factor** assumed identical for all firms in the industry.
- Recall that the discount factor can be expressed as $\delta = \frac{1}{1+r}$, where r is the **interest rate** between two periods of time.
("The value in today's terms of €1 received in the next period")
- Note that $\delta \rightarrow 0$ corresponds to the case where $r \rightarrow \infty$: €1 earned in the future is not worth anything in today's terms.
*("people are **infinitely impatient** / no value attached to the future")*
- $\delta \rightarrow 1$ corresponds to the case where $r \rightarrow 0$: €1 earned in any future period has the same value as €1 earned today.
*("people are **infinitely patient** / equal value to future as present")*

Incentive Constraint for Collusion

- **Collusion** can arise only if each firm prefers to play the **collusive action** than to **deviate** from it (and be punished).
- Hence, for each firm for $i = 1, 2, \dots, n$ it must hold that:

$$\pi_i^{col} + \delta V_i^{col} \geq \pi_i^{dev} + \delta V_i^{pun} \quad (\text{ICC})$$

- The **lower** the **deviation profit** relative to the **collusive profit**, and the **lower** the **punishment phase profit**, the more likely that **collusion** is sustained.
- The **ICC** can also be written as

$$\pi_i^{dev} - \pi_i^{col} \leq \delta(V_i^{pun} - V_i^{col})$$

for every firm $i = 1, 2, \dots, n$.

("The gains from deviating today must be lower than the losses from deviating from tomorrow onwards!")

A Large Enough Discount Factor Makes It Possible For Collusion To Arise

- The **ICC** can also be expressed as

$$\delta \geq \bar{\delta} \quad \text{where} \quad \bar{\delta} = \frac{\pi_i^{dev} - \pi_i^{col}}{V_i^{pun} - V_i^{col}}$$

for every firm $i = 1, 2, \dots, n$.

- Thus, **collusion** arises at equilibrium only if the **discount factor** is **large enough**, i.e. larger than some critical discount factor $\bar{\delta}$.
- Only if firms are **patient enough** will the **collusive agreement** be **sustained**.
- Intuitively, if the **discount factor** is very **low**, firms give **little importance** to what happens in the **future** and prefer to **cheat** so as to reap all the benefit they can **today**: **collusion** will **not arise**.
- Note that the **ICC** holds for both **tacit** as well as **overt collusion**.

Analyzing Facilitating Factors: The Basic Model

- Consider an **infinite Bertrand game** with n identical firms producing the same **homogenous good** at the **same unit cost** c .
- In each period t of the game, firms **simultaneously** set **prices**.
- All firms share the same **discount factor** δ .
- Note that an equivalent analysis applies to a game where the **market exists** in the following period with a **probability** $\varphi \in [0; 1]$ with $\delta = d\varphi$ and d being the same discount factor of all firms.
- There are **no capacity constraints** and each firm maximizes its **present discounted value of profit**.

Analyzing Facilitating Factors: The Basic Model

- The **demand** for firm i is specified as follows:
 - If all firms charge the same price p , then they share demand equally, so that $D_i = \frac{D(p)}{n}$ as well as the corresponding profit, i.e. $\pi_i = \frac{\pi(p)}{n}$, where $\pi(p)$ denotes the aggregate profit with all firms charging p .
 - If firm i sets a price $p_i < p_j$ for every $j \neq i$, then it obtains the whole market, i.e. $D_i = D(p_i)$ with profits $\pi_i = \pi(p_i)$.
 - If there exists a firm $k \neq i$ such that $p_i > p_k$, then firm i obtains zero demand, i.e. $D_i = 0$ with profits $\pi_i = 0$.

- Consider the following **trigger strategies** for firm i :
 - At the **initial period** $t = 0$ set the **collusive price** $p_i = p_{col}$, which is the price that maximizes joint profits.
 - At period t set the price $p_i = p_{col}$ if all firms have set p_{col} in every preceding period, otherwise set $p_i = c$ forever.

Analyzing Facilitating Factors: The Basic Model

- Suppose that all firms use the **trigger strategies**.
- Intuitively, each firm behaves in a **collusive way** as long as all other do, but if one **deviates**, the **punishment** is triggered and all revert to the one-shot Bertrand equilibrium strategy forever.
- Note that this is the **harshest punishment**: after a **deviation** all firms earn **zero profits** forever.
- No credible punishment can be harsher and thus – with homogenous goods and price decisions – no other strategies can improve the chances of **collusion**.

Analyzing Facilitating Factors: The Basic Model

- **Collusion** arises at equilibrium if **no firm** has an **incentive to deviate** from the **trigger strategies** (“**ICC**”):

$$\frac{\pi(p_{col})}{n}(1 + \delta + \delta^2 + \delta^3 + \dots) \geq \pi(p_{col})$$

needs to hold for all firms in the industry.

- The **LHS** gives the total payoff a firm receives if it **colludes** and all others too: in every period the firm gets $\frac{1}{n}$ -th of aggregate profit, where profits at time t are discounted by a factor δ^t .
- The **RHS** gives the total payoff under the optimal **deviation**.
- If a firm **cheats** while all others collude, the best payoff obtains by **slightly undercutting**: with $p_{col} - \epsilon$ all consumers buy from the deviator with its profits being $\pi(p_{col} - \epsilon)$ in the deviating period.
- In all further periods **punishment** yields zero profit to the deviator.

Analyzing Facilitating Factors: The Basic Model

- As $\sum_{t=0}^{\infty} \delta^t = \frac{1}{1-\delta}$, the ICC simplifies to

$$\delta \geq 1 - \frac{1}{n} = \frac{n-1}{n}$$

- For $n = 2$ the standard duopoly case ensues: collusion is sustainable as long as $\delta \geq \frac{1}{2}$.
- For $n \rightarrow \infty$ collusion is impossible, as a discount factor $\delta > 1$ would directly contradict $\delta \in [0; 1]$.

Analyzing Facilitating Factors: Concentration

- From the ICC as $\delta \geq 1 - \frac{1}{n}$ it follows that the larger the number of firms n the tighter the ICC, i.e. the less likely that collusion will be sustained at equilibrium.
- Equivalently, an increase in concentration – with $\frac{1}{n}$ being an inverse index of concentration – makes collusion more likely.
- Note that asymmetries that increase concentration measures could actually hinder collusion and thus perturb the above argument based on concentration.

Analyzing Facilitating Factors: Irregular Orders

- Suppose that at $t = 0$ market demand and aggregate profit are $kD(p)$ and $k\pi(p)$, respectively, with $k > 1$.
- In the following periods $t = 1, 2, \dots$ market demand and aggregate profit are back to the usual levels $D(p)$ and $\pi(p)$.
- Note that this is equivalent to saying that there is an **unusually large order** in one period (in fact in the initial period).
- The **ICC** becomes:

$$\frac{\pi(p_{col})}{n} (k + \delta + \delta^2 + \delta^3 + \dots) \geq k\pi(p_{col})$$

which is equivalent to $\delta \geq \frac{(n-1)k}{1+(n-1)k}$.

- The **ICC** is more binding as k is larger, since k increase the RHS more than the LHS. *(In the limit case of $k \rightarrow \infty$ there would be no value of δ that can satisfy the condition for collusion.)*

Analyzing Facilitating Factors: Price Elasticity

- Note that the **price elasticity of demand** enters the **ICC** only through the expression of **profits**

$$\pi(p) = (p - c)D(p)$$

and these **cancel out**.

- Therefore, the **price elasticity of demand** does **not** seem to have any obvious impact on the **likelihood** of **collusion**.

Analyzing Facilitating Factors: Demand Evolution

- At time $t = 0$ demand and profit are given by $D(p)$ resp. $\pi(p)$, and at time $t > 0$ they are given by $\theta^t D(p)$ resp. $\theta^t \pi(p)$ with $\theta > 0$.
- The ICC then reads as follows:

$$\frac{\pi(p_{col})}{n} (1 + \delta\theta + \delta^2\theta^2 + \delta^3\theta^3 + \dots) \geq \pi(p_{col})$$

or equivalently $\delta \geq \frac{1}{\theta} (1 - \frac{1}{n})$.

- Demand growth** ($\theta > 1$): as the ICC is relaxed, collusion becomes easier (*“the expected rise in future demand increases the future cost of a deviation”*).
- Demand decline** ($\theta < 1$): as the ICC is tightened, collusion is less likely (*“the temptation to deviate is stronger because the future cost of deviating – the punishment – is lower”*).
- Thus, collusion is more likely to break when demand is falling.

Analyzing Facilitating Factors: Symmetry

- Consider a market A where two firms 1 and 2 operate with market shares λ and $1 - \lambda$, respectively.
- Assume that $\lambda > \frac{1}{2}$, i.e. that firm 1 is **large** and 2 is **small**.
- The firms have the same technology (no fixed cost but constant marginal cost c) and the same discount factor δ .
- The **ICC** for firm $i \in \{1, 2\}$ is given by

$$s_i \cdot (p_{col} - c) \cdot q(p_{col}) \cdot \frac{1}{1 - \delta} \geq (p_{col} - c) \cdot q(p_{col})$$

where s_i denotes the market share of firm i .

- Hence, $\frac{\lambda}{1 - \delta} \geq 1$ obtains for firm 1 and $\frac{1 - \lambda}{1 - \delta} \geq 1$ obtains for firm 2.

Analyzing Facilitating Factors: Symmetry

- The conditions simplify to $\delta \geq 1 - \lambda$ for the large firm 1 and $\delta \geq \lambda$ for the small firm 2.
- The **binding constraint** for **collusion** in market A thus is $\delta \geq \lambda > \frac{1}{2}$.
- Under **collusion** the **large firm** gets a **larger share**, while by deviating each firm obtains (for one period) all the market.
- Intuitively, the **incentive to deviate** is **higher** for the **small firm**, which can capture a **higher additional share** by **price cuts**.
- **Collusion** is **limited** by the extent to which the market shares are **asymmetric**: the higher the asymmetry the more stringent the **ICC** of the **smallest firm**.
- In the **symmetric** case, where firms have the same market share, the **standard condition** for **collusion** applies: $\delta \geq \frac{1}{2}$.

Analyzing Facilitating Factors: Multi-Market Contacts

- Suppose that firms are active in two markets A and B .
- Firm 1 has a market share λ (resp. $1 - \lambda$) in market A (resp. B), and firm 2 has a market share $1 - \lambda$ (resp. λ) in market A (resp. B), where $\lambda > \frac{1}{2}$.
- The ICC for firm $i \in \{1, 2\}$ in market $j \in \{A, B\}$ in isolation:

$$s_i^j \cdot (p_{col} - c) \cdot q(p_{col}) \cdot \frac{1}{1 - \delta} \geq (p_{col} - c) \cdot q(p_{col})$$

where s_i^j denotes the market share of firm i in market j .

- Note that firm 2's ICC, i.e. $\delta \geq \lambda$, is the binding constraint in market 1, while firm 1's ICC, i.e. $\delta \geq \lambda$, is binding in market 2.
- Collusion will thus arise in each market if $\delta \geq \lambda$, where $\lambda > \frac{1}{2}$.

Analyzing Facilitating Factors: Multi-Market Contacts

- However, each firm sells in two market and will hence **take into account both markets** when making its decisions.
- Accordingly, the **ICC** for firm $i \in \{1, 2\}$ reads as follows

$$s_i^A \cdot (p_{col} - c) \cdot q(p_{col}) \cdot \frac{1}{1 - \delta} + s_i^B \cdot (p_{col} - c) \cdot q(p_{col}) \cdot \frac{1}{1 - \delta} \geq 2 \cdot (p_{col} - c) \cdot q(p_{col})$$

- The incentive constraints for both firms simplify to $\delta \geq \frac{1}{2}$.
- Therefore, **multi-market contacts** help **collusion**, since the critical discount factor is lower.
- Generally, under **multi-market contacts** firms **pool** their **incentive constraints** and can use slackness of the constraint in one market to enforce more collusion in the other.
- Intuitively, **multi-market contacts** restore **symmetry** in markets which are **asymmetric** (and where market shares are inverse).

Multiplicity of Equilibria

- One problem with infinite horizon repeated games is that they admit a **continuum of equilibria**.
- In fact, equilibria can be formed with the **trigger strategies** for any price $p \in [c; p_m]$, where p_m denotes the monopoly price.
- The corresponding **ICC** reads as follows

$$\frac{\pi(p)}{n} (1 + \delta + \delta^2 + \delta^3 + \dots) \geq \pi(p)$$

which amounts to $\delta \geq 1 - \frac{1}{n}$.

- Therefore, the **same value** of the discount factor allows for a **continuum of equilibria**: any price between the **Bertrand price** and the **monopoly price** can be sustained in equilibrium.
- This result is not satisfactory, since a number of outcomes are possible and a priori it cannot be said which ones are more likely.

Agenda

- What Is Collusion?
- Factors Facilitating Collusion
- Modelling Collusion
- **Policy Practice**

Standards of Proof for Collusion

- A **collusive outcome** obtains when **prices** are “high enough”.
- One could then think that to **verify** the existence of **collusion** in the **legal sense**, one has to analyze **price data** in a given industry and infer whether they are **above some threshold levels**.
- Yet, it would be difficult in practice to look at **market outcomes** to decide whether there has been an **infringement of anti-trust law**.
- **Firstly**, often price data might simply be **not available**, and if they are they usually refer to **list prices** rather than effective prices.
- **Secondly**, even if price data were to exist, there would probably be **disagreement** about the **monopoly price**.
- **Thirdly**, even with agreement on the monopoly price, how close should prices be to be judged “**too high**” and thus **collusive**?
- **Fourthly**, the very principle to convict firms on the grounds of “**too high prices**” is dangerous, as also **penalizing successful firms**.

Standards of Proof for Collusion

- Rather than looking at the **level of prices**, one might then be tempted to analyze the **evolution of prices** over time.
- For instance, courts have sometimes charged for collusion when firms have charged similar prices over time. (**price parallelism**)
- But **common exogenous shocks** could also be inducing firms to proportional price increases without them colluding.
- Besides, a **collusive outcome** might arise **without** firms **agreeing or communicating** to coordinate their behaviour.
- If a seller increases prices by 10 % and the next day a rival follows: is this price parallelism enough evidence for conviction?
- Maybe they have taken their decisions **without communication**: the first firm might have expected the rival to follow and the rival might have expected to trigger a price war if not rising his prices.
- In the **absence of hard evidence** a court would have to argue by **second-guessing** the firms' intentions and motivations.

Standards of Proof for Collusion

- **Parallelism-plus** rule: **illegal behaviour** whenever **price parallelism** is accompanied by a **facilitating factor** (e.g. RPM).
- However, this rule does not seem more convincing unless it can be proven that firms have **coordinated** in order to introduce or keep the **facilitating practice** at stake.
- The very fact that firms have **followed** a particular practice should **not** be **proof of collusion**.

Standards of Proof for Collusion

- The presence of **price war periods** is also **no proof of collusion**.
- Under **imperfect price observability** and **demand uncertainty** full collusion cannot be sustained and **price wars** are an integral part of collusion.
- However, episodes in an industry with falling prices might be consistent with other events (e.g. new capacities appearing in the market; occasional competitors; demand reduction, etc.).
- Repeated episodes of this type would **raise suspicion** and deserve a **careful scrutiny** of the industry, but they should **not** be seen as the ultimate **proof** that collusion exists.
- Besides, even if good and reliable data existed, **econometric techniques** might not always provide unambiguous answers.
- Thus, **econometrics** is more likely to give **complementary evidence** rather than **conclusive proof** of collusion.

Standards of Proof for Collusion

- For all these reasons, inferring **illegal collusive behaviour** from market data (i.e. only outcomes) is **not desirable**.
- A legal approach that requests some **hard evidence** as **proof of collusion** is **sensible practice**.
- Firms should be convicted for **anti-competitive behaviour** only insofar as there is proof that they have **communicated** with each other to sustain **collusion**.
- This approach has the advantage that it is based on **observable elements** **verifiable in court**.
- If there is any **evidence on communication or coordination** (on prices, quantities, or facilitating practices) among the firms, they should be **fined**, otherwise not.

Standards of Proof for Collusion

- Accordingly, **tacit collusion** might be sustained by firms.
- However, there are good reasons why firms would like to **communicate** and/or **coordinate** their actions.
- They might want to avoid **unnecessary and costly experiments** with the market and choose instead the best prices, create facilitating practices, improve observability, to favour collusion.
- This induces firms to try to communicate so as to coordinate their actions, thereby leaving **traces of hard evidence** behind.
- Any other rule (e.g. inference from market data) which is **not** based on **observables** could not be easily enforced in courts.
- It would also be **detrimental to legal certainty**, as firms would not know whether their pricing policies might be accepted or fined.
- At the same time competition authorities would have to decide on a **case-by-case basis** rather than follow a clear rule.

Ex Ante Competition Policies against Collusion

- **Collusive agreements** are possibly the most **serious** infringement of competition law in any jurisdictions and are heavily penalized.
- **Firstly**, firms will generally **pay a fine** (which usually is a transfer to the country's general budget) .
- **Secondly**, firms might have to **pay damages** to private parties.
- **Thirdly**, managers might be given **prison sentences** (USA).
- Yet, what matters for **deterrence purposes** is not the size of the fine if found guilty of collusion, but the **expected fine**, i.e. the fine times the probability of being caught and found guilty.
- This raises the issue (so far little studied) of how anti-trust authorities should design their **policies** and organize their **investigations** so as to **efficiently deter collusion**.

Ex Ante Competition Policies against Collusion: Black List of Facilitating Practices

- Since **collusion** is **facilitated by certain practices**, authorities should identify business **practices** that should be **forbidden** and others which might be **tolerated** apart from specific cases.
- Some practices should therefore be on a **black list** and **per se prohibited**, and others should be under a **rule of reason**.
- Firms might ask for an **individual exemption** provided that they prove to achieve **efficiency gains**.

Ex Ante Competition Policies against Collusion: Auction Design to avoid Bid-Rigging

- One problem in **auctions** is that firms might use their bids to **signal their collusive intentions**.
- Auctions should thus be **designed** to minimize such problems.
- It is better to try to create an **environment** that **discourages collusion** in the first place than trying to prove unlawful behaviour afterwards.
- In the case of auction markets the **environment** can be **affected directly**, since the rules of the game are specified at the beginning by the **auctioneer**.
- In simultaneous ascending auctions **signalling can be avoided**:
 - Authorising round number and/or anonymous bidding only.
 - Objects can be aggregated into larger lots so as to make it harder for players to divide them.
 - Final round with sealed bid offers among the two remaining players.

Ex Ante Competition Policies against Collusion: Merger Control

- A reduction in the number of firms in the industry or a more symmetric distribution of their assets favours collusion.
- Hence, by increasing concentration, and to the extent that they increase symmetry, mergers might create favourable conditions for collusion to be sustained in a given industry.
- It is crucial, therefore, that competition authorities are vigilant on mergers.

Ex Post Competition Policies against Collusion: Dawn Raids

- Next to **ex ante measures** aimed at **preventing collusion**, authorities should also intervene to try to **break existing cartels**.
- One measure to discover “hard evidence” are surprise inspections, so-called “**dawn raids**”.
- Hence, competition authorities should be given **extensive search powers** so that they can, in collaboration with police forces, seize documents which might help prove collusive agreements.

Ex Post Competition Policies against Collusion: Leniency Programmes

- Competition authorities might also resort to more clever ways to break collusion, and provide **incentives** for firms to **withdraw from collusive agreements** and **reveal hard information**.
- In recent years, competition authorities have devoted a lot of attention to more sophisticated fine schemes.
- Such schemes (**leniency programmes**) grant **total or partial immunity from fines** to firms collaborating with the authorities.
- The idea is that people who break the law may actually **report** their crimes or illegal activities if given **proper incentives**.

Ex Post Competition Policies against Collusion: Leniency Programmes in the USA

- **Automatic leniency** is granted for firms that report evidence of a cartel **before** an investigation has begun provided that:
 - The firm is the first to come forward.
 - The firm terminates participation in the illegal activity.
 - The firm fully and continuously collaborates with the DOJ.
 - The firm makes restitution to the injured parties.
 - The firm did not coerce another party in the activity nor was it its leader or originator.
- **Discretionary leniency** exists for firms that report evidence **after** an investigation has begun provided that the DOJ does not yet have evidence against the firm for a likely sustainable conviction.
- Cooperating managers are **protected** from **criminal prosecution**.