

# ECN 453: Collusion and Price Wars 2

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## Collusion and Price Wars: Review

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- Main idea:

## Collusion and Price Wars: Review

- Last time: we studied how repeated interactions between firms can facilitate collusion.
- Main idea: firms can now threaten to punish each other in the future if they do not collude in the current period.
- Collusion required that the *discount factor*  $\delta$  be sufficiently high so that firms care 'enough' about future punishments.
  - E.g. 'Let's set the monopoly price together today otherwise I'll punish you tomorrow'.

# Plan

1. Stability of collusive agreements: discount factor
2. Factors that facilitate collusion
3. Price wars

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## Stability of collusive agreements: discount factor

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Then:

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

## Stability of collusive agreements: discount factor

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- If interest rate is  $r$  per period then an investor might use \$1 to gain  $\$(1+r)$  next period.  
Then:

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- What if  $r$  is the annual rate but firms can change their prices  $f$  times per year? Then:

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

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- E.g. Two pharmaceutical firms colluding. What if a third firm discovers an innovation (e.g. a superior drug) that would eliminate the market for the two firms? (This story is probably unlikely for some other industries like cement.)
- Let  $h$  be the probability that the industry will cease to exist one period later. Then:

$$\delta = \frac{1 - h}{1 + r/f}$$

## Stability of collusive agreements: discount factor

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- E.g. Two pharmaceutical firms colluding. What if a third firm discovers an innovation (e.g. a superior drug) that would eliminate the market for the two firms? (This story is probably unlikely for some other industries like cement.)
- Let  $h$  be the probability that the industry will cease to exist one period later. Then:

$$\delta = \frac{1 - h}{1 + r/f}$$

- What if industry is growing at rate  $g$ ? Then, profits in  $t + 1$  are  $1 + g$  greater than in period  $t$ .
- Could model this with a discount factor:

$$\delta = \frac{(1 + g)(1 - h)}{1 + r/f}$$

## Stability of collusive agreements: discount factor

$$\delta = \frac{(1 + g)(1 - h)}{1 + r/f}$$

- Collusion is normally easier to maintain when firms interact frequently and when the probability of industry continuation and growth is high.

# Plan

1. Stability of collusive agreements: discount factor
2. **Factors that facilitate collusion**
3. Price wars

## Factors that facilitate collusion: market structure

- Collusion is more likely in concentrated industries than fragmented ones
  - Easier to *establish* an agreement (anecdotal)
  - Easier to *Maintain* a collusive agreement

## Factors that facilitate collusion: market structure

- Example about maintaining an agreement:
- **Setup:**
- Consider the n-firm Bertrand model (i.e. homogeneous product, price competition etc) that is repeated infinitely many times. Assume agents have the discount factor  $\delta$ .
- Assume that firms sustain collusion using a 'grim trigger strategy' where:
  - They set the monopoly price  $p^M$  if the monopoly price has been set in all previous periods
  - Otherwise, set the perfectly competitive price  $p = MC$  if there is any deviation from the monopoly price.
- **Question:** How does the minimum discount factor that sustains collusion change with the number of firms  $n$ ?

## Factors that facilitate collusion: solution

- Maintain agreement:  
$$\Pi = \pi^M/n + \delta\pi^M/2 + \delta^2\pi^M/n + \dots = \frac{\pi^M/n}{1-\delta}$$
- Deviate:  
$$\Pi' = \pi^M + \delta 0 + \delta^2 0 = \pi^M + \frac{0}{1-\delta}$$
- Collude if:  $\Pi \geq \Pi'$ . Equivalently:  $\delta \geq 1 - \frac{1}{n}$
- So, as number of firms  $n$  increases, the minimum discount factor  $1 - \frac{1}{n}$  also increases.
- Intuition: benefit of staying in the agreement is lower with more firms (since the profits need to be split amongst more firms) but the punishment from the grim trigger strategy is the same.

## Factors that facilitate collusion: market structure

- Easier to maintain collusion amongst *similar* firms
- **Example:** Bromide cartel
  - In 1885-1914 industry was dominated by a cartel.
  - Six price wars occurred
  - Why? Wars were over disagreements about how to split the profits from the cartel, since the members of the cartel were many different sizes.
  - If the firms were all the same size, simply equally distribute the profits.
- **Overall: collusion is normally easier to maintain among few and similar firms.**

## Factors that facilitate collusion: multimarket contact

- What if firms compete with each other in several different markets?
- **Example:** Flight routes between two cities
- Average contact in each market: compute average number of other markets where competing airlines face each other
- This measure is positively correlated with airfares
- One explanation: airlines use competition on other routes as a means to collude on a given route.



## Factors that facilitate collusion: multimarket contact

- In what situations will multimarket contact facilitate collusion? Actually not obvious!
- **Setup:**
  - Note: in this example multimarket contact will *not* facilitate collusion
- Consider the collusion setup from the previous lecture with two *identical* firms: the firms choose prices (like in Bertrand) and sustain collusion using a grim trigger strategy.
- **Questions:**
  - What discount factors sustain collusion if the firms compete in a single market?
  - What discount factors sustain collusion if the firms compete in two identical markets?

## Factors that facilitate collusion: multimarket contact

- **Question:** What discount factors sustain collusion if the firms compete in a single market?
- **Solution:** From the last lecture, we found that  $\delta \geq 0.5$

## Factors that facilitate collusion: multimarket contact

- **Question:** What discount factors sustain collusion if the firms compete in two identical markets?
- **Solution:** Condition is now:

$$\frac{1}{1-\delta}0.5\pi^M + \frac{1}{1-\delta}0.5\pi^M \geq \pi^M + \pi^M$$

- $\delta \geq 0.5$ , so no change in range of discount factors that sustain collusion when there are more markets in this example.
- Why? Different markets are just a replication of each other so as costs of deviating increase, so do the benefits.

## Factors that facilitate collusion: multimarket contact

- **Setup:**
- Same setup as before (two markets, firms choose prices). Except:
- Firm 1 has cost advantage in market 1, with cost for Firm 2 higher than Firm 1  $\bar{c} > \underline{c}$ .
- Similarly, Firm 2 has cost advantage in market 2, with cost for Firm 1 higher than Firm 2  $\bar{c} > \underline{c}$ .
- Use numbers:  $\bar{c} = 1$ ,  $\underline{c} = 0$ ,  $p^M = 5$  and  $q = 1.0$  for all prices below  $p^M$ .
- **Question:** does multimarket contact facilitate collusion in this case?

## Factors that facilitate collusion: multimarket contact

- **Solution:**
- Consider the 'efficient' collusive agreement: lowest cost firm takes over each market.
  - Specifically, lowest cost firm prices at the monopoly price. The higher cost firm prices above the monopoly price so that the lower cost firm takes over the market.
- If no multimarket contact (i.e. firms look at each market in isolation) this agreement is *not* stable.
  - Why? The other firm could enter and undercut, and there's no way to punish this behavior.

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- What if there is multimarket contact? Specifically consider the threat that if firms deviate from the above agreement then the higher cost firm will undercut the other firm and price at  $\bar{c} = 1$ .

## Factors that facilitate collusion: multimarket contact

- **Solution:**
  - Consider the 'efficient' collusive agreement: lowest cost firm takes over each market.
    - Specifically, lowest cost firm prices at the monopoly price. The higher cost firm prices above the monopoly price so that the lower cost firm takes over the market.
  - What if there is multimarket contact? Specifically consider the threat that if firms deviate from the above agreement then the higher cost firm will undercut the other firm and price at  $\bar{c} = 1$ .
    - Remain in agreement:
      - $\Pi = (5 - 0) + \delta(5 - 0) + \delta^2(5 - 0) + \dots = \frac{5}{1-\delta}$
      - Deviate from agreement:
        - $\Pi' = (5 - 0) + (5 - 1) + \delta(1 - 0) + \delta^2(1 - 0) = 9 + \frac{\delta}{1-\delta}$
        - So, agreement sustainable if:  $\delta \geq 0.5$ . (Much better with multimarket contact than without, where the agreement was not at all sustainable.)

## Factors that facilitate collusion: information sharing

- Natural (but not always true) presumption: transparency increases competition
- But: may actually *enhance* collusion. Why?

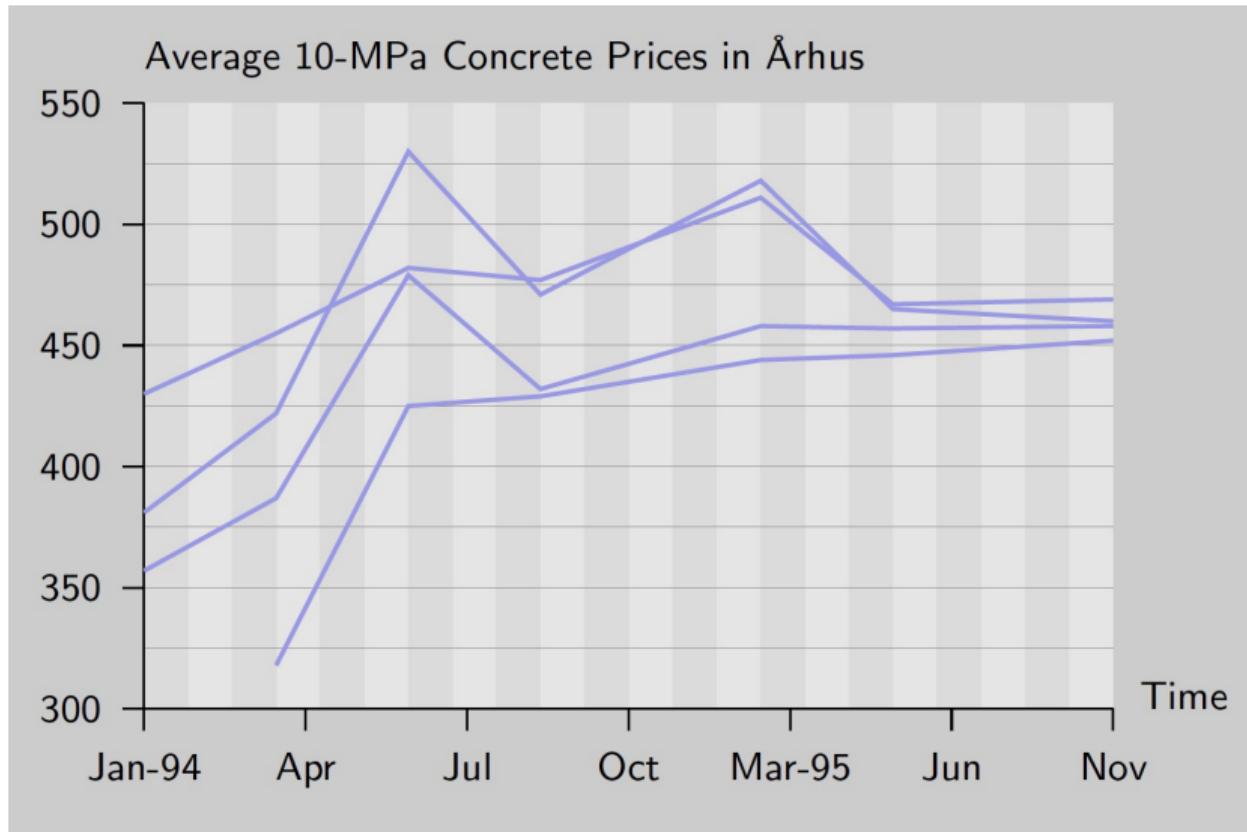
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- Example:
  - In the US until 1986 railroads could enter into confidential agreements with grain shippers.
  - In 1986: law passed that forced disclosure of certain terms of a contract
  - Empirical evidence: suggest that this caused prices to *increase*
  - Why? Public prices makes monitoring other firms and ensuring they stick to the agreement much easier.

## Factors that facilitate collusion: information sharing

- Another example: Danish ready-mixed concrete market
  - Regional oligopolies of a few firms
  - Until 1993, prices were frequently confidential
  - Regulator in October 1993 (Danish Competition Council) gathered and published actual transaction prices every week to try to increase competition and lower prices.
  - This resulted in higher prices (the regulation actually had the opposite intended effect)

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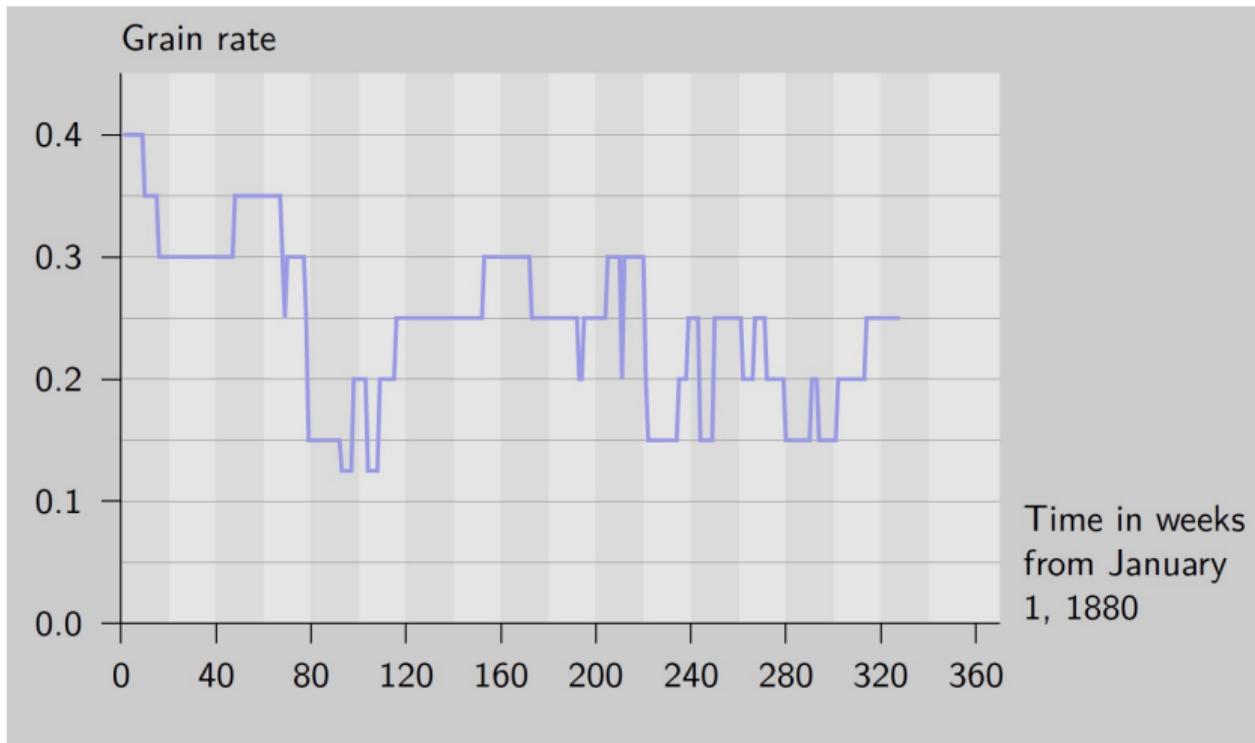
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## Price wars

- Implication of the model of collusion we have seen so far:
  - We should never actually see the threat of punishment being carried out.
- But in reality we see patterns of **price wars** in real-world cartels. Why?
  - Price war: prices oscillate between (high) collusive prices and (low) competitive prices.
- Example: Joint Executive Committee (a railroad cartel which controlled eastbound freight shipments from Chicago to the Atlantic in the 1880s)

## Price wars: the Joint Executive Committee, Porter (1983)



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- For each firm, there is a guessing problem:

## Price wars: the Joint Executive Committee, Porter (1983)

- Explanation for price wars: total demand fluctuates and these fluctuations cannot be perfectly observed. Each firm only sees the demand it receives.
- For each firm, there is a guessing problem:
  - Is my demand low because my rival has undercut me and cheated on the cartel agreement?
  - Or is it low because overall demand is low?

## Price wars: the Joint Executive Committee, Porter (1983)

- Potential solutions to the guessing problem:
  - No punishment. Not an equilibrium since then other firms could always blame market conditions and deviate from the agreement.
  - Indefinite price war. Would prevent cheating but would always end up in an indefinite price war when there is a demand shock (and so what is the point of the cartel?)
  - Intermediate solution: every time a firm receives low demand, revert to a temporary price war and after some time revert back to the previous arrangement.
    - Deters cheating
    - But avoids an indefinite price war
- **If price cuts are difficult to observe, then occasional price wars may be necessary to discipline collusive agreements.**

## Summary of key points\*

- Know how to compute the present discounted value given a discount factor
- Know what the grim trigger strategy is and how to check whether it is an equilibrium (and, alternatively, for what discount factors it is an equilibrium)
- Know how different industries may have different discount factors (which can affect how stable collusive agreements are).
- Understand different factors that facilitate collusion (market structure, multimarket contact, information sharing)
- Know that price wars may result as a way for cartels to enforce agreements with unobserved demand fluctuations

\*To clarify, all the material in the slides, problem sets, etc is assessable unless stated otherwise, but I hope this summary might be a useful place to start when studying the material.