Cartel

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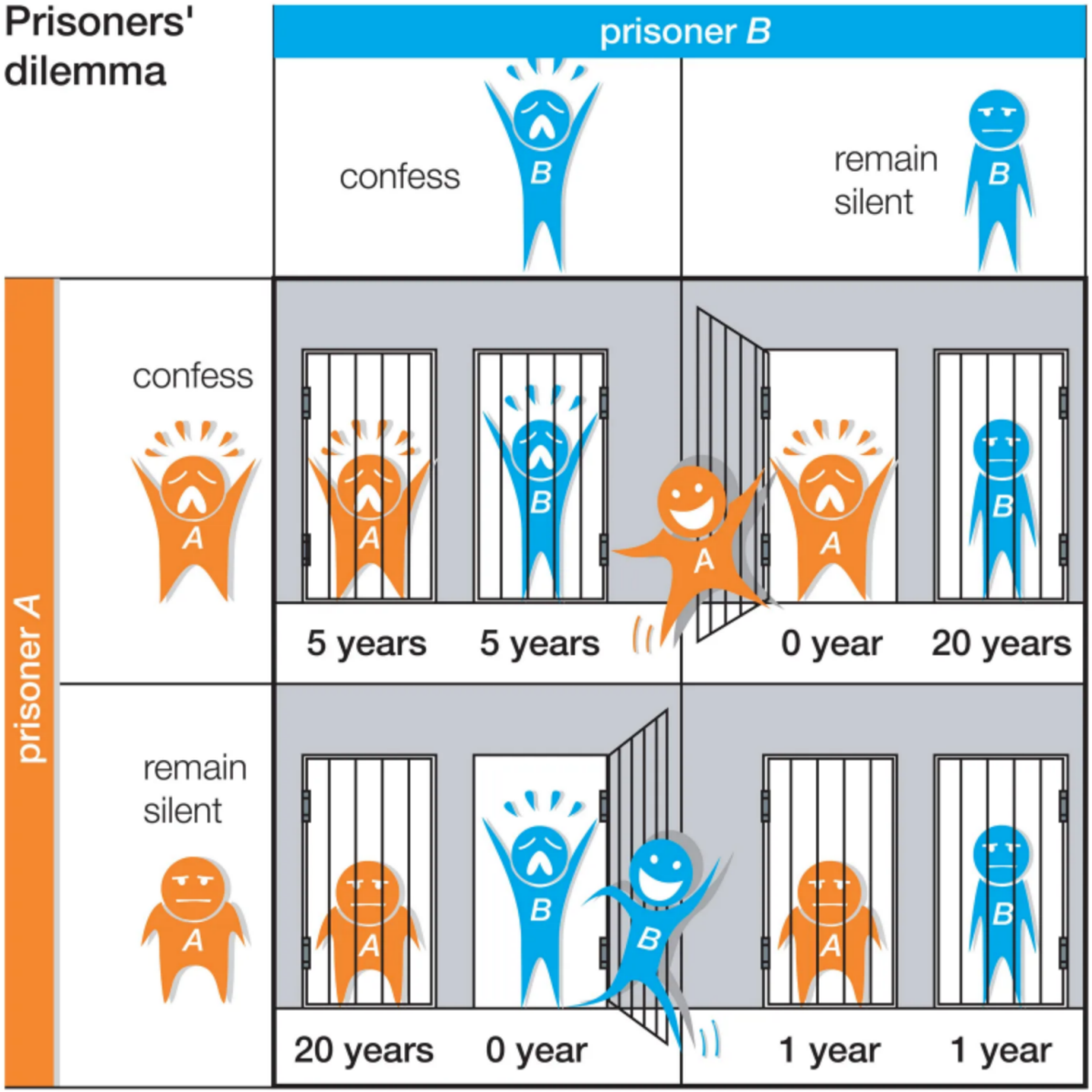
Outline

Prisoner's Dilemma[1]



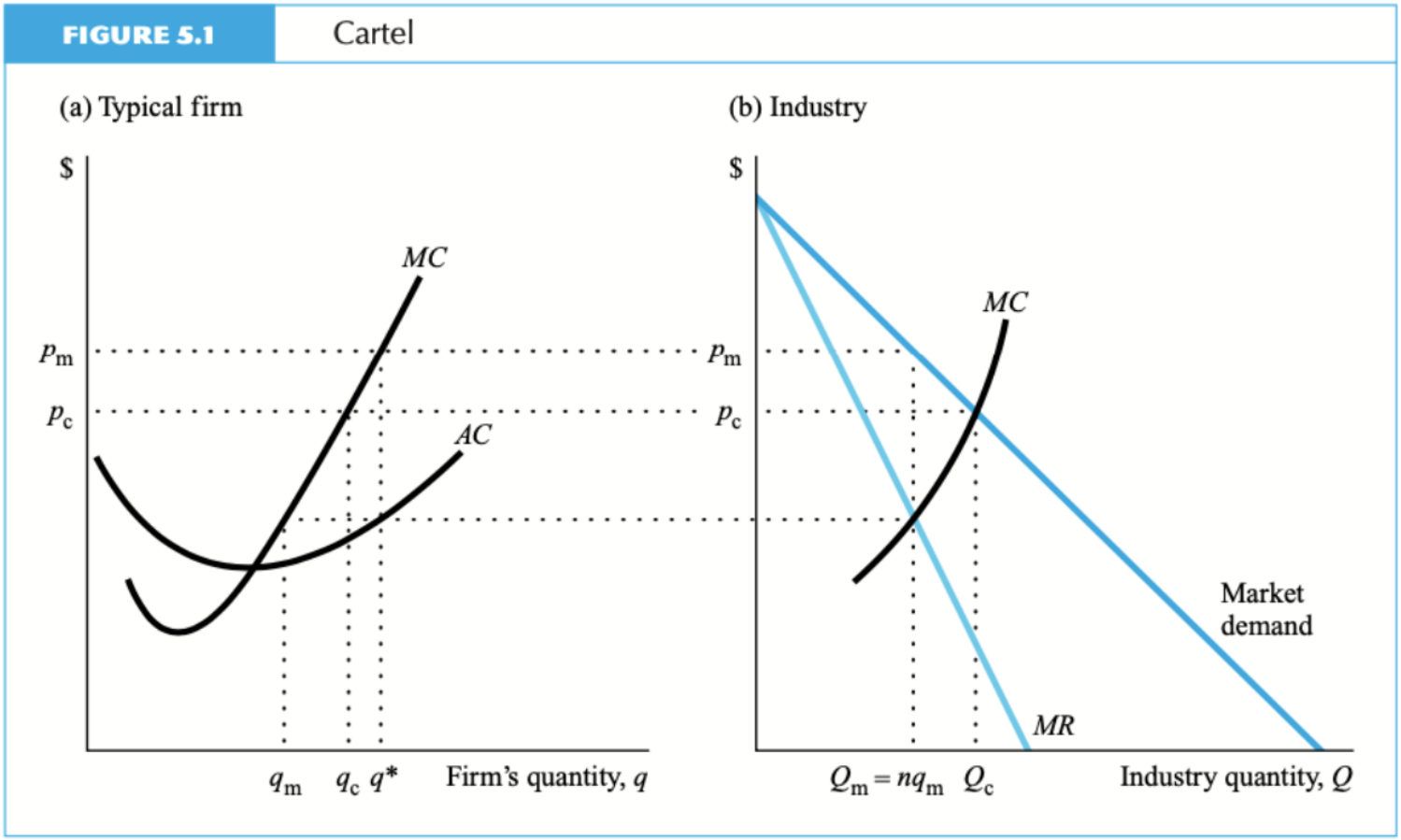
Prisoner's Dilemma[2]

Table: Payoff Matrix

		Player B	
		Confess	Remain Silent
Player A	Confess	[-5, -5]	[0,-20]
	Remain Silent	[-20,0]	[-1,-1]

Outline

Why Cartels Form[1]



Why Cartels Form[2]

- The competitive output Q_c is determined by the intersection of supply curve with the market demand curve (Figure 5.1b), with each firm producing q_c units of output (Figure 5.1a) and the market price is p_c
  - As with a monopoly, the cartel can restrict output and let the demand curve determine price or raise price and let the demand curve determine output
  - At the competitive output, the cartel's $MC > MR$ (Figure 5.1b), so it pays the cartel to reduce its output
  - Because the demand curve slopes downward, the marginal revenue curve lies below the demand curve, and $MR < MC$ at Q_c
  - Thus, it pays for the cartel to reduce output from the competitive level until its marginal revenue equals marginal cost, which guarantees that profits are maximized
  - The cartel increases its profits by lowering the aggregate cartel output to Q_m where $MR = MC$ (Figure 5.1b), whcih the price rises to p_m
  - Because the cartel is made up of n identical firms, it requires each firm to reduce its output to $q_m = \frac{Q_m}{n}$
  - In this example, the identical firms share in the extra profits equally
  - When all firms belong to the cartel, all the gains from reducing output and raising price go to the cartel, which divides the gains among its members

Outline

Outline

Three Major Factors

Three major factors are necessary to establish a cartel:

1. A cartel must be able to raise price above the noncartel level without inducing substantial increased competition from nonmember firms
2. The expected punishment for forming a cartel must be low relative to the expected gains
3. The cost of establishing and enforcing an agreement must be low relative to the expected gains

The Ability to Raise the Market Price

- Only if a cartel is expected to raise the price above the noncartel price and keep it high do firms join
- The more inelastic the demand curve facing a cartel, the higher the price the cartel can set and the greater its profits
  - if the cartel's demand curve is inelastic (relatively vertical at the current price), raising price can significantly raise revenues (quantity demanded falls by a smaller percentage than price rises) and profits
  - if a potential cartel faces an elastic demand curve (relatively horizontal), raising price causes revenues to fall
- Entry by nonmember firms or close substitutes produced in other industries prevents a cartel from raising price
  - if the cartel controls only a small share of the relevant market, firms not in the cartel undercut the cartel and prevent it from raising the market price
- Even if all firms initially in a market form a cartel and raise the price, the higher price may induce enough new firms to enter that the cartel is unable to keep the price high in the long run

Low Expectation of Severe Punishment

- Cartels only form if members do not expect the government to catch and severely punish them
- Large expected penalties reduce the expected value of forming a cartel in the first place

Low Organizational Costs[1]

- The more complex the negotiations, the greater the cost of creating a cartel
- Four factors keep the cost low facilitating the creation of a cartel:
  - **Few firms are involved**
  - **The market is highly concentrated**
    - ⋆ if a few large firms make most of the sales in a market, they can raise price without involving all the other (smaller) firms in the market

Low Organizational Costs[2]

- Four factors keep the cost low facilitating the creation of a cartel (cont'd):
  - **All firms produce a nearly identical product**
    - ⋆ firms have more difficulty agreeing on relative prices when each firm's product has different qualities or properties
    - ⋆ each time a product is modified, a new relative price must be established
    - ⋆ it is easier for a cartel to spot cheating when all it has to examine is a single price
    - ⋆ it is relatively difficult to detect price cutting that is achieved by an increase in quality: a firm could increase its quality and hold its price constant if it wanted to increase sales without explicitly violating the pricing agreement
  - **A trade association exists**
    - ⋆ by lowering the costs of meeting and coordinating activities among firms in a market, facilitate the establishment and enforcement of cartels

Outline

Detecting Cheating[1]

- A cartel cannot succeed if members can and want to cheat on the agreement
- Cartel agreements are easier to enforce if detecting violations is easy
- Four factors aid in the detection of cheating:
  - **There are few firms in the market**
    - with relatively few firms, the cartel may more easily monitor each one, and increases in one firm's share of the market (an indication of price cutting) are easier to detect
  - **Prices do not fluctuate independently**
    - if a market has frequent shifts in demand, input costs, or other factors, prices in that market have to adjust often, cheating on a cartel arrangement may be difficult to detect

Detecting Cheating[2]

- Four factors aid in the detection of cheating (cont'd):
  - **Prices are widely known**
    - ⋆ cheating is easier to detect if prices are known
    - ⋆ public availability of information can greatly simplify cartel enforcement. Publicly announcing price increases and decreases well in advance is one method of making price information available to all interested parties
  - **All cartel members sell identical products at the same point in the distribution chain**
    - ⋆ if some firms are vertically integrated (the same firm produces inputs, manufactures the product, and sells at the retail level), it may be difficult for the cartel to determine at what point in the distribution chain cheating occurs
    - ⋆ if all firms sell to the same type of customer (for example, at the retail level), cheating is easier to detect

Cartels with Little Incentive to Cheat[1]

- Members have no incentive to cheat on the cartel agreement if their marginal cost curves are relatively inelastic, their fixed costs are low relative to total costs, their customers place small, frequent orders, or they have a single sales agent
  - If a firm's marginal cost curve is nearly vertical, it has little to gain by cheating on the cartel agreement because it costs too much to substantially increase its output
  - In Figure 5.1a, if the marginal cost curve were nearly vertical, q^* would be close to q_c. Marginal cost curves are likely to be nearly vertical if firms are operating near their full capacities

Cartels with Little Incentive to Cheat[2]

- If there are many customers in a market who make small purchases, no firm has an incentive to lower prices below the cartel level
- If a firm lower prices without announcing the price cut, other customers are unlikely to learn of the price cut and hence its sales will not rise
- In contrast, when only a few customers place large, infrequent orders, a cartel has trouble detecting and preventing cheating. Firms have an incentive to grant price reductions to large buyers to keep them as customers

Methods of Preventing Cheating[1]

Unless a cartel can detect violations of its price-fixing agreement and prevent reoccurrences, member firms engage in secret price cutting that destroys the cartel. There are 6 methods of preventing cheating:

- **Fix more than just price**
- **Divide the market**
  - by assigning each firm certain buyers or geographic areas, which allows cheating to be detected easily
- **Fix market shares**
  - as long as market shares are easily observable, no firm has an incentive to cut its price
  - if a firm lowered its price, its share would increase, and other firms would retaliate
- **Use most-favored-nation(MFN) clauses in a sales contract**
  - guarantees the buyer that the seller is not selling at a lower price to another buyer

Methods of Preventing Cheating[2]

- **Use meeting-competition clauses in a long-term supply contract or in an advertisemen**
  - guarantees the buyer that if another firm offers a lower price, the seller will match it or release the buyer from the contract
  - such a clause makes it difficult for a firm to cheat, because buyers will bring news of lower prices to the cartel
- **Establish trigger prices**
  - All cartel members could agree that if the market price drops below a certain level (called a trigger price), each firm will expand its output to the precartel level
    - ⋆ In this case, a firm that cuts its price might gain in the extremely short run, but would lose in the end due to the destruction of the cartel by this predetermined punishment mechanism
    - ⋆ This mechanism may be attractive to the cartel because, if the punishment period (when all firms produce large levels of output) is long enough, it is never in a firm's best long-run interest to cheat on the cartel

Cartels and Price Wars

- Many observers, seeing large price fluctuations in a market, argue that the firms in that market are trying to form a cartel that keeps breaking apart.
- They conclude that government intervention is not required because competitive forces keep destroying the cartel.
- Yet, these fluctuations could be part of a rational, long-run cartel policy involving trigger prices, as discussed in the preceding section. This trigger-price argument holds that price wars occur more
  - often during unexpected business cycle downturns (recessions and depressions) when price is likely to decline in response to lowered demand (Green and Porter 1984; Staiger and Wolak 1992). We expect then that cartels are more likely to terminate during a price war.
  - Other economists argue that price wars should occur in periods of high demand (Rotemberg and Saloner 1986). They reason that the benefit from undercutting the cartel price is greatest during booms.

What Determines Cartel Success?[1]

- Valerie Y. Suslow (1998) investigates the stability of cartels over the business cycle by examining 72 international cartel agreements covering 47 industries during the period 1920–39.
  - Because major European countries had no systematic antitrust legislation prior to World War II, these cartels were legal and had formal written contracts.
    - ★ As of 1927, cartels were legal in Switzerland, whereas Belgium, France, Spain, Italy, and the Netherlands did not explicitly prohibit them. Under German law, cartels were legal; however, Germany passed antitrust legislation in 1923 that was designed to guard against abuses of economic power.
    - ★ In 1930, Great Britain adopted a resolution recognizing cartels as a fact of economic life, but calling for the principle of publicity, which required compulsory notification, registration, and publication of the cartel agreements. Other European countries followed Great Britain's policy in the mid1930s. It was not until after World War II that France passed legislation to control cartel activity.

What Determines Cartel Success?[2]

- It should have been easier for these cartels to survive than for illegal ones in the United States.
  - German, French, or British firms were participants in roughly half the cartels, and U.S. firms were involved in one-third of them. In the 1940s, U.S. firms were indicted for their participation in 10 of these international cartels.
  - According to Suslow, the median cartel lasted slightly more than 5 years; 75 percent lasted more than 2 years, and 20 percent lasted more than 10 years.
- There was an industry pattern.
  - Of the single-episode cartels, 40 percent involved chemicals, with only 6 percent in metals.
  - In contrast, 46 percent of the multiple-episode cartels involved metals, with only 17 percent in chemicals.
  - In the 42 cartel episodes in which the number of firms is known, 83 percent had 10 or fewer firms, 64 percent had 5 or fewer, and 39 percent had 3 or fewer. Of the 74 percent of the 39 cartels for which there is market-share information, each had a world market share of over 50 percent.
  - Thus, as with U.S. cartels, these international cartels involved relatively few firms with large collective market shares.

What Determines Cartel Success?[3]

- Suslow estimates the probability that a cartel will fall apart at a specific time, given that it survives until that time.
- Controlling for other factors, she found that cartels are more likely to fail during business-cycle downturns (recessions and depressions).
- Moreover, cartels that were alive during periods of growth were less likely to end than others.
- In general, greater volatility in aggregate economic activity over the lifetime of the cartel (frequent upswings and downturns) increases the probability of cartel breakdowns.
- We have discussed several factors that help a cartel to form and to prevent cheating. Many large, successful cartels possess these properties. Table 5.1 (from Connor 2003) shows the presence of these market conditions in the lysine, citric acid, and vitamins A and E industries in the early 1990s, when each had an operating cartel. Entry plays a particularly important role (see de Roos 1999 on lysine).

[Illustration] Market Conditions for Cartel Success

TABLE 5.1 **Market Conditions Facilitating Global Price Fixing in Lysine, Citric Acid, and Vitamins A and E in the Early 1990s**

Market Conditions	Lysine	Citric Acid	Synthetic Vitamins A & E
High seller concentration (CR4[a])			
Global market	> 95%	> 80%	> 95%
U.S. market	> 97%	= 90%	100%
Few cartel participants	4 or 5	4 or 5	3
High cartel supply control	95–99%	65–70%	95–100%
Low buyer concentration (CR4)	< 30%	< 40%	< 20%
Homogeneous product	Perfect	High	High
High barriers to market entry:			
Large plant scales	$150 million+	$150 million	Probably
Sunk investment costs	Yes	Yes	Yes
Technology secret	Yes	Yes	Yes
Slow building of new plants	3 years+	3 years+	3 years+
Buyers' observation of market prices	None	Some	Little
Annual market growth	10%, steady	8%, steady	2–3%, steady

[a] CR4 is the share of sales of the four largest firms in the industry.

Source: Connor (2003).

[Example] Vitamins Cartel[1]

- In the 1990s, there was a massive worldwide cartel involving many different vitamins, including biotin, folic acid, and vitamins A, B1, B2, B5, B6, C, and E, among others.
- Vitamins have a wide variety of uses as additives to human and animal diets and in skin and healthcare products. The various vitamins are not substitutes for each other.
- Vitamin production is highly concentrated among a few firms.
  - At the time of the cartel, the three largest producers were Hoffman-LaRoche (which since has sold its vitamins business), which produced 40 to 50 percent of all vitamins; BASF, with a 20 to 30 percent share;
  - and Aventis (formerly Rhone-Poulenc), with a 5 to 15 percent share.
  - These major manufacturers produced many of the same vitamins.
  - Over half of all vitamin sales were for vitamins A and E, which were sold by all three major producers.
- Allegedly beginning in 1989, Hoffman-LaRoche, BASF, and Rhone-Poulenc held meetings to discuss allocations of market sales around the world so as to reduce competition, and soon thereafter other firms became involved in a worldwide cartel.

[Example] Vitamin Cartel[2]

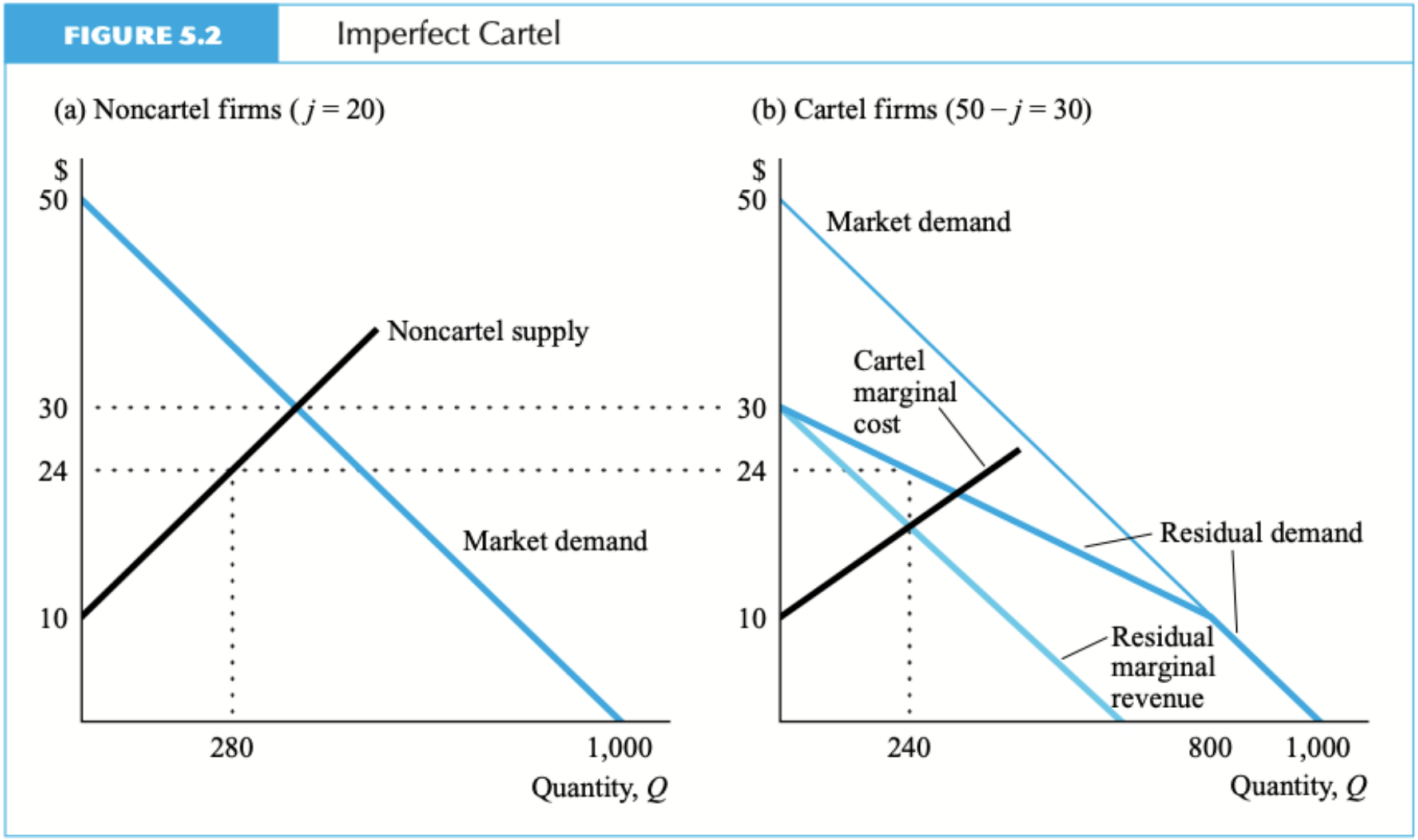
- The cartel fixed market shares for each vitamin by country, agreed on price increases, specified target prices and minimum prices, and shared information to ensure that each firm was abiding by its allocation.
- Sometimes the firms explicitly discussed large individual customers and agreed on those customers' prices and how much of the customers' needs each manufacturer would supply.
- The firms met regularly. There were four levels of meetings:
  - the highest level involving senior executives who determined overall strategy and adherence to the agreements;
  - the next level involving marketing executives about two or three times a year;
  - another meeting (usually quarterly) involving marketing managers of individual products to monitor the implementation of the allocations;
  - and finally, quarterly meetings of regional marketing managers to discuss pricing, implement price increases, and adjust allocations. The "budget meetings" in August were used to outline allocations for the coming year, together with price increases.

See [3] for further reading.

Outline

Consumers Gain as Cartels Fail[1]

- The violators of the cartel agreement produce more than the cartel wants, which lowers the market price



Consumers Gain as Cartels Fail[2]

- The market in this example includes 50 identical firms. Assume that no more firms can enter this market
  - Of the 50 firms, j firms do not follow the cartel's agreement to restrict output; they sell as much as they want (price takers)
  - The cartel is a dominant firm facing a competitive fringe. The residual demand facing the cartel is obtained by subtracting the fringe supply from the market demand
- Figure 5.2b shows the residual demand curve (thick dark blue line) that lies below the market demand curve (thin blue line) at prices above the competitive firms' shutdown level ($p = 10$). The residual demand curve has a kink in it at $p = 10$

Consumers Gain as Cartels Fail[3]

- Because cartel firms have the same cost functions as noncartel firms, the cartel cannot afford to produce at prices below $p = 10$ either, so the lower portion of the residual demand curve is not of interest
- The profit-maximizing cartel chooses its output $Q_{cartel} = 240$ by setting its residual marginal revenue equal to its marginal cost, as shown in Figure 5.2b. This output determines the cartel price ($p_{cartel} = 24$)
- At that price, the noncartel firms' output is $Q_{noncartel} = 280$ as Figure 5.2a shows

Consumers Gain as Cartels Fail[4]

TABLE 5.2 **Market Variables Under Various Degrees of Cartelization (50 Firms)**

	Number of Noncartel Firms	Price (p)	Market Elasticity	Market Output	Industry Profits (π)	Consumer Surplus (CS)	Welfare ($CS + \pi$)
Monopoly	0	33.33	−2.00	333	6,667	2,778	9,445
	1	32.41	−1.84	352	6,524	3,094	9,618
	10	26.97	−1.17	461	5,318	5,304	10,622
	20	24.00	−0.92	520	4,360	6,760	11,120
	30	22.44	−0.81	551	3,743	7,591	11,337
	40	21.67	−0.76	567	3,391	8,027	11,418
	49	21.431	−0.75	571	3,267	8,162	11,428
Competition	50	21.429	−0.75	571	3,265	8,163	11,429

CS = Consumer Surplus is the triangle with area $(1{,}000 - 20p)^2/40$.
Cartel's Market Share (as a percentage) = 100 times the cartel's sales divided by total sales.
DWL = Deadweight Loss (competitive welfare − actual welfare).
Price Markup (as a percentage) = $100(p - MC)/p$.

			Cartel Firm		Noncartel Firm	
DWL as % of Sales	Cartel's Market Share (%)	Price Markup (%)	Output	Profits	Output	Profits
17.9	100	50	6.66	133.33	—	—
15.9	94	48	6.72	128.02	22.41	251.10
6.5	63	36	7.27	96.95	16.97	143.99
2.5	46	25	8.00	80.00	14.00	98.00
0.7	32	16	8.89	71.08	12.44	77.38
0.1	18	8	10.00	66.70	11.67	68.09
0.0	2	1	11.27	65.32	11.431	65.33
—	0	—	—	—	11.429	65.31

Consumers Gain as Cartels Fail[5]

- Table 5.2 shows what happens as the number of firms belonging to the cartel changes
- The market is in competitive equilibrium when all 50 firms act independently and do not belong to the cartel ($j = 50$). The competitive market price is \$21.43, and consumer surplus and total welfare are maximized
- At the other extreme, if all the firms join the cartel ($j = 0$), the cartel is a monopoly. The monopoly price is \$33.33. Only 333 units of output are produced by the market. However, each firm's profits of \$133.33 is more than double the competitive level, \$65.31
- Consumer surplus is only about one-third as great, and total welfare is only 83 percent as great as under competition; that is, consumer losses are greater than the cartel gains

Consumers Gain as Cartels Fail[6]

- As the cartel gains members, the incentive of a cartel firm to cheat also grows, because the discrepancy between a nonmember's profit and a cartel firm's profit increases
- At every price, nonmembers earn more than cartel members, because nonmembers produce more yet sell at the same price as cartel members
- The welfare losses from such a limited cartel are small. The larger the market share of the cartel, the greater the efficiency cost

Outline

Price-Fixing Laws

- The Sherman Antitrust Act of 1890 was passed in response to cartels "to protect trade and commerce against unlawful restraints and monopolies"
- In 1914, the Federal Trade Commission Act established the Federal Trade Commission (FTC), and its Section 5 holds that "unfair methods of competition are hereby declared illegal"
- This approach to preventing price fixing is based on evidence of conspiracy rather than the economic effects of the conspiracy: government seeks evidence of conspiracies (such as secret meetings in smoke-filled rooms) rather than economic evidence (such as price increases)

Outline

The Effects of Cartel Size[1]

The followings demonstrate how price and output vary with the number of cartel members. The total number of firms is assumed to be fixed at n (no further entry is possible)

- Market demand curve is linear:

$$Q = a - bp \tag{5A.1}$$

- Where a and b are positive constaints, Q is market ouput and $p$is the price
- The elasticity of demand is

$$\epsilon = \frac{dQ}{dp}\frac{P}{Q} = 1 - \frac{a}{Q} = \frac{-bp}{a - bp} \tag{5A.2}$$

The Effects of Cartel Size[2]

- Each firm has a linear marginal cost (MC) of

$$MC = d + eq \tag{5A.3}$$

- Where q is the outpot of one of the $n$firms and d and e are positive constants
- As a result, the competitive supply is

$$Q = nq = \frac{n(p-d)}{e} \tag{5A.4}$$

The Effects of Cartel Size[3]

- Competitive equilibrium is determined by setting the right-hand sides of the quantity-demanded equation (5A.1) and the quantity-supplied equation (5A.4) equal, and solving for p_c (equilibrium price). The equilibrium quantity Q_c can be found by substituting p_c into Equation (5A.1) or (5A.4). The equilibrium values are

$$p_c = \frac{ae + nd}{be + n} \tag{5A.5}$$

$$Q_c = n\left(\frac{a - bd}{be + n}\right) \tag{5A.6}$$

- Now suppose that $(n - j)$ firms in the market form a cartel and the remaining j firms $(j < n)$ do not. As shown in Figure 5.2b, the residual demand Q_r is the market demand minus the noncartel supply $Q_{nc} = jq$

$$Q_r = Q - jq = a - bp - \frac{j(p - d)}{e} \tag{5A.7}$$

The Effects of Cartel Size[4]

- The cartel acts as a monopoly with respect to its residual demand and sets its marginal revenue, MR_m, equal to its marginal cost. The cartel's revenues R_m may be found by solving Equation (5A.7) for p as a function of Q_r and multiplying that by Q_r to obtain

$$R_m = pQ_r = \left(\frac{ae + jd - eQ_r}{be + j}\right) Q_r \tag{5A.8}$$

- By differentiating R_m with respect to Q_r, we obtain the cartel's marginal revenue:

$$MR_m = \frac{ae + jd}{be + j} - \left(\frac{2e}{be + j}\right) Q_r \tag{5A.9}$$

- The cartel's marginal cost is

$$MC_m = d + \left(\frac{e}{n - j}\right) Q_m \tag{5A.10}$$

The Effects of Cartel Size[5]

- The quantity the cartel chooses to produce Q_m $(= Q_r)$ is determined by equating the cartel's marginal revenue, Equation (5A.9), and marginal cost, Equation (5A.10):

$$Q_m = \frac{(n-j)(a-bd)}{be+2n-j} \tag{5A.11}$$

- By differentiating Q_m with respect to j, it can be shown that the cartel's output falls as the number of nonmember firms rises

For Further Reading I

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- Belleflamme, Paul., and Martin. Peitz. Industrial Organization : Markets and Strategies. Cambridge, UK ;: Cambridge University Press, 2010. Print.
- Igami, Mitsuru, and Takuo Sugaya. "Measuring the Incentive to Collude: The Vitamin Cartels, 1990–99." The Review of Economic Studies 89.3 (2022): 1460-1494.