

INTRODUCTION TO INDUSTRIAL ORGANIZATION

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DO EXERCISE 3 REVIEW QUESTION 3.5, 3.8 AND 3.10

EXERCISE 3 REVIEW AND PRACTICE EXERCISES

- 3.1** Explain why the assumption of profit maximization is or is not reasonable.
- 3.2** Should firms have their own catering services, or should they outsource this? What are the main trade-offs? Are there other alternatives in addition to “make or buy”?
- 3.3** Two parts in an automobile taillight are the plastic exterior cover and the light bulb. Which of these parts is a car company more likely to manufacture in-house? Why? ⁴⁰
- 3.4** There are three main suppliers of commercial jet engines—Pratt & Whitney, General Electric, and Rolls-Royce. All three maintain extensive support staff at major (and many minor) airports throughout the world. Why doesn't one firm service each airport? Why do all three feel they need to provide service and support operations worldwide themselves? Why don't they subcontract this work? Why don't they leave it entirely to the airlines? ⁴¹
- 3.5** The Smart car was created as a joint venture between Daimler-Benz AG and Swatch Group AG. Although Micro Compact Car AG (the name of the joint venture) was originally jointly owned, in November of 1998 Daimler-Benz AG took complete control by buying Swatch's share. ⁴¹ The deal put an end to a very stressed relationship between Daimler and Swatch. What does [section 3.2](#) suggest as to what the sources of strain might have been?
- 3.6** Why do television networks have a few “owned and operated” stations but work through independent affiliates in most geographic locations? ⁴²
- 3.7** Empirical evidence from franchise retailing suggests that, even when stores have similar characteristics, the mother company resorts to a mix between company-owned stores and franchised ones. ⁴³ How can this be justified?
- 3.8** The U.K. Body Shop franchise network consists of three types of stores—franchised, company-owned, and partnership stores. All stores that are distant from headquarters by more than 300 miles are franchised. More than half of the company-owned stores are within 100 miles of headquarters. ⁴⁴ How can you explain these facts?
- 3.9** Explain why Intel has maintained, if not increased, its competitive advantage with respect to rivals. Indicate the explanatory power of the different causes considered in the text (impediments to imitation, causal ambiguity, strategy, history).

EXTENSION EXERCISES

3.10*** suppose that a firm's profits are given by $\pi = \alpha + \phi(e) + \epsilon$ where α denotes the intensity of product market competition, e effort by the manager, and ϵ a random shock. The function $\phi(e)$ is increasing and concave, that is, $\phi' > 0$ and $\phi'' < 0$.

For the firm to survive, it must be that profits are greater than π . The manager's payoff is $\beta > 0$ if the firm survives and zero if it is liquidated, that is, if profits fall short of the minimum target. The idea is that if the firm is liquidated, then the manager loses his job and the rents associated with it.

Suppose that ϵ is normally distributed with mean μ and variance σ^2 , and that $\mu > \pi$. Show that increased product market competition (lower α) induces greater effort by the manager, that is, $\frac{\partial e}{\partial \alpha} < 0$.

NOTES

^a The first two questions—profit maximization and firm boundaries—have been extensively examined by industrial economists over the past two decades or so. Much less so the third question, although one can argue that it is the most important of the three questions.

^b This argument suggests that monitoring by shareholders is more frequent when ownership is more concentrated. However, anecdotal evidence suggests that German banks, which own significant shares in other firms, do not monitor CEOs to any significant extent. Evidence from the U.S. banking industry (see [box 3.2](#)) also suggests that shareholder concentration has little effect.

^c We say that an agent is risk neutral if he or she is indifferent between receiving 100 for sure and receiving 0 or 200 with probability 50% each. Generally, a risk-neutral agent cares only about the expected value of each outcome. By contrast, a risk-averse agent would prefer a safe outcome to another outcome with the same expected value but greater risk. In the preceding example, a risk-averse agent would prefer 100 for sure to the 0 or 200 gamble.

^d Eventually, Lockheed exited from the civil aviation market. McDonnell Douglas, in turn, was acquired by Boeing. In the meantime, Airbus appeared in the scene, challenging Boeing's dominance.

BOX 3.2 FIRM MONITORING AND FIRM PERFORMANCE: EVIDENCE FROM THE U.S. BANKING INDUSTRY³²

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Banking regulation varies considerably throughout the United States. In particular, some states are "takeover-friendly," whereas others are not. This fact provides a natural experiment on the effect of takeovers and the threat of takeover on firm performance. Based on a cross section of states, the following results are obtained:

Explanatory Variables:

- Takeover are allowed in state (1 if Yes, 0 if no)
- Percentage of shares controlled by five largest nonmanagement shareholders
- Common stock and stock options owned by most highly paid officer divided by annual

* Same as third variable in row
 ** Not statistically different from zero.

Explained Variance	
profit margin	stock options
.112	-4.77
xx	xx
-0.023	

The .112 coefficient indicates that, everything else constant, profit margins are 11.2% higher in states that allow takeovers than in states that do not. This result suggests that the threat of takeovers significantly disciplines managerial behavior. Shareholder concentration, by contrast, seems to have no effect on firm profitability (second row variable). Performance pay (third variable in row) has a *negative*

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DO EXERCISE 4. ALL QUESTIONS QUESTIONS REVIEW AND PRACTICE EXERCISES

4.1 What are the assumptions regarding player rationality implicit in solving a game by elimination of dominated strategies? Contrast this with the case of dominant strategies.

4.2 The U.K. Office of Fair Trading has recently unveiled a plan that will offer immunity from prosecution to firms who blow the whistle on their co-cartel conspirators. In the United States, this tactic has proven extremely successful: Since its introduction in 1993, the total amount of fines for anticompetitive behavior has increased twentyfold.

Show how the tactic initiated by the U.S. Department of Justice, soon to be followed by the U.K. Office of Fair Trading, changes the rules of the game played between firms in a secret cartel.

4.3 Figure 4.11 represents a series of two-player games that illustrate the rivalry between *Time* magazine and *Newsweek*. Each magazine's strategy consists of choosing a cover story: "Impeachment" and "Financial Crisis" are the two choices.

The first version of the game corresponds to the case when the game is symmetric (*Time* and *Newsweek* are equally well positioned). As the payoff matrix suggests, "Impeachment" is a better story but payoffs are lower when both magazines choose the same story. The second version of the game corresponds to the assumption that *Time* is a more popular magazine (*Time*'s payoff is greater than *Newsweek*'s when both magazines cover the same story). Finally, the third version of the game illustrates the case in which the magazines are sufficiently different that some readers will buy both magazines even if they cover the same story.

Figure 4.11 DOMINANT STRATEGIES, DOMINATED STRATEGIES, AND NASH EQUILIBRIUM

PLAYER 2

	L	C	R
T	1, 1	2, 0	1, 1
M	0, 0	1, 1	-1, 0
B	2, 1	1, 0	2, 2

Figure 4.11

Newsweek

	Impeachment	Financial crisis
Impeachment	35, 35	70, 30
Financial crisis	30, 70	15, 15

(i) Time and Newsweek are evenly matched

	Impeachment	Financial crisis
Impeachment	42, 28	70, 30
Financial crisis	30, 70	18, 12

(ii) Time is more popular than Newsweek

	Impeachment	Financial crisis
Impeachment	42, 28	70, 50
Financial crisis	50, 70	30, 20

(iii) Some readers will buy both magazines

FIGURE 4.11 THE COVER-STORY GAME.

For each of the three versions of the game,

- Determine whether the game can be solved by dominant strategies.
- Determine all Nash equilibria.
- Indicate clearly which assumptions regarding rationality are required in order to reach the solutions in (a) and (b).

4.4* In the movie *E.T.*, a trail of Reese's Pieces, one of Hershey's chocolate brands, is used to lure the little alien out of the woods. As a result of the publicity created by this scene, sales of Reese's Pieces trebled, allowing Hershey to catch up with rival Mars.

Universal Studio's original plan was to use a trail of Mars' M&Ms. However, Mars turned down the offer, presumably because it thought \$1 million, the price demanded by the producer of *E.T.*, was very high. The makers of *E.T.* then turned to Hershey, who accepted the deal.

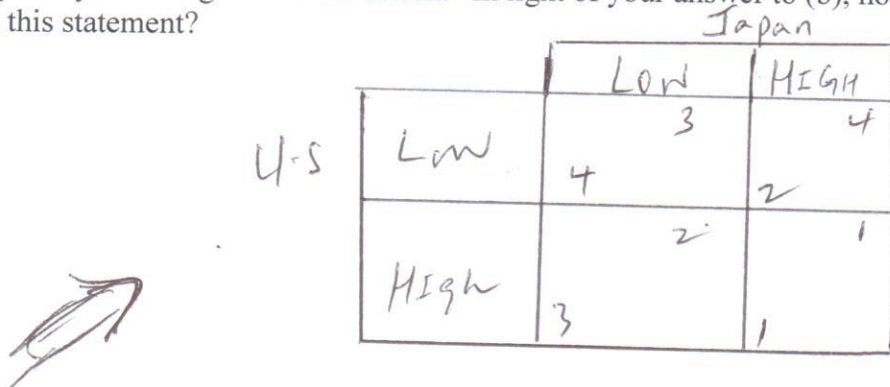
Suppose that the publicity generated by having M&Ms included in the movie would increase Mars' profits by \$800,000. Suppose moreover that Hershey's increase in market share cost Mars a loss of \$500,000. Finally, let b be the benefit for Hershey from having its brand be the chosen one.

Describe the preceding events as a game in extensive form. Determine the equilibrium as a function of b . If the equilibrium differs from the actual events, how do you think they can be reconciled?

4.5 Hernan Cortéz, the Spanish navigator and explorer, is said to have burnt his ships upon arrival to Mexico. By so doing, he effectively eliminated the option of him and his soldiers returning to their homeland. Discuss the strategic value of this action, knowing the Spanish colonists were faced with potential resistance from the Mexican natives.

4.6 Consider the following game depicting the process of standard setting in high-definition television (HDTV).⁴⁷ The United States and Japan must simultaneously decide whether to invest a high or a low value into HDTV research. Each country's payoffs are summarized in [figure 4.12](#).

- Are there any dominant strategies in this game? What is the Nash equilibrium of the game? What are the rationality assumptions implicit in this equilibrium?
- Suppose now that the United States has the option of committing to a strategy before Japan's decision is reached. How would you model this new situation? What are the Nash equilibria of this new game?
- Comparing the answers to (a) and (b), what can you say about the value of commitment for the United States?
- "When precommitment has a strategic value, the player that makes that commitment ends up 'regretting' its actions, in the sense that, given the rival's choices, it could achieve a higher payoff by choosing a different action." In light of your answer to (b), how would you comment on this statement?



		Japan	
		Low	HIGH
U.S.	Low	3	4
	High	2	1

FIGURE 4.12 THE HDTV GAME: EACH COUNTRY CHOOSES A HIGH OR A LOW LEVEL OF R&D ON HDTV.

4.7 Consider a one-shot game with two equilibria and suppose that this game is repeated twice. Explain in words why there may be equilibria in the two-period game that are different from the equilibria of the one-shot game.

EXTENSION EXERCISE

4.8** Consider the game in [figure 4.13](#).⁴⁸ Show, by backward induction, that rational players choose d at every node of the game, yielding a payoff of 2 for Player 1 and zero for Player 2. Is this equilibrium reasonable? What are the rationality assumptions implicit in it?

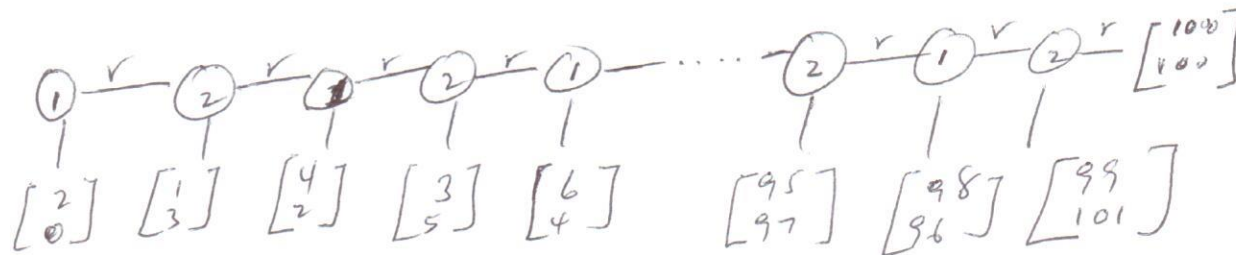


FIGURE 4.13 THE CENTIPEDE GAME.

In the payoff vectors, the top number is player 1's payoff, the bottom one player 2's.

NOTES

^a Economic analysis is based on the use of models. Models are stylized representations of reality, highlighting the particular aspects of interest to the economist. Being stylized is not a defect of models, rather it should be seen as a requisite: A completely realistic model would be as useful as an exceedingly detailed description of reality, so complete that the main points would be buried in the abundance of detail. It is important to keep this point in mind when judging the very stylized nature of some of the games and models presented in this text.

^b For the sake of rigor, two qualifications are in order: First, existence of Nash equilibrium applies to most games but not to all. Second, equilibria sometimes require players to randomly choose one of the actions (mixed strategies), whereas we have considered only the case when one action is chosen with certainty (pure strategies).

^c [Sections 4.2](#) and [4.3](#) cover relatively more advanced material, which may be skipped in a first reading of the book.

^d From this and the previous sections, one might erroneously conclude that games with simultaneous choices must be represented in the normal form, and games with sequential moves in the extensive form. In fact, both simultaneous and sequential choice games can be represented in both the normal and extensive forms. However, for simple games such as those considered in this chapter, the choice of game representation considered in the text is the more appropriate.

^e This is a very strong assumption as most contracts are renegotiable. However, for the purposes of the present argument, what is important is that Player 2 has the option of imposing on itself a cost if it does not choose r . This cost may result from breach of contract or from a different cause.

^f *Technical note:* We are referring only to equilibria in pure strategies.

^g This game is identical to that in [figure 4.1](#) except that we add a third strategy to each player. Although this third strategy leads to an extra Nash equilibrium, the main feature of the game in

[figure 4.1](#) is still valid—namely, the conflict between individual and joint incentives that characterizes the “prisoner’s dilemma.”

^hIn each cell, the first number is the payoff for the row player (*Time*).

Do Questions 5.2, 5.4, and 5.5 REVIEW AND PRACTICE EXERCISES

5.1 “The degree of monopoly power is limited by the elasticity of demand.” Comment.

5.2 A firm sells one million units at a price of \$100 each. The firm’s marginal cost is constant at \$40, and its average cost (at the output level of one million units) is \$90. The firm estimates that its elasticity of demand is constant at 2.0. Should the firm raise price, lower price, or leave price unchanged? Explain.⁵⁹

5.3 One study estimates the long-run demand elasticity of AT&T in the period 1988–1991 to be around 10.⁶⁰ Assuming the estimate is correct, what does this imply in terms of AT&T’s market power?

5.4 Sprint offers long-distance telephone service to residential customers at a price of 8¢ per minute. At this price, Sprint sells 200 million minutes of calling per day. Sprint believes that its marginal cost per minute of calling is 5¢. So, Sprint’s residential long-distance telephone service business is contributing \$6 million per day toward overhead/fixed costs.

Based on a statistical study of calling patterns, Sprint estimates that it faces a constant elasticity of demand for long-distance calling by residential customers of 2.0.

a. Based on this information, should Sprint raise, lower, or leave unchanged its price?

b. How much additional contribution to overhead, if any, can Sprint obtain by optimally adjusting its price?⁶¹

5.5 After spending 10 years and \$1.5 billion, you have finally gotten Food and Drug Administration (FDA) approval to sell your new patented wonder drug, which reduces the aches and pains associated with aging joints. You will market this drug under the brand name of Ageless. Market research indicates that the elasticity of demand for Ageless is 1.25 (at all points on the demand curve). You estimate the marginal cost of manufacturing and selling one additional dose of Ageless is \$1.

a. What is the profit-maximizing price per dose of Ageless?

b. Would you expect the elasticity of demand you face for Ageless to rise or fall when your patent expires?⁶²

5.6 Is the Windows operating system an essential facility? What about the Intel Pentium microprocessor? To what extent does the discussion in [section 5.3](#) on essential facilities (vertical integration, access pricing) apply to the preceding examples?

NOTES

^a Alternatively, we may write the above equation as $\frac{p}{MC} = \frac{1}{\epsilon}$, which shows more clearly that the monopolist optimally sets a markup over marginal cost.

^b In 1996, AT&T ceased to be subject to price regulation. Moreover, the rivals' capacity and market share increased considerably. The recent proposed merger between MCI and Sprint would represent an additional important change in the market, which now more resembles a duopoly than one with a dominant firm.

^c MCI changed its rates in the same month as AT&T in 5 out of 12 price changes. Sprint has set the exact same rates as AT&T from 1991 to 1994 (although it reacted to the latter's changes with some lag).

^d For a while, Apple allowed other firms to manufacture the MacIntosh—or “Mac clones”—but this is no longer the case.

^e Further discussion on merger policy may be found in [chapter 15](#).

^f See also the discussion on rent seeking presented in [chapter 1](#).

^g If there is only one output and capital is the only input, then this is exactly the same mechanism as average cost pricing.

^h The latter example is open to debate, however. Some argue that not even the local network is a natural monopoly.

ⁱ The 1996 Telecommunications Act allows for the possibility of local operators entering into longdistance telecommunications as well.

^j [Box 5.2](#) looks at the cases of France and Germany.

^k To avoid this problem, some authors have proposed a solution whereby the upstream firm is subject to a price-index cap. The price index includes both the final price set by the integrated firm and the access price charged to downstream competitors. This implies that, if the integrated firm wants to increase the final price, it has to decrease the access price, and vice versa. ⁵⁶

DO QUESTIONS 6.1, 6.2, AND 6.3 REVIEW AND PRACTICE EXERCISES

6.1 The technology of book publishing is characterized by a high fixed cost (typesetting the book) and a very low marginal cost (printing). Prices are set at much higher levels than marginal cost. However, book publishing yields a normal rate of return. Are these facts consistent with profit maximizing behavior by publishers? Which model do you think best describes this industry?

6.2 The market for laundry detergent is monopolistically competitive. Each firm owns one brand, and each brand has effectively differentiated itself so that it has some market power (i.e., faces a downward sloping demand curve). Still, no brand earns economic profits because entry causes the demand for each brand to shift in until the seller can just break even. All firms have identical cost functions, which are U-shaped.

Suppose that the government does a study on detergents and finds out they are all alike. The public is notified of these findings and suddenly drops allegiance to any brand. What happens to price when this product that was brand-differentiated becomes a commodity? What happens to total sales? What happens to the number of firms in the market?⁷¹

6.3** Show that, in a long-run equilibrium with free entry and equal access to the best available technologies, the comparison of price to the minimum of average cost and the comparison of price to marginal cost are equivalent tests of allocative efficiency. In other words, price is greater than the minimum of average costs if and only if price is greater than marginal cost.

Show, by example, that the same is not true in general.

NOTES

^a In fact, there may be economies of scale in multi-plant firms—for example, large-scale purchasing discounts—that counteract increased managerial costs. But this would take us back to a U-shaped cost curve and the prediction that all firms have the same number of plants.⁶³

^b By “one order of magnitude higher,” we mean with one extra digit, that is, about ten times greater.

^c Industries are classified in groups, subgroups, subsubgroups, and so forth. For each subdivision, one digit is added to the classification. So, a five-digit classification is more detailed than a four-digit one.

^d Each bar on a histogram gives the frequency with which a given firm size occurs. For example, the first bar in the histogram for France indicates that most firms in France have fewer than 10 employees: The area of the first bar is greater than the total area of the remaining bars.

^e One possibility is to assume that firms invest in R&D and that efficiency levels result from these R&D investments.⁶⁹

A completely different approach to understanding the firm size distribution is to consider a model of dynamic stochastic growth wherein different growth rates result in a distribution of firm sizes. Suppose, for example, that there is a set of laser machine manufacturers and that, in each period, a new machine is demanded in the market. Suppose, moreover, that each of the existing firms receives each new order with equal probability. It can be shown that a process of this sort implies a distribution of firm size, in fact, one that approximates the empirically observed distribution fairly well. We return to this sort of model in [chapter 14](#).

^f We use lowercase d to indicate that this is the demand curve faced by each firm, not the market demand curve.

^g To be more precise, zero profits result from free entry *and* equal access to the best available technologies. The case when the first condition holds but not the second was addressed in [section 6.3](#)

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DO QUESTION 7.1, 7.3 AND 7.5 REVIEW AND PRACTICE EXERCISES

7.1 According to Bertrand's theory, price competition drives firms' profits down to zero even if there are only two competitors in the market. Why don't we observe this in practice very often?

7.2 Three criticisms are frequently raised against the use of the Cournot oligopoly model: (1) firms normally choose prices, not quantities; (2) firms don't normally make their decisions simultaneously; (3) firms are frequently ignorant of their rivals' costs; in fact, they do not use the notion of the Nash equilibrium when making their strategic decisions.

How would you respond to these criticisms? (*Hint*: in addition to this chapter, you may want to refer to [chapter 4](#).)

7.3 Which model (Cournot, Bertrand) would you think provides a better approximation to each of the following industries: oil refining, internet access, insurance. Why?

7.4* Two firms, CS Corporation and jl & Associates, make identical goods, GPX units, and sell them in the same market. The demand in the market is $Q = 1200 - p$. Once a firm has built capacity, it can produce up to its capacity each period with a marginal cost of $MC = 0$. Building a unit of capacity costs 2400 (for either CS or jl) and a unit of capacity lasts four years. The interest rate is zero. Once production occurs each period, the price in the market adjusts to the level at which all production is sold. (In other words, these firms engage in quantity competition, not price competition.)

a. If CS knew that jl were going to build 100 units of capacity, how much would CS want to build? If CS knew that jl were going to build x units of capacity, how much would CS want to build (that is, what is CS's best response function in capacity)?

b. If CS and jl each had to decide how much capacity to build without knowing the other's capacity decision, what would the one-shot Nash equilibrium be in the amount of capacity built?⁷⁹

7.5** Consider a market for a homogeneous product with demand given by $Q = 37.5 - p/4$. There are two firms, each with constant marginal cost equal to 40.

a. Determine output and price under a Cournot equilibrium.

b. Compute the efficiency loss as a percentage of the efficiency loss under monopoly.

7.6** Show analytically that equilibrium price under Cournot is greater than price under perfect competition but lower than monopoly price.

EXTENSION EXERCISES

7.6** Consider a duopoly for a homogenous product with demand $Q = 10 - p/2$. Each firm's cost function is given by $C = 10 + q(q + 1)$. Determine the values of the Cournot equilibrium.

NOTES

- ^a Moreover, in a dynamic setting, Compaq must also take into account that current price choices will likely influence the rival's future price choices. This we will see in [chapter 8](#).
- ^b The Bertrand model is more general than the simplified version presented here, but the main ideas are the same.
- ^c What does “just below” mean? If p_1 could be any real number, then “just below” would not be well defined: There exists no real number “just below” another real number. In practice, prices have to be set on a finite grid (in cents of the dollar, for example), in which case “just below” would mean one cent less. This points to an important assumption of the Bertrand model: Firm 1 will steal all of Firm 2's demand even if its price is only one cent lower than the rival's.
- ^d This expression for firm i 's residual demand, $D(p_i) - k_j$, is valid only under the assumption that the customers served by firm j are the ones with the greatest willingness to pay.
- ^e $D(p)$, the direct demand curve (or simply demand curve), corresponds to taking price as the independent variable, that is, quantity as a function of price; $P(Q)$, the inverse demand curve, corresponds to taking quantity as the independent variable, that is, price as a function of quantity.
- ^f If capacity costs are sufficiently high, then firms' capacity levels will surely be sufficiently low such that the previous result holds. However, it can be shown that, even if capacity costs were low, the same would be true.
- ^g The same applies for the choice of production capacity. However, for the purpose of this section, we focus on the case when firms choose output level in the first place.
- ^h This results from our assumption that demand is linear. In general, the marginal revenue curve has the same intercept as the demand curve and a higher slope (in absolute value), not necessarily twice the slope of the demand curve.
- ⁱ The equilibrium concept we are using here is that of Nash equilibrium, or Nash–Cournot equilibrium, thus the notation N . In general, more than one equilibrium can exist. However, when the demand curve is linear and marginal cost is constant, there exists only one equilibrium.
- ^j There are, however, other aspects to be taken into account in an industry like software: product differentiation (see [chapter 12](#)) and network externalities (see [chapter 17](#)). The same qualification applies to the video-game industry.
- ^k Firm 1's reaction function depends on the rival's output but not on the rival's marginal cost. *In equilibrium*, the rival's output will depend on its marginal cost, so that, *indirectly*, Firm 1's output will depend on Firm 2's marginal cost. However, when we talk about the reaction function, what is important is whether Firm 1's output depends *directly* on Firm 2's marginal cost, which is not the case.

ⁱ In fact, the point we are making here is more generally applicable to the justification of Nash equilibria in a certain class of games. The argument we are using is similar to elimination of dominated strategies, a topic we dealt with in [chapter 4](#).

ⁱⁱ In fact, the dynamic process we consider earlier is not very realistic: At each moment in time, one of the firms is choosing an optimal output, assuming that the rival's output remains constant, which in fact does not occur except in the Nash equilibrium

DO QUESTIONS 8.3, 8.6 AND ,8.14 REVIEW AND PRACTICE EXERCISES

8.1 Explain why collusive pricing is difficult in one-period competition and easier when firms interact over a number of periods.

8.2 After several years of severe price competition that damaged Boeing's and Airbus's profits, the two companies have recently pledged that they will not sink into another price war. However, in June 1999, Boeing made an unusual offer to sell 100 small aircraft to a leasing corporation at special discount prices. (Although customers never pay list prices, it was felt that this deal was particularly attractive.) Boeing's move follows a similar one by Airbus.⁹⁵

Based on the analysis of [section 8.1](#), why do you think it is so difficult for aircraft manufacturers to collude and avoid price wars?

8.3* In a market with annual demand $Q = 100 - p$, there are two firms, A and B, that make identical products. Because their products are identical, if one charges a lower price than the other, all consumers will want to buy from the lower-priced firm. If they charge the same price, consumers are indifferent and end up splitting their purchases about evenly between the firms. Marginal cost is constant and there are no capacity constraints.

a. What are the single-period Nash equilibrium prices, p_A and p_B ?

b. What prices would maximize the two firms' joint profits?

Assume that one firm cannot observe the other's price until after it has set its own price for the year. Assume further that both firms know that if one undercuts the other, they will revert forever to the noncooperative behavior you described in (a).

c. If the interest rate is 10%, is one repeated-game Nash equilibrium for both firms to charge the price you found in part (b)? What if the interest rate is 110%? What is the highest interest rate at which the joint profit-maximizing price is sustainable?

d. Describe qualitatively how your answer to (c) would change if neither firm was certain that it would be able to detect changes in its rival's price. In particular, what if a price change is detected with a probability of 0.7 each period after it occurs? (*Note:* Do not try to calculate the new equilibria.)

Return to the situation in part (c), with an interest rate of 10%. But now suppose that the market for this good is declining. The demand is $Q = A - p$ with $A = 100$ in the current period, but the value of A is expected to decline by 10% each year (i.e., to 90 next year, then 81 the following year, etc.).

e. Now, is it a repeated-game Nash equilibrium for both firms to charge the monopoly price from part (b)?

8.4* You compete against three major rivals in a market where the products are only slightly differentiated. The “Big Four” have historically controlled about 80% of the market, with a fringe of smaller firms accounting for the rest. Prices have been rather stable, but your market share has been eroding slowly, from 25% just a few years ago to just over 15% now. You are considering adopting an aggressive discounting strategy to gain back market share. Discuss how each of the following factors would enter into your decision.

- a. You have strong brand identity and attribute your declining share to discounting by your rivals among the Big Four.
- b. The Big Four have all been losing share gradually to the fringe, as the product category becomes more well known and customers become more and more willing to turn to smaller suppliers to meet their needs.
- c. You believe your rivals are producing at close to their capacity, and capacity takes a year or two to expand.
- d. You can offer discounts selectively, in which case it will take one or two quarters before your rivals are likely to figure out that you have become more aggressive in pricing.
- e. Your industry involves high fixed costs and low marginal costs, as applies for most information goods.
- f. The entire market is in rapid decline because of technological shifts unfavorable to this product.⁹⁶

8.5 “Price wars imply losses for all of the firms involved. The empirical observation of price wars is therefore a proof that firms do not behave rationally.” True or false?

8.6 Empirical evidence from the U.S. airline industry suggests that fare wars are more likely when carriers have excess capacity, caused by GDP growth falling short of its predicted trend. Fare wars are also more likely during the spring and summer quarters, when more discretionary travel takes place.⁹⁷ Explain how these two observations are consistent with the theories presented in section 8.2.

8.7 A 1998 news article reported that

*Delta Air Lines and American Airlines tried to raise leisure air fares 4% in most domestic markets, but the move failed Monday when lone-holdout Northwest Airlines refused to match the higher prices. The aborted price boost illustrates the impact Northwest’s woes already are having on the industry. Months of labor unrest . . . are prompting passengers to book away from the fourth largest carrier.*⁹⁸

What does this say about the nature of price dynamics in the airline industry?

8.8 In the third quarter of 1999, most North American paper and forest-products companies experienced an improvement in their profits. The industry, analysts said, was in a cyclical upswing: Not only was demand increasing at a moderate pace; more importantly, the industry practiced restraint in keeping low production levels, thus providing support for higher prices.⁹⁹

How do you interpret these events in light of the models presented in [section 8.2](#)?

8.9 In 1918, the U.S. Congress passed a law allowing American firms to form export cartels. Empirical evidence suggests that cartels were more likely to be formed in industries where American exporters had a large market share, in capital-intensive industries, in industries selling standardized goods, and in industries that enjoyed strong export growth.¹⁰⁰ Discuss.

8.10 The endowments of the Ivy League universities have increased significantly. Princeton, the richest of all, boosted its endowment from \$400,000 per student in 1990 to more than \$750,000 in 1997. In the same period, both Harvard and Yale more than doubled their endowments.

Notwithstanding these riches, the universities have restrained from using financial incentives as a means to compete for students. For many years, the manual of the council of Ivy League Presidents stated that the schools should “neutralize the effect of financial aid so that a student may choose among Ivy Group institutions for non-financial reasons.” In 1991, the Justice Department argued that this amounted to price collusion and forced the agreement to end. However, no significant price competition took place until 1998, when Princeton University started offering full scholarships for students with incomes below \$40,000. Stanford, MIT, Dartmouth, and Cornell followed suit. Allegedly, Harvard sent a letter to accepted 1998 applicants stating that “we expect that some of our students will have particularly attractive offers from the institutions with new aid programs, and those students should not assume that we will not respond.”¹⁰¹

How do you interpret these events in light of the theories discussed in this chapter?

8.11 Based on data from the Spanish hotel industry, it was estimated that the rate set by hotel i in market k is positively influenced by a variable that measures the intensity of multimarket competition between hotel i and its competitors in market k : The more markets $m \neq k$ in which firm i and its competitors meet, the greater the measure of multimarket contact. It was also observed that the measure of multimarket contact is highly correlated with hotel chain size, that is, the larger hotel i 's chain, the greater the measure of multimarket contact for firm i .¹⁰²

Provide two interpretations for the positive coefficient of multimarket contact on hotel rates, one based on collusion, one based on a different effect.

8.12 Comment on the following excerpt from a 1998 news item.¹⁰³

LONG-STALLED SHIPPING REFORM BILL TAKEN UP BY SENATE. Washington—The Senate has formally begun consideration of a shipping reform bill that, if passed, would create changes for all countries shipping manufactured goods to and from the United States . . .

Until now, U.S. shipping law has been founded on the principle of common carriage—“Everybody pays the same tariff (rate) to go from Oakland to Yokohama,” said the Department of Transportation (DOT) official, who asked not to be identified. Under this system, groups of liners called conferences—legal cartels with immunity from antitrust law—set the rates for their members and make those rates public through registration with the federal government. If the shipping bill passes, however, liners could make private, confidential deals with exporters-importers outside of conferences at market-set rates.

“This is going to bring marketplace economics into ocean shipping like we’ve never seen before,” the official said. “It’s going to really change the influence of ocean shipping conferences in the marketplace.” . . .

The Transportation Department official said the Clinton administration has generally supported legislation for shipping reform in line with its promotion of deregulation in airlines and trucking, but has stated concerns about specific provisions of the Senate bill. Probably, the Administration’s biggest concern is a provision of the bill allowing conferences also to engage in confidential contracting, he said. “In the Administration view, that conveys too much market power to the conferences,” the official said.

8.13 In 1986, the U.S. Congress enacted a regulation (PL99-509) requiring railroads to disclose contractual terms with grain shippers. Following the passing of the legislation, rates increased on corridors with no direct competition from barge traffic, while rates decreased on corridors with substantial direct competition.¹⁰⁴ How do you interpret these events?

EXTENSION EXERCISES

8.14* Consider an n firm homogeneous-good oligopoly with constant marginal cost, the same for all firms. Let δ be the minimum value of the discount factor such that it is possible to sustain monopoly prices in a collusive agreement. Show that δ is increasing in n . Interpret the result.

8.15** Consider the model of multimarket contact presented in [section 8.3](#). Determine the minimum value of the discount factor such that the optimal collusive solution is stable.

NOTES

^a Note that, because Firm 2 knows that its deviation implies that Firm 1 reverts to pricing at marginal cost, Firm 2 also will set price at marginal cost level following a deviation by itself. Thus the designated strategy calls for firms to revert to pricing at marginal cost whenever *some* firm sets price different from monopoly price in the past.

^b The exact value of Firm 1’s payoff would be smaller than π^M , as it needs to undercut its rival. But because ϵ can be arbitrarily small, we assume that the profit from deviation is equal to π^M .

^c Recall that, under duopoly competition with a homogeneous product and constant marginal cost, a firm that undercuts its rival doubles its profit. If demand is higher, then this gain is also higher.

^d The argument is similar to the one in footnote (c).

^e This type of strategy is examined in [chapter 15](#).

^f The diamond industry is an important exception to this rule. Given the peculiar nature of the product (diamonds), the leadership of one of the firms (DeBeers) has played an essential role in maintaining high prices, basically by maintaining—through advertising and stock management—the perception that diamonds are scarce (though they are not).

^g Strictly speaking, Firm 2 can impose an equally severe punishment on Firm 1: By setting $p_2 = c$, Firm 2 forces Firm 1 to zero profits. The problem is that in the process, Firm 2 makes losses, which in many real-world settings may be difficult to sustain.

^h It can be shown that this constitutes an equilibrium of the static price game.

ⁱ These measures are also known as **facilitating practices**.

^j If demand is linear and marginal cost constant, the efficiency loss is a quadratic function of the difference between price and marginal cost.

^k The particular case of R&D agreements is addressed in greater detail in [chapter 16](#).

^l See exercise 8.12. This is the same argument as was discussed in the case in [box 8.6](#), except here the government is taking the opposite approach.