

## ■ Additional Questions and Problems

1. The following game is called a zero-sum game, because the winnings of one player are always taken directly from the other player (such as a market share battle between two firms). In the payoff matrix shown below, payoffs shown are for player *A* (*B* gets minus one times what *A* receives). What strategy would each player select? Does it matter which player gets to choose first? Can you determine a general rule for strategies when the game is zero-sum? Would collusion alter the outcome? Why or why not?

		<i>B</i>	
		<i>B</i> <sub>1</sub>	<i>B</i> <sub>2</sub>
<i>A</i>	<i>A</i> <sub>1</sub>	4	-1
	<i>A</i> <sub>2</sub>	2	1

2. In each payoff matrix shown below, determine the strategy of each player assuming they must play simultaneously. Would collusion alter the outcome? Why or why not? Payoffs shown are *A*, *B*.

a.

		<i>B</i>	
		<i>B</i> <sub>1</sub>	<i>B</i> <sub>2</sub>
<i>A</i>	<i>A</i> <sub>1</sub>	4, 2	1, 1
	<i>A</i> <sub>2</sub>	2, 1	0, 0

b.

		<i>B</i>	
		<i>B</i> <sub>1</sub>	<i>B</i> <sub>2</sub>
<i>A</i>	<i>A</i> <sub>1</sub>	-1, -2	1, -3
	<i>A</i> <sub>2</sub>	2, 3	2, 2

c.

		<i>B</i>	
		<i>B</i> <sub>1</sub>	<i>B</i> <sub>2</sub>
<i>A</i>	<i>A</i> <sub>1</sub>	3, 3	7, 2
	<i>A</i> <sub>2</sub>	1, 7	6, 6

3. What types of industries or firms would a local government be most likely to subsidize? Why?
4. Describe, using game theory, the recent rash of professional sports teams receiving generous deals for new stadiums from state and local governments.

5. Suppose the market demand function facing three firms is  $Q = 500 - 2p$ . Each firm has a marginal cost of \$5 per unit. What is the cartel solution? Suppose instead that one of the firms could supply up to 100 units at  $MC = 4$ , and the other two firms had a marginal cost of \$5. How would this alter the final output, price, and profit? Does this complicate the division of profits? How?
6. In an industry where any firm can enter the industry and produce according to the cost function  $C = 50 + 5q$ , what is the optimal number of firms? Does your answer change if there are no fixed costs?
7. True, false, or uncertain; explain your answer. "If all firms charge the same price, they must be colluding." Does your answer create difficulties for those charged with enforcing industrial policy?
8. In a Cournot duopoly, each firm has marginal cost  $MC = 20$ , and market demand is  $Q = 100 - 1/2p$ . What are the best response functions of each firm? What is the best output level for each? How does the total output level compare to the cartel output level?
9. Assume that the payoffs in the matrix below are profits from various output choices, based on a non-cooperative game, with  $A$  as the leader. Because of product tie-ins, the firms must choose to produce either 60 units or 30. No other output levels are possible. Re-write the payoffs in extended "tree" form similar to Figure 13.5 in the text. Payoffs shown are  $A, B$ . What is the equilibrium? How would your answer change if  $B$  was the leader?

		Player A's Output	
		60	30
Player B's Output	60	3, 3	4, 8
	30	8, 4	6, 6

10. Suppose in Question 9 that movement was simultaneous rather than sequential. Is there a unique equilibrium? If so, what is it? Instead, suppose movement was simultaneous, but collusion were permitted. Would the outcome change?
11. How do a Bertrand equilibrium output and price compare to those of competitive equilibrium?

## ■ Answers to Additional Questions and Problems

1. In the payoff matrix, player  $A$ 's highest payoff is in the upper left ( $A_1, B_1$ ), but  $B$  regards this as the least preferred. Since  $B$  will not select  $B_1$ ,  $A$  can assure that they will not lose by selecting strategy  $A_2$ . This is referred to as a maximin strategy—choosing the strategy with the highest minimum payoff. Player  $B$  will choose Strategy 2, in an attempt to minimize  $A$ 's payoff (which also maximizes their own payoff). This is referred to as a minimax strategy. This solution would be the outcome regardless of which player goes first. Collusion would never alter the outcome of a zero-sum game because what is better for one player is, by definition, worse for the other.
2.
  - a. Dominant strategies are  $A_1, B_1$ . Collusion would not alter the outcome because there is no other combination in which both players are at least as well off.
  - b. Dominant strategies are  $A_2, B_1$ . Collusion would not alter the outcome because there is no other combination in which both players are at least as well off.
  - c. Prisoners' dilemma. Dominant strategies are  $A_1, B_1$ . If the players could collude they would choose  $A_2, B_2$ , which has a higher payoff for both.
3. Local governments are most likely to subsidize firms that will bring in large quantities of tax revenue (once the subsidies expire) and employment opportunities. All else equal, a firm that promises to generate the greatest total payroll is likely to receive the highest subsidy offer. Not only does the creation of jobs increase political officials' chances of re-election, but also increases in employment in the local economy raise taxes indirectly through real estate, sales, and occupational privilege taxes.
4. Because the teams have the ability to make a credible threat that they will leave and move to another city, they are able to force the current host city into a prisoners' dilemma game against other potential sites. Cities that currently have teams with old stadiums or buildings that lack revenue-enhancing features such as superboxes are aware that other teams in similar circumstances have been lured away by other cities with promises of new buildings and favorable treatment. Thus, the cities end up in a battle trying to outbid each other for the right to host a team. This has resulted in numerous heavily debated proposals to issue municipal bonds to construct new stadiums.
5. In a cartel solution, the firms set a monopoly price using  $MC = MR$ .

$$MR = 250 - Q$$

$$MC = 5$$

$$Q^* = 245$$

$$p^* = 127.5$$

If one firm can supply the first 100 units at  $MC = 4$ , price and quantity remain unchanged, but profits are increased by \$100. This complicates the division of profits because the firms must

now agree on how the profits are to be divided, given that they are not generated by equal contributions of each firm.

6. With only one firm, average cost will fall continuously as the \$50 fixed cost is spread across increasing quantities of output. Thus the optimal number of firms from a cost standpoint is one. If there are no fixed costs, there is neither an advantage nor a disadvantage to adding additional firms, as any firm can produce at the same marginal cost.
7. Uncertain. If all firms in an industry have the same cost function, they will naturally end up charging the same price without collusion. The difficulty that this creates for the Federal Trade Commission and the Justice Department is that it complicates the process of proving collusive behavior.
8. First, calculate the residual demand function.

$$q_1 = 100 - 1/2 p - q_2$$

$$p = 200 - 2q_1 - 2q_2.$$

Then, to derive the best-response function, set  $MC = MR$  for each firm.

$$MR_1 = 200 - 4q_1 - 2q_2 = 20 \qquad MR_2 = 200 - 2q_1 - 4q_2 = 20$$

$$q_1 = 45 - 1/2 q_2 \qquad q_2 = 45 - 1/2 q_1$$

The equilibrium output level for each firm is

$$q_1 = 45 - 1/2 (45 - 1/2 q_1) = 30$$

$$q_2 = 45 - 1/2 (45 - 1/2 q_2) = 30$$

The cartel output level is 45 (obtained by setting market  $MR$  equal to  $MC$ ). Thus, the Cournot output level is  $1/3$  greater than that of the cartel.

9. See Figure 13.1. Firm A as the leader will choose to produce 60, knowing that B's best response is to produce 30. Because the matrix is symmetric, the game players would end up with the same total output, but would produce 60 and A would produce 30.

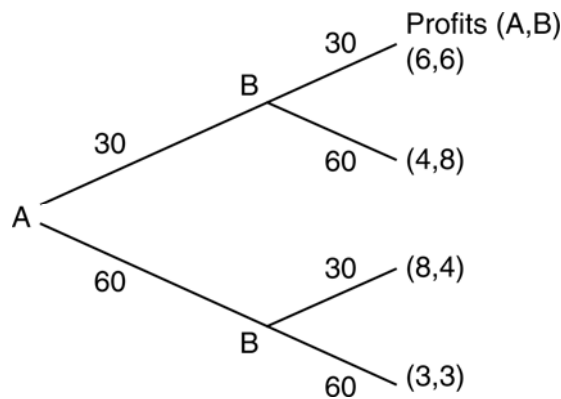


Figure 13.1

10. If movement were simultaneous, there is no unique equilibrium because neither player has a dominant strategy. There is no combination of choices that results in a payout that both players will choose to keep even if the other player commits to not changing, and neither can make a credible threat to try to force a favorable outcome. If collusion were allowed, both players should realize the lack of equilibrium, and agree to both produce 30 units.

11. The Bertrand equilibrium has the same output and price as the competitive equilibrium.