Chapter 14 – Oligopoly

Chapter Outline and Learning Objectives

1. **Market Structure in an Oligopoly**

   - Describe the structure and characteristics of oligopolistic industries.

2. **Oligopoly Models**

   - Compare and contrast three oligopoly models.

3. **Game Theory**

   - Explain the principles and strategies of game theory.

- Most industries fall somewhere between the two "pure" market structures: *perfect competition and pure monopoly*.

- **oligopoly** A form of industry (market) structure characterized by a few dominant firms. Products may be homogenous or differentiated.

- Oligopolists compete with one another not only in price but also in developing new products, marketing and advertising those products, and developing complements to use with the products.

- There is great complexity of competition and interdependence among oligopolists!

- To find the right strategy, firms need to anticipate the reactions of their customers and their rivals.

- When the managers of a firm evaluate the potential consequences of their decisions, they must assume that their competitors are as rational and intelligent as they are.

- There is no single model of profit-maximizing oligopoly behavior that corresponds to economists' models of perfect competition, monopoly, and monopolistic competition. Uncertainty about the interaction of rival firms makes specification of a single model of oligopoly impossible.

- In some oligopolistic markets, some or all firms earn substantial profits over the long run because *barriers to entry* make it difficult or impossible for new firms to enter.

- Oligopoly is a prevalent form of market structure. Examples of oligopolistic industries include automobiles, steel, aluminum, petrochemicals, electrical equipment, and computers.

➢ Reasons for barriers:

   1) "Natural" entry barriers which are basic to the structure of the particular market.

      - Scale economies may make it unprofitable for more than a few firms to coexist in the market; patents or access to a technology may exclude potential competitors; and the need to spend money for name recognition and market reputation may discourage entry by new firms.

   2) Incumbent firms may take strategic actions to deter entry.

      - They might threaten to flood the market and drive prices down if entry occurs, and to make the threat credible, they can construct excess production capacity.

- In perfect competition and monopolistic competition, each firm could take price or market demand as given and largely ignore its competitors.

- In an oligopolistic market, however, a firm sets price or output based partly on strategic considerations regarding the behavior of its competitors. At the same time, competitors' decisions depend on the first firm's decision.

- Remember how we described an equilibrium in competitive and monopolistic markets: When a market is in equilibrium, *firms are doing the best they can and have no reason to change their price or output*.

- With some modification, apply the same principle to the oligopolistic market.

Market Structure in an Oligopoly

- **Five Forces model:** A model developed by Michael Porter that helps us understand the five competitive forces that determine the level of competition and profitability in an industry.

Figure 14.1 Forces Driving Industry Competition
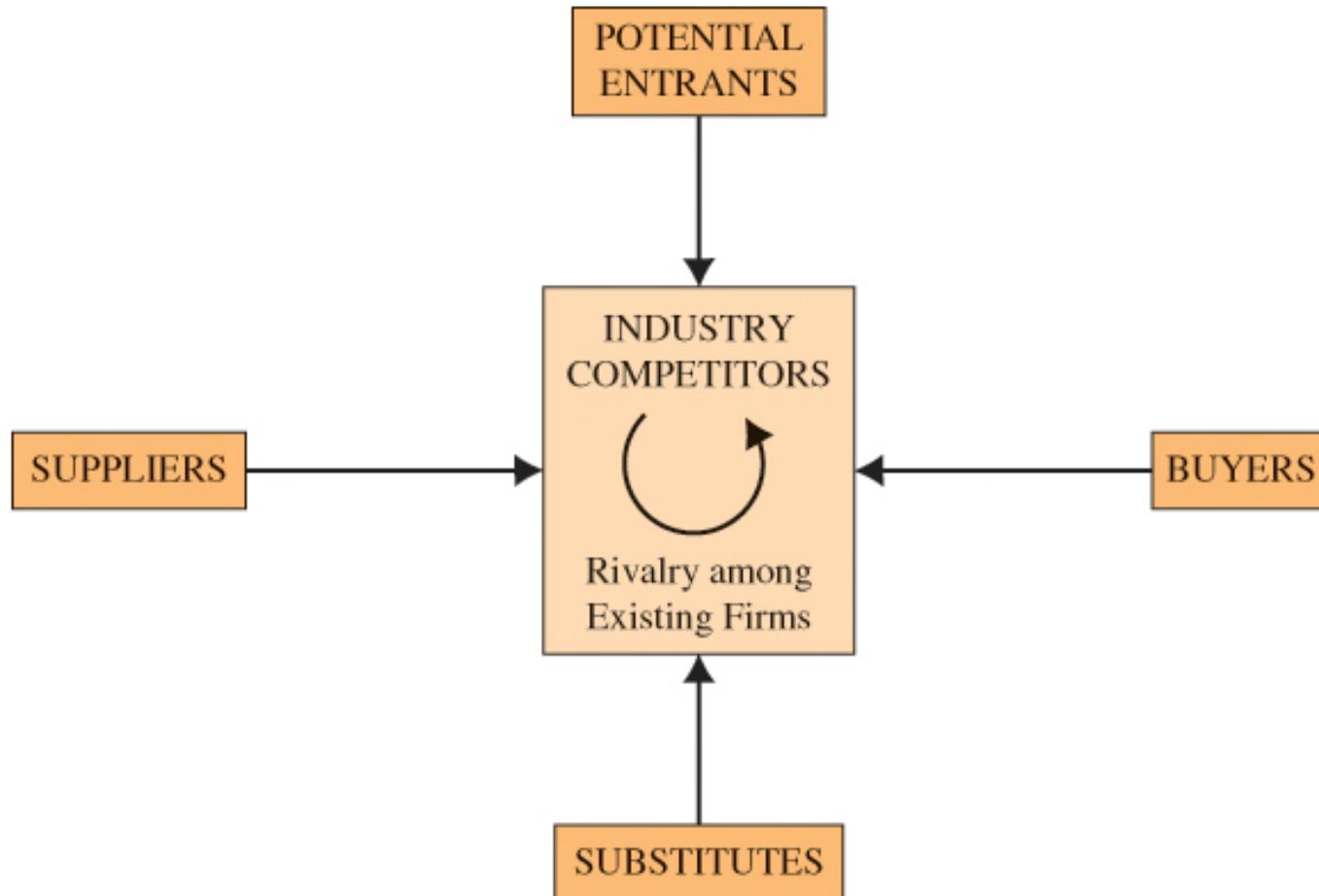
Table 14.1 Percentage of Value of Shipments accounted for by the largest Firms in High-Concentration Industries, 2002

| Industry Designation	Four Largest Firms	Eight Largest Firms	Number of Firms
Primary copper	99	100	10
Cigarettes	95	99	15
Household laundry equipment	93	100	13
Cellulosic man-made fiber	93	100	8
Breweries	90	94	344
Electric lamp bulbs	89	94	57
Household refrigerators and freezers	85	95	18
Small arms ammunition	83	89	109
Cereal breakfast foods	82	93	45
Motor vehicles	81	91	308
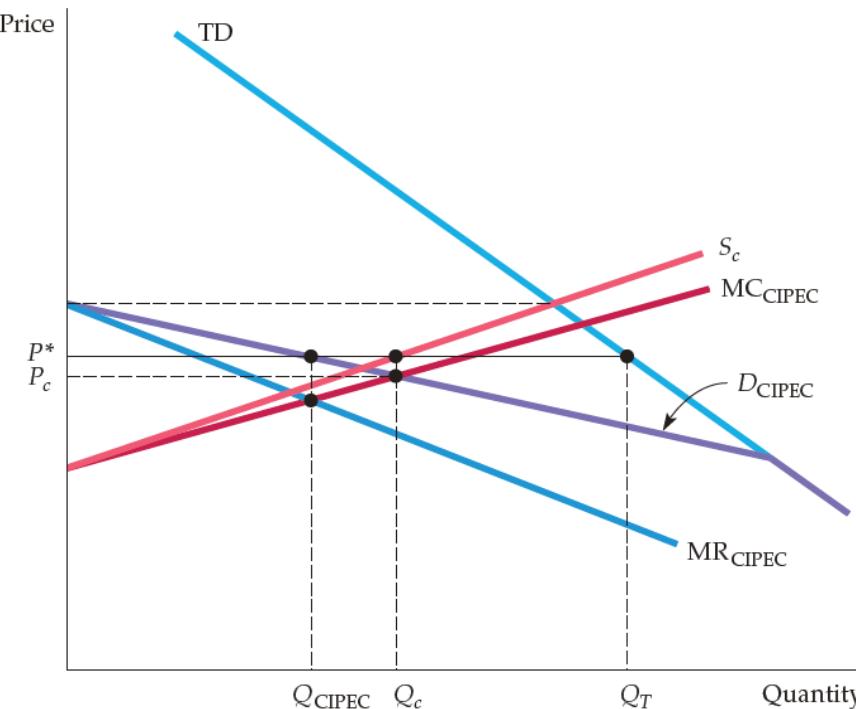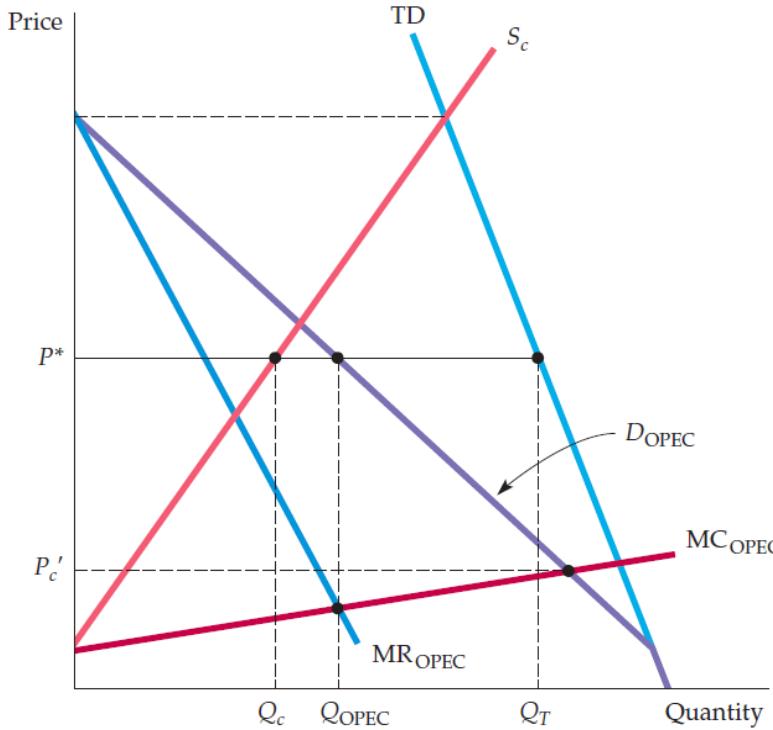
- One structural feature of an industry is the number and size distribution of firms.

  - **concentration ratio:** The share of industry output in sales or employment accounted for by the top firms.

- Another structural feature of an industry is product differentiation.

  - The more differentiated products made by oligopolists are, the more their behavior will resemble that of the monopolist.

- The threat of entry by new firms also plays an important role in industry competition.

  - **contestable markets** Markets in which entry and exit are easy enough to hold prices to a competitive level even if no entry actually occurs.

All kinds of oligopolies have one thing in common: The behavior of any given oligopolistic firm depends on the behavior of the other firms in the industry composing the oligopoly.

Oligopoly Models - The Collusion Model

- When a group of profit-maximizing oligopolists colludes on price and output, the result is the same as it would be if a monopolist controlled the entire industry. (MR=MC, P>MC)!

- **cartel:** A group of firms that gets together and makes joint price and output decisions to maximize joint profits.

- OPEC is a cartel of governments. Cartels consisting of firms, by contrast, are illegal! All agreements aimed at fixing prices or output levels, regardless of whether the resulting prices are high, are illegal!

- Antitrust laws prohibit companies from colluding. However, nothing prevents countries, or companies owned or controlled by foreign governments, from forming cartels.

- **tacit collusion:** Collusion occurs when price- and quantity-fixing agreements among producers are explicit. Tacit collusion occurs when such agreements are implicit.

- ➢ Cartel attempts to drive up the prices of copper, tin, coffee, tea, and cocoa have also failed. Why do some cartels succeed while others fail?

- For a cartel to work, a number of conditions must be present. First, demand for the cartel's product must be *inelastic*. Second, the members of the cartel must play by the rules. Third, either the cartel must control nearly all the world's supply or, if it does not, the supply of non-cartel producers must not be price elastic

The OPEC Oil Cartel vs The CIPEC Copper Cartel
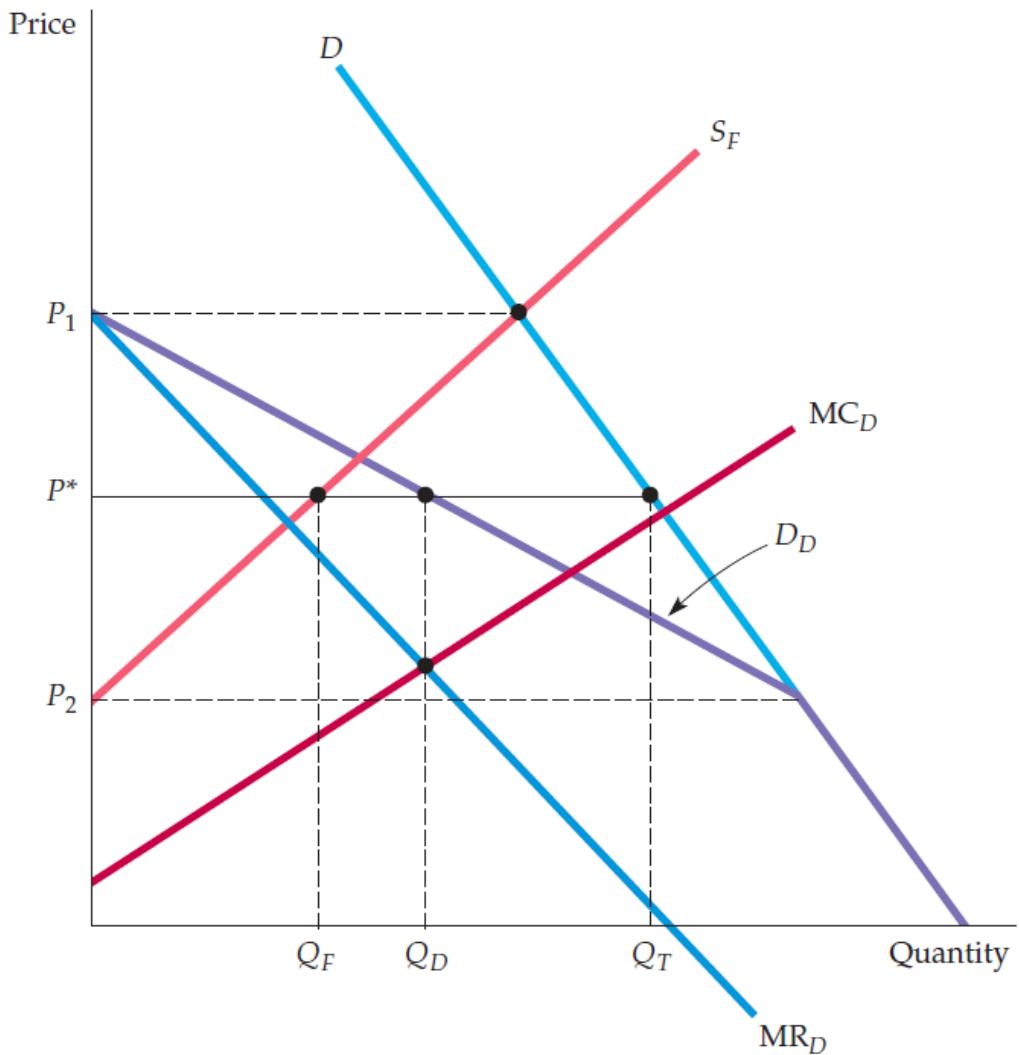
- TD is the total world demand curve for oil, and S_C is the competitive (non-OPEC) supply curve. OPEC's demand D_{OPEC} is the difference between the two. If OPEC producers had not cartelized, price would be P_C but not!

- In the long run, both demand and supply will be much more elastic, which means that OPEC's demand curve will also be much more elastic. We would thus expect that in the long run OPEC would be unable to maintain a price that is so much above the competitive level.

- Four copper-producing countries: Chile, Peru, Zambia, and Congo (formerly Zaire), that collectively account for less than half of world copper production. In these countries, production costs are lower than those of non-CIPEC producers. Why can't CIPEC increase copper prices much?

Oligopoly Models - The Price-Leadership Model

- **price leadership:** A form of oligopoly in which one dominant firm sets prices and all the smaller firms in the industry follow its pricing policy.

- The dominant firm derives its own demand curve and maximizes profit subject to the constraint of market demand and subject to the behavior of the smaller competitive firms. Smaller firms then can essentially sell all they want at this market price.

- For a monopolist, the only constraint it faces comes from consumers, who at some price will forgo the good the monopolist produces.

- In an oligopoly, with a dominant firm practicing price leadership, the existence of the smaller firms (and their willingness to produce output) is also a constraint.

- For this reason, the output expected under price leadership lies between that of the monopolist and the competitive firm, with prices also set between the two price levels.

- The dominant firm has an incentive to push small firms out of the market either by buying up or merging or *predatory pricing*.

- The dominant firm can try cutting prices aggressively, even below their own costs, to create such large losses for weaker, smaller firms until the smaller firms leave.

PRICE SETTING BY A DOMINANT FIRM
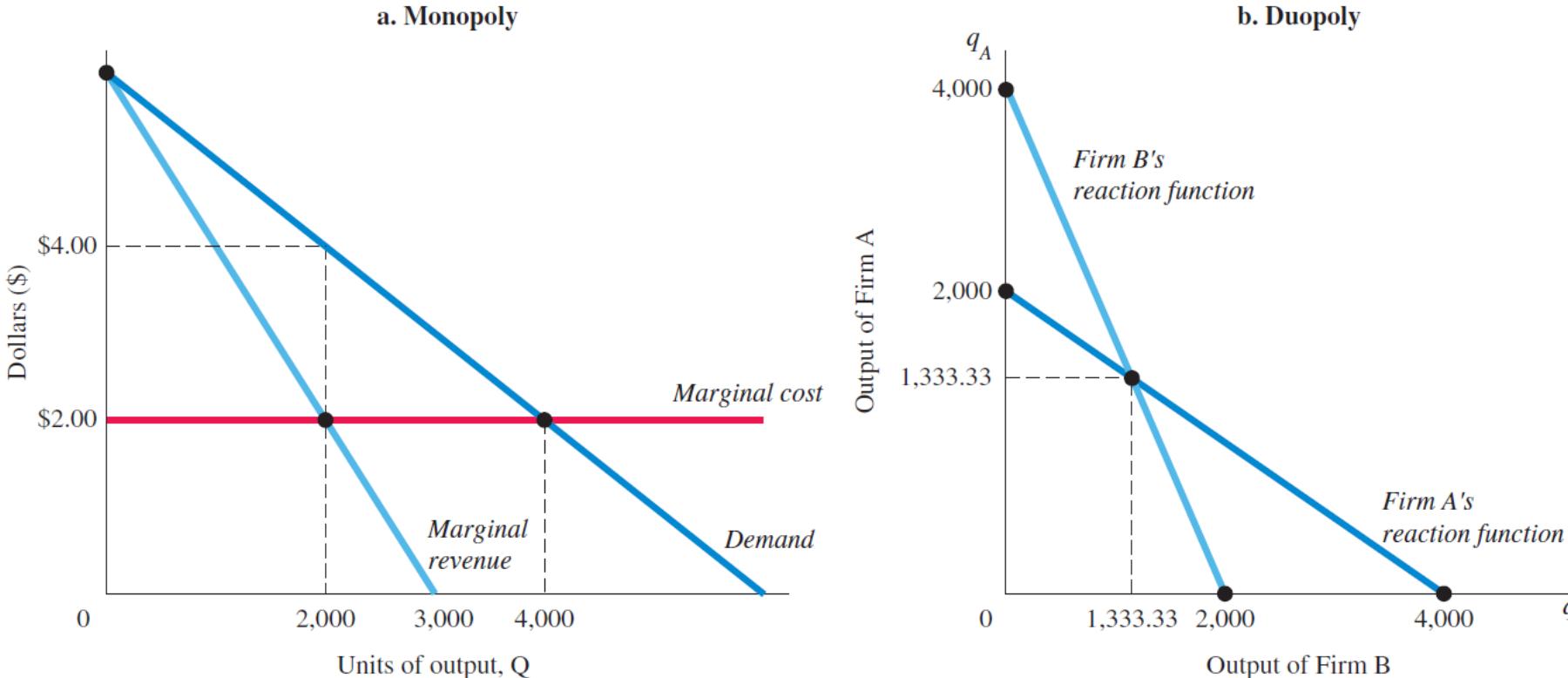
- **dominant firm:** Firm with a large share of total sales that sets price to maximize profits, taking into account the supply response of smaller firms.

- The other firms, which individually could have little influence overprice, would then act as perfect competitors: They take the price set by the dominant firm as given and produce accordingly.

- But what price should the dominant firm set? To maximize profit, it must take into account how the output of the other firms depends on the price it sets.

- The dominant firm's demand curve, D_D, is the difference between market demand D and the supply of fringe firms S_F.

- The dominant firm sets price at P^* and sells Q_D while other smaller firms quantity suppy is Q_F.

Oligopoly Models - The Cournot Model

- **duopoly:** A two-firm oligopoly, producing _identical_ products and not colluding.

- A firm's optimal decisions depend on the actions of the other individual firms in its industry.

- In choosing the optimal output, the monopolist had only to consider its own costs and the demand curve that it faced. The duopolist has another factor to consider: how much output will its rival produce? The more the rival produces, the less market is left for the other firm in the duopoly.

- In the Cournot model, each firm looks at the market demand, subtracts what it expects the rival firm to produce, and chooses its output to maximize its profits based on the market that is left.

- **Cournot model:** Oligopoly model in which firms produce a homogeneous good, each firm treats the output of its competitors as fixed, and all firms decide simultaneously how much to produce.

- **Reaction functions**, showing each firm's optimal, profit-maximizing output as it depends on its rival's output.

- Firm A's reaction curve shows how much it will produce as a function of how much it thinks FirmB will produce.

- Firm B's reaction curve shows its output as a function of how much it thinks Firm A will produce.

Figure 14.2 Graphical Depiction of the Cournot Model

a. Monopoly

b. Duopoly

At the point of intersection, each firm is doing the best it can, given the actual output of the other firm, also called as the best response equilibrium.

Each firm is producing 1,333.33 units for an industry total of 2,666.66. This output is more than the original monopolist produced in this market, but less than the 4,000 units that a competitive industry would produce.
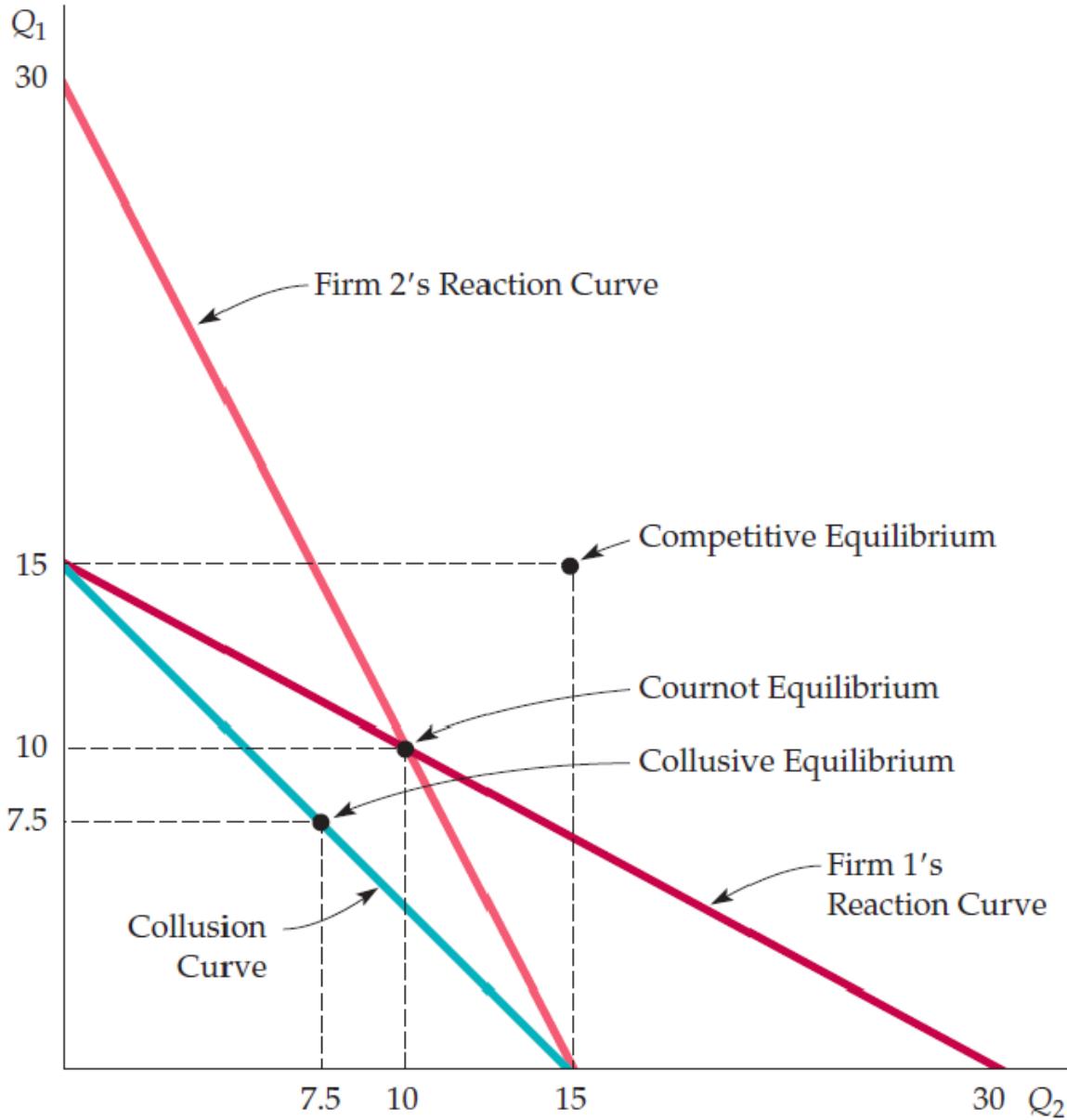
The more firms we have, behaving as Cournot predicted, the closer output (and thus prices) will be to the competitive levels.

- **Nash Equilibrium:** Each firm is doing the best it can given what its competitors are doing.

- Cournot equilibrium is an example of a Nash equilibrium.

- As a result, no firm would individually want to change its behavior. In the Cournot equilibrium, each firm is producing an amount that maximizes its profit given what its competitor is producing, so neither would want to change its output.

Derivation of a Firm's Reaction Curve

- If it thinks Firm 2 will produce nothing, its demand curve, labeled $D_1(0)$, is the market demand curve. The corresponding marginal revenue curve, labeled $MR_1(0)$, intersects Firm 1's marginal cost curve MC_1 at an output of 50 units.

- If Firm 1 thinks that Firm 2 will produce 50 units, its demand curve, $D_1(50)$, is shifted to the left by this amount. Profit maximization now implies an output of 25 units.

- Finally, if Firm 1 thinks that Firm 2 will produce 75 units, Firm 1 will produce only 12.5 units.

- Firm 1's profit-maximizing output is thus a decreasing schedule of how much it thinks Firm 2 will produce.

- We call this schedule Firm 1's reaction curve.

Duopoly Example

- The demand curve is P= 30 – Q, and both firms have zero marginal cost. In Cournot equilibrium, each firm produces 10.

- The collusion curve shows combinations of Q_1 and Q_2 that maximize total profits.

- If the firms collude and share profits equally, each will produce 7.5.

- Also shown is the competitive equilibrium, in which price equals marginal cost and profit is zero.

- **Turkish Competition Authority**

- «On the other hand, government intervention is made unavoidable due to the fact that when markets are left to their own devices, there is a risk of undertakings in the market entering a destructive race or, instead of a race, into co-operations which negatively affect social welfare and economic development. At the same time, such actions will restrict the freedom of enterprise, consequently interrupting the fundamental democratic rights and freedoms. Prevention of the aforementioned problems will only be possible by supporting the economic system with a competition act and by establishing an efficient competition authority to enforce that act.»

- «The main goal of the Competition Act is the prohibition of cartels and other restrictions on competition, prevention of abuse of dominant position by a firm which has dominance in a certain market and prevention of the creation of new monopolies by monitoring some merger and acquisition transactions.»

Game Theory

- **game theory:** Analyzes the choices made by rival firms, people, and even governments when they are trying to maximize their own well-being while anticipating and reacting to the actions of others in their environment.

- **payoff:** Value associated with a possible outcome.

- **strategy:** Rule or plan of action for playing a game. >>>> each firm's payoff depends on what the other firm does!

- **optimal strategy:** Strategy that maximizes a player's expected payoff.

- If I believe that my competitors are rational and act to maximize their own payoffs, how should I take their behavior into account when making my decisions?

- Determining optimal strategies can be difficult, even under conditions of complete symmetry and perfect information.

- Players choose strategies without knowing with certainty what strategy the opposition will use.

- **dominant strategy:** In game theory, a strategy that is best no matter what the opposition does.
- Advertising is a dominant strategy for Firm A. The same is true for Firm B: No matter what firm A does, Firm B does best by advertising. The outcome for this game is that both firms will advertise.
- Unfortunately, not every game has a dominant strategy for each player.
- Now Firm A has no dominant strategy. <u>Its optimal decision depends on what Firm B does</u>. If Firm B advertises, Firm A does best by advertising; but if Firm B does not advertise, Firm A also does best by not advertising.

Figure 14.3 Payoff Matrix for Advertising Game
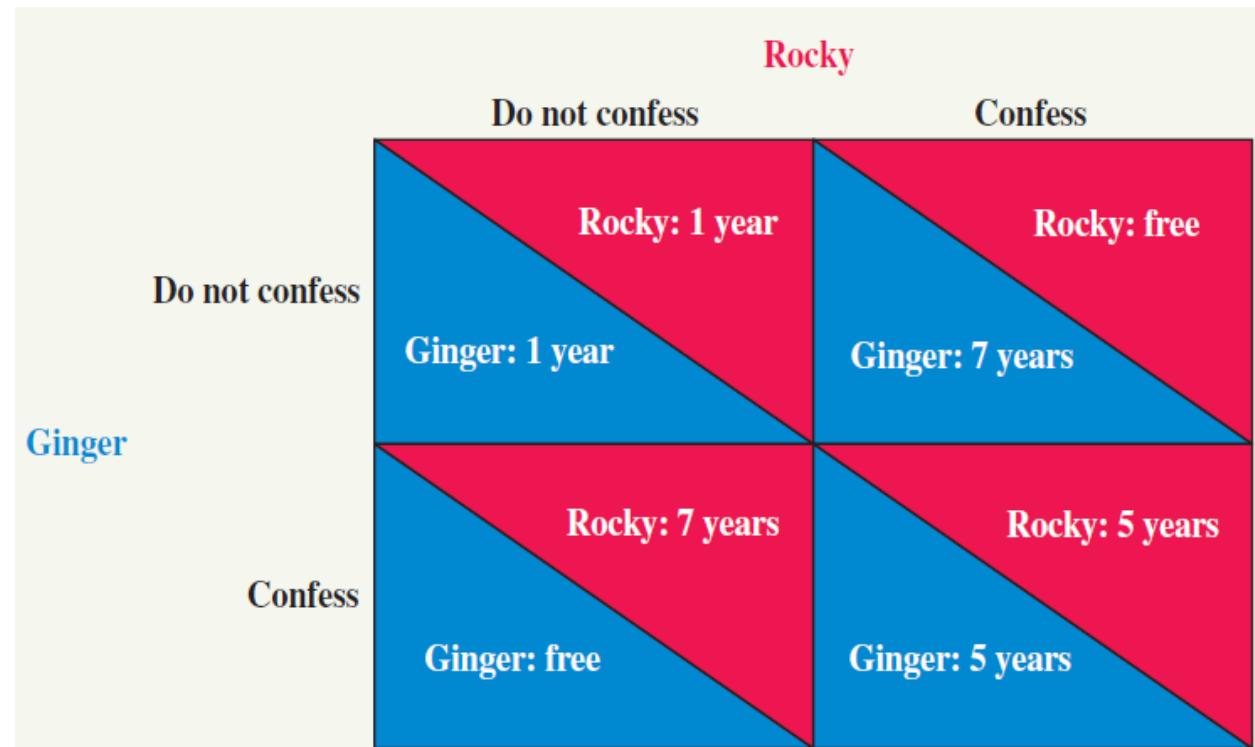
Payoff Matrix for Modified Advertising Game

- **prisoners' dilemma:** A game in which the players are prevented from cooperating and in which each has a dominant strategy that leaves them both worse off than if they could cooperate.

- Both players have a dominant strategy and will confess. if Rocky does not confess, Ginger will because going free beats a year in jail. Similarly, if Rocky does confess, Ginger will confess because 5 years in the slammer is better than 7. Rocky has the same set of choices. if Ginger does not confess, Rocky will because going free beats a year in jail. Similarly, if Ginger does confess, Rocky also will confess because 5 years in the slammer is better than 7. Both will confess regardless of what the other does.
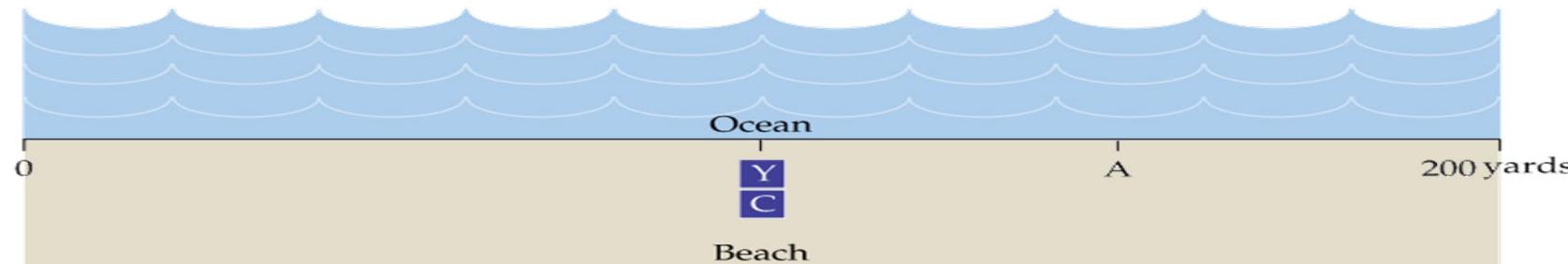
Figure 14.4 The Prisoners' Dilemma

	Rocky	
	Do not confess	**Confess**
Ginger — Do not confess	Rocky: 1 year / Ginger: 1 year	Rocky: free / Ginger: 7 years
Ginger — Confess	Rocky: 7 years / Ginger: free	Rocky: 5 years / Ginger: 5 years

- **Dominant Strategies:**   I'm doing the best I can *no matter what you do*.

   You're doing the best you *can no matter what I do*.

- **Nash Equilibrium:**   I'm doing the best I can given *what you are doing*.

   You're doing the best you can given *what I am doing*.

BEACH LOCATION GAME
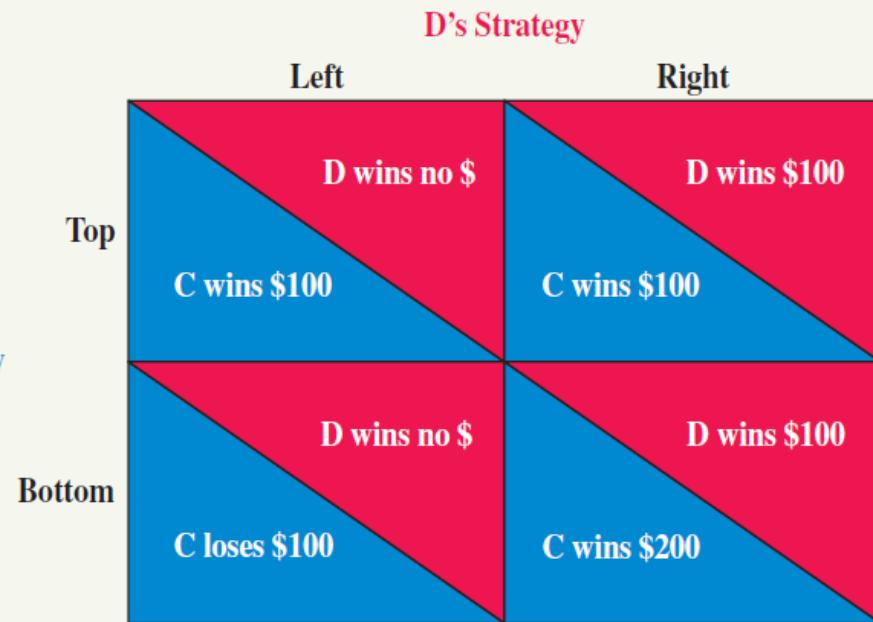
- You (Y) and a competitor (C) plan to sell soft drinks on a beach.

- If sunbathers are spread evenly across the beach and will walk to the closest vendor, the two of you will locate next to each other at the center of the beach. This is the only Nash equilibrium.

- If your competitor located at point A, you would want to move until you were just to the left, where you could capture three-fourths of all sales.

- But your competitor would then want to move back to the center, and you would do the same.

- Beach location game as an example of Nash equilibrium!
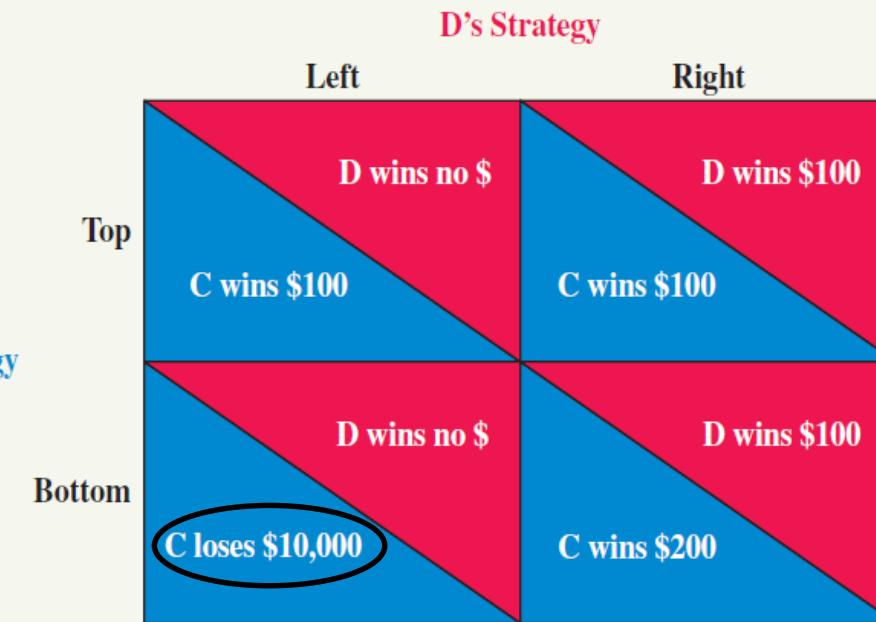
- **maximin strategy:** In game theory, a strategy chosen to maximize the minimum gain that can be earned. In essence, one who plays a maximin strategy assumes that the opposition will play the strategy that does the most damage.

- In the original game (a), C does not have a dominant strategy. if D plays left, C plays top; if D plays right, C plays bottom. D, on the other hand, does have a dominant strategy: D will play right regardless of what C does. if C believes that D is rational, C will predict that D will play right. if C concludes that D will play right, C will play bottom. The result is a Nash equilibrium because each player is doing the best that it can given what the other is doing.

- But if C is concerned that the managers of D might not be fully informed or rational—C might choose to play "Left-Top" especially for the new game!

Figure 14.5 Payoff Matrixes for Left/right–Top/Bottom Strategies

If C is unsure about what D will do but can assign probabilities to each feasible action for D, it could instead use a strategy that *maximizes its expected payoff.*

United States's Decision
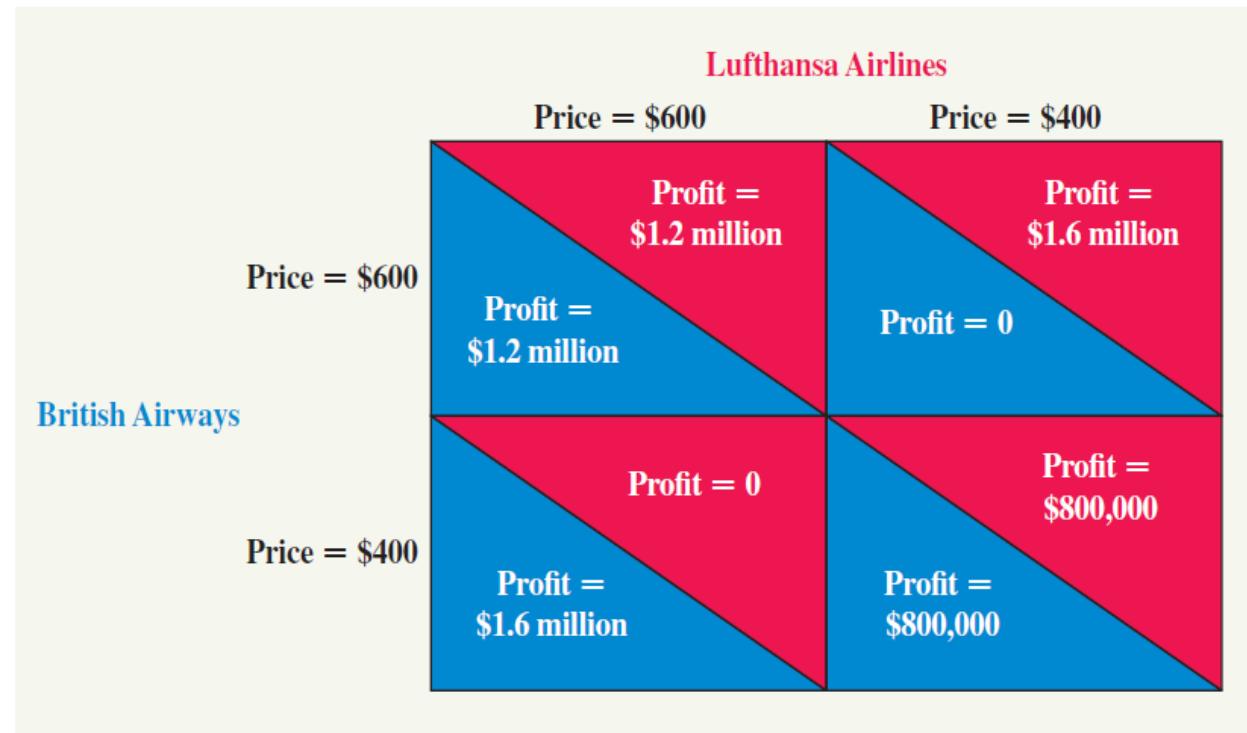
	Low Tariffs	High Tariffs
Mexico's Decision — Low Tariffs	U.S. gains $25 billion / Mexico gains $25 billion	U.S. gains $30 billion / Mexico gains $10 billion
Mexico's Decision — High Tariffs	U.S. gains $10 billion / Mexico gains $30 billion	U.S. gains $20 billion / Mexico gains $20 billion

Decision of the United States (U.S.)

	Arm	Disarm
Decision of the Soviet Union (USSR) — Arm	U.S. at risk / USSR at risk	U.S. at risk and weak / USSR safe and powerful
Decision of the Soviet Union (USSR) — Disarm	U.S. safe and powerful / USSR at risk and weak	U.S. safe / USSR safe

- **repeated game:** game in which actions are taken and payoffs received over and over again.

- **tit-for-tat strategy:** A repeated game strategy in which a player responds in kind to an opponent's play, cooperating with cooperative opponents and retaliating against uncooperative ones.

- In a single play, both British Airways (BA) and Lufthansa Airlines (IA) have dominant strategies. if LA prices at $600, BA will price at $400 because $1.6 million beats $1.2 million. If, on the other hand, LA prices at $400, BA will again choose to price at $400 because $800,000 beats zero. Similarly, LA will choose to price at $400 regardless of which strategy BA chooses.

Figure 14.6 Payoff Matrix for Airline game

- **sequential game:** game in which players move in turn, responding to each other's actions and reactions. For example; one firm sets output before the other does.

|		Firm A	Firm B
		Crispy	Sweet
Firm A	Crispy	−5, −5	10, 20
Firm B	Sweet	20, 10	−5, −5
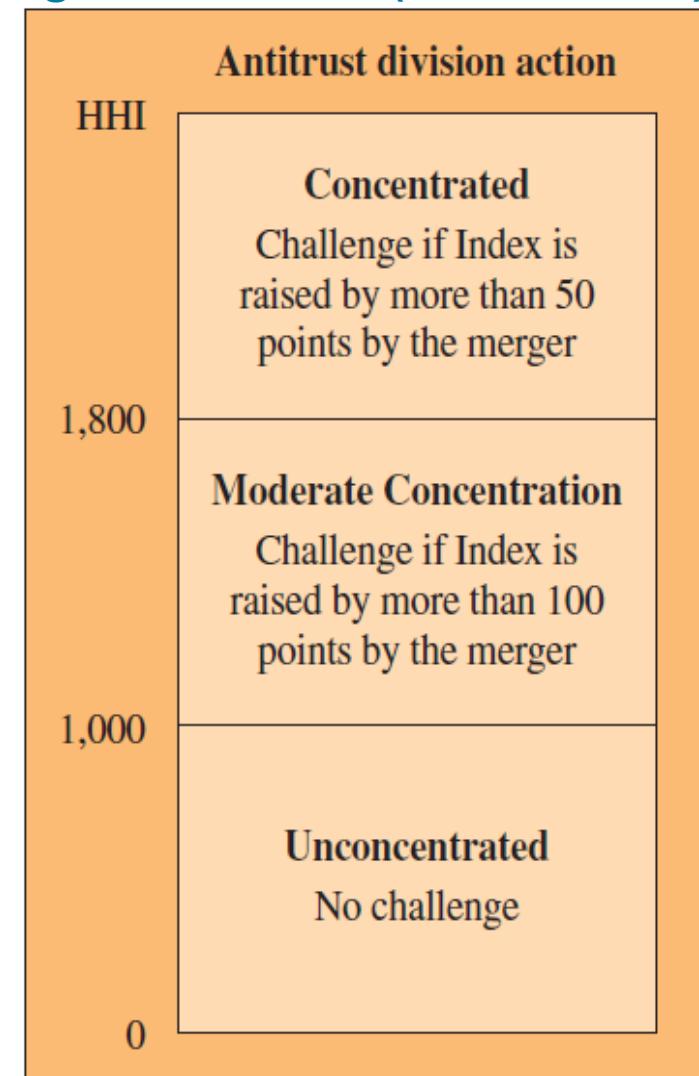
- Two new variations of cereal can be successfully introduced—provided that each variation is introduced by only one firm.

- Each firm is indifferent about which product it produces—so long as it does not introduce the same product as its competitor. The strategy set given by the bottom left-hand corner of the payoff matrix is stable and constitutes a Nash equilibrium.

- Suppose that both firms, in ignorance of each other's intentions, must announce their decisions _independently_ and simultaneously. In that case, both will probably introduce the sweet cereal—and both will lose money. In a sequential game, Firm 1 introduces a new cereal, and then Firm 2 introduces one.

- **Herfindahl-Hirschman Index (HHI):** An index of market concentration found by summing the square of percentage shares of firms in the market.

Figure 14.7 Department of Justice Merger Guidelines (revised 1984)

Table 14.2 Calculation of a Simple Herfindahl-Hirschman Index for Four Hypothetical Industries, each with No More Than Four Firms

Percentage Share of:

	Firm 1	Firm 2	Firm 3	Firm 4	Herfindahl-Hirschman Index
Industry A	50	50	–	–	$50^2 + 50^2 = 5,000$
Industry B	80	10	10	–	$80^2 + 10^2 + 10^2 = 6,600$
Industry C	25	25	25	25	$25^2 + 25^2 + 25^2 + 25^2 = 2,500$
Industry D	40	20	20	20	$40^2 + 20^2 + 20^2 + 20^2 = 2,800$

Antitrust division action

HHI

Concentrated
Challenge if Index is raised by more than 50 points by the merger

1,800

Moderate Concentration
Challenge if Index is raised by more than 100 points by the merger

1,000

Unconcentrated
No challenge

0

- A Game with Many Players: Collective Action Can Be Blocked by a Prisoner's Dilemma

- Coordinated collective action in everybody's interest can be blocked under some circumstances.

- A multiple-player game can result in a classic prisoners' dilemma, where collusion if it could be enforced would result in an optimal outcome but where dominant strategies result in a suboptimal outcome.

- To break this dilemma, we pass laws that allow government to become a player.

- The only necessary condition of oligopoly is that firms are large enough to have some control over price.

Figure 15.1 Characteristics of Different Market Organizations

	Number of firms	Products differentiated or homogeneous	Price a decision variable	Easy entry	Distinguished by	Examples
Perfect competition	Many	Homogeneous	No	Yes	Market sets price	Wheat farmer Textile firm
Monopoly	One	One version or many versions of a product	Yes	No	Still constrained by market demand	Public utility Patented drug
Monopolistic competition	Many	Differentiated	Yes, but limited	Yes	Price and quality competition	Restaurants Hand soap
Oligopoly	Few	Either	Yes	Limited	Strategic behavior	Automobiles Aluminum