OBJECTIVES

- Explain how managers of firms that operate in an oligopoly market can use strategic decision making to maintain relatively high profits
- Understand how the reactions of market rivals influence the effectiveness of decisions in an oligopoly market

OLIGOPOLY: Characteristics

- A market structure characterized by few sellers and interdependent price/output decisions
- Few sellers. A handful of firms produce the bulk of industry output.
- Blockaded entry and exit. Firm are heavily restricted from entering or leaving the industry.
- Imperfect dissemination of Information. Cost, price and product quality information are withheld from uninformed buyers.
- Homogeneous or unique product. Oligopoly output can be perceived as homogeneous or distinctive.

OLIGOPOLY: A MARKET WITH A SMALL NUMBER OF FIRMS

- Characterized by interdependence and the need for managers to explicitly consider the reactions of rivals
- Protected by barriers to entry that result from government fiat, economies of scale, or control of strategically important resources

COOPERATIVE BEHAVIOR

- The small number of firms in an oligopoly market tends to encourage cooperative behavior (collusion).
  - Increase profits
  - Decrease uncertainty
  - Raise barriers to entry

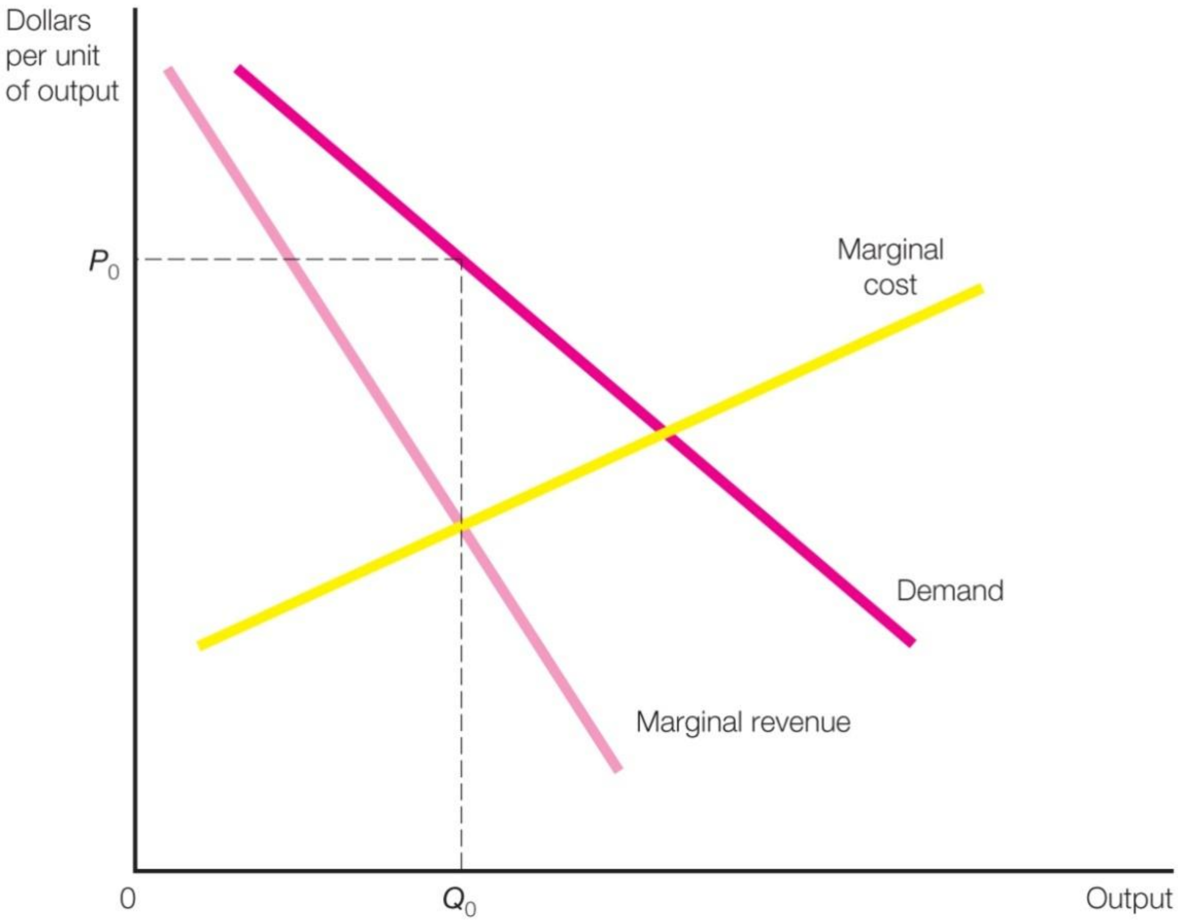
COOPERATIVE BEHAVIOR

- Cartel: A collusive arrangement made openly and formally
  - Cartels, and collusion in general, are illegal in the United States.
  - Cartels maximize profit by restricting the output of member firms to a level that the marginal cost of production of every firm in the cartel is equal to the market's marginal revenue and then charging the market-clearing price.
  - The need to allocate output among member firms results in an incentive for the firms to cheat by overproducing and thereby increase profit.

PRICE AND OUTPUT DETERMINATION BY A CARTEL

FIGURE 11.1

Price and Output Determination by a Cartel



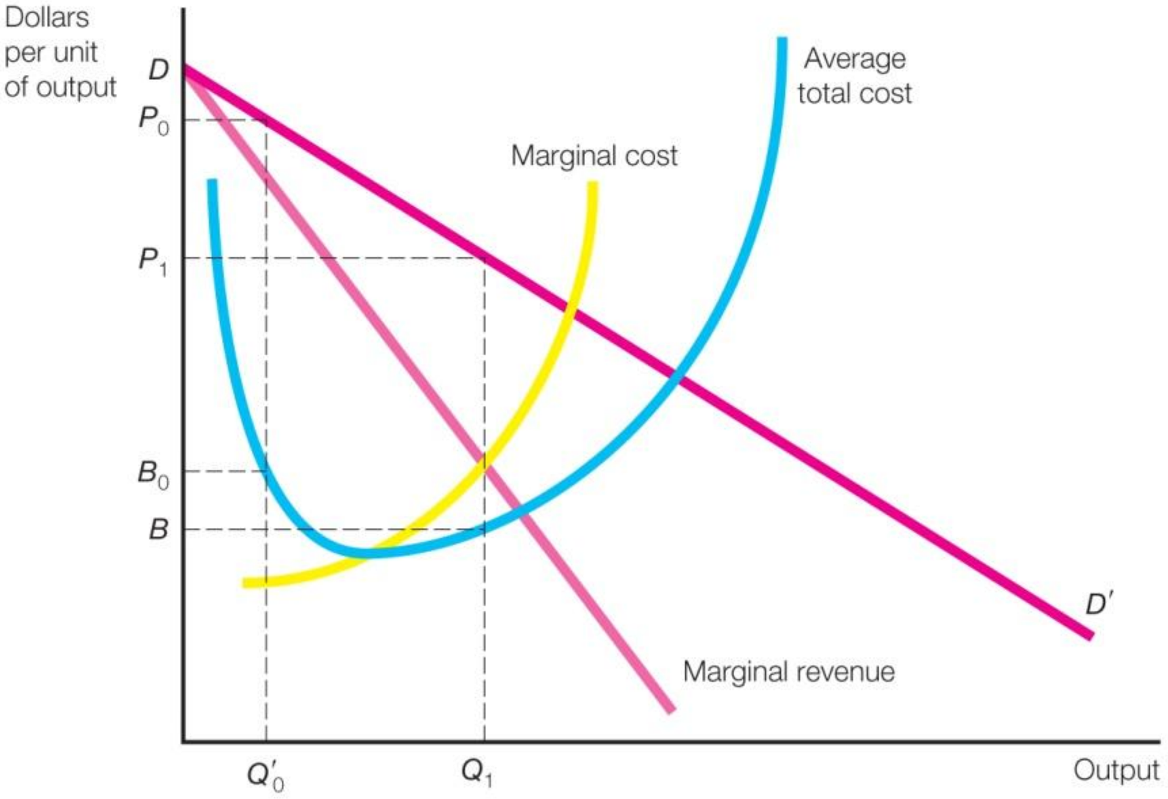
THE BREAKDOWN OF COLLUSIVE AGREEMENTS

- By producing a quantity of output that exceeds the quota established by a cartel, a firm can generally increase profits.

INSTABILITY OF CARTELS

FIGURE 11.2

Instability of Cartels



PRICE LEADERSHIP

- Price leadership: In oligopolistic industries, managers at one firm have significant market power and can set their price.
- Rivals then follow their lead.

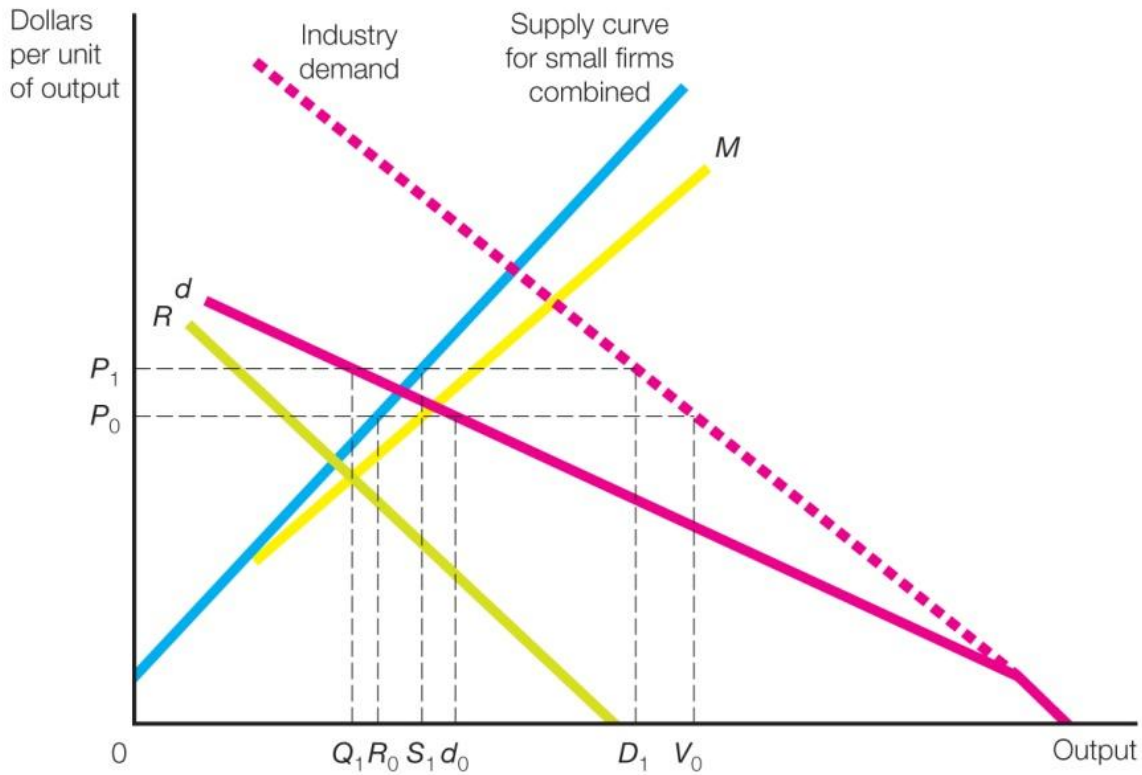
PRICE LEADERSHIP

- Assumptions
  - There is a single firm, the price leader, that sets price in the market.
  - There are also follower firms who behave as price takers, producing a quantity at which marginal cost is equal to price. Their supply curve is the horizontal summation of their marginal cost curves.
  - The price leader faces a residual demand curve that is the horizontal difference between the market demand curve and the followers' supply curve.
  - The price leader produces a quantity at which the residual marginal revenue is equal to marginal cost. Price is then set to clear the market.

PRICE LEADERSHIP BY A DOMINANT FIRM

FIGURE 11.3

Price Leadership by a Dominant Firm



POSSIBLE BEHAVIOR IN MARKETS WITH FEW RIVALS

- Duopoly: Market in which there are only two sellers
  - Firms produce identical products.
  - Rival managers make decisions simultaneously.
- When Rivals Are Few: Price Competition
  - Price competition tends to drive prices down to marginal cost and so should be avoided by managers.

POSSIBLE BEHAVIOR IN MARKETS WITH FEW RIVALS

- When Rivals Are Few: Price Competition (cont'd)
  - Example
    - Two firms with identical total cost functions:

      $TC_i = 500 + 4q_i + 0.5q_i^2$
    - Market demand: $P = 100 - Q = 100 - q_A - q_B$
    - Marginal cost: $MC_i = 4 + q_i$

POSSIBLE BEHAVIOR IN MARKETS WITH FEW RIVALS

- When Rivals Are Few: Price Competition (cont'd)
  - Example (cont'd)
    - Set $MC_A = P$ to get firm A's reaction function:

      $4 + q_A = 100 - q_A - q_B$

      $\Rightarrow q_A = 48 - 0.5q_B$
    - Set $MC_B = P$ to get firm B's reaction function:

      $4 + q_B = 100 - q_A - q_B$

      $\Rightarrow q_B = 48 - 0.5q_A$
    - Solve the reaction functions simultaneously:

      $q_A = q_B = 32$, $P = 36$, and each firm earns a profit of \$12

TABLE 11.1

Profit-Maximizing Output Responses of Managers of Firm *A* Given Their Assumptions about Firm *B* Output

If Firm *B* Produces	Then Firm *A* Produces
0	32
50	15.33
96	0

POSSIBLE BEHAVIOR IN MARKETS WITH FEW RIVALS

- When Rivals Are Few: Collusion
  - Example
    - Two firms with identical total cost functions:

      $TC_i = 500 + 4q_i + 0.5q_i^2$
    - Market demand: $P = 100 – Q = 100 – q_A – q_B$
    - Marginal revenue: $100 – 2Q$
    - Marginal cost: $MC_i = 4 + q_i$
    - Horizontal summation of MC: $Q = q_A + q_B = –8 + 2MC$
      $\Rightarrow MC = 4 + 0.5Q$
    - Set MC = MR: $4 + 0.5Q = 100 – 2Q$
      $\Rightarrow Q = 38.4$ ($q_i = 19.2$) and $P = 61.6$
    - Total profit is $843.20, or $421.60 for each firm.

POSSIBLE BEHAVIOR IN MARKETS WITH FEW RIVALS

- When Rivals Are Few: Quantity (Capacity) Competition
  - Rivals make simultaneous decisions, have the same estimate of market demand, have an estimate of the other's cost function, and assume that the other firm's level of output is given.
  - Example 1: Monopoly by firm A
    - Market demand: $P = 100 – Q = 100 – q_A$
    - Marginal revenue: $100 – 2Q$
    - Marginal cost: $MC_A = 4 + Q$
    - $MC = MR$: $4 + Q = 100 – 2Q \Rightarrow Q = 32$ and $P = 68$

POSSIBLE BEHAVIOR IN MARKETS WITH FEW RIVALS

- When Rivals Are Few: Quantity (Capacity) Competition (cont'd)
  - Example 2: Firm B produces $q_B = 96$
    - Residual market demand to firm A: $P = 4 – q_A$
    - Optimal output is $q_A = 0$
  - Example 3: Firm B produces $q_B = 50$
    - Residual market demand to firm A: $P = 50 – q_A$
    - Optimal output is $q_A = 15.33$

POSSIBLE BEHAVIOR IN MARKETS WITH FEW RIVALS

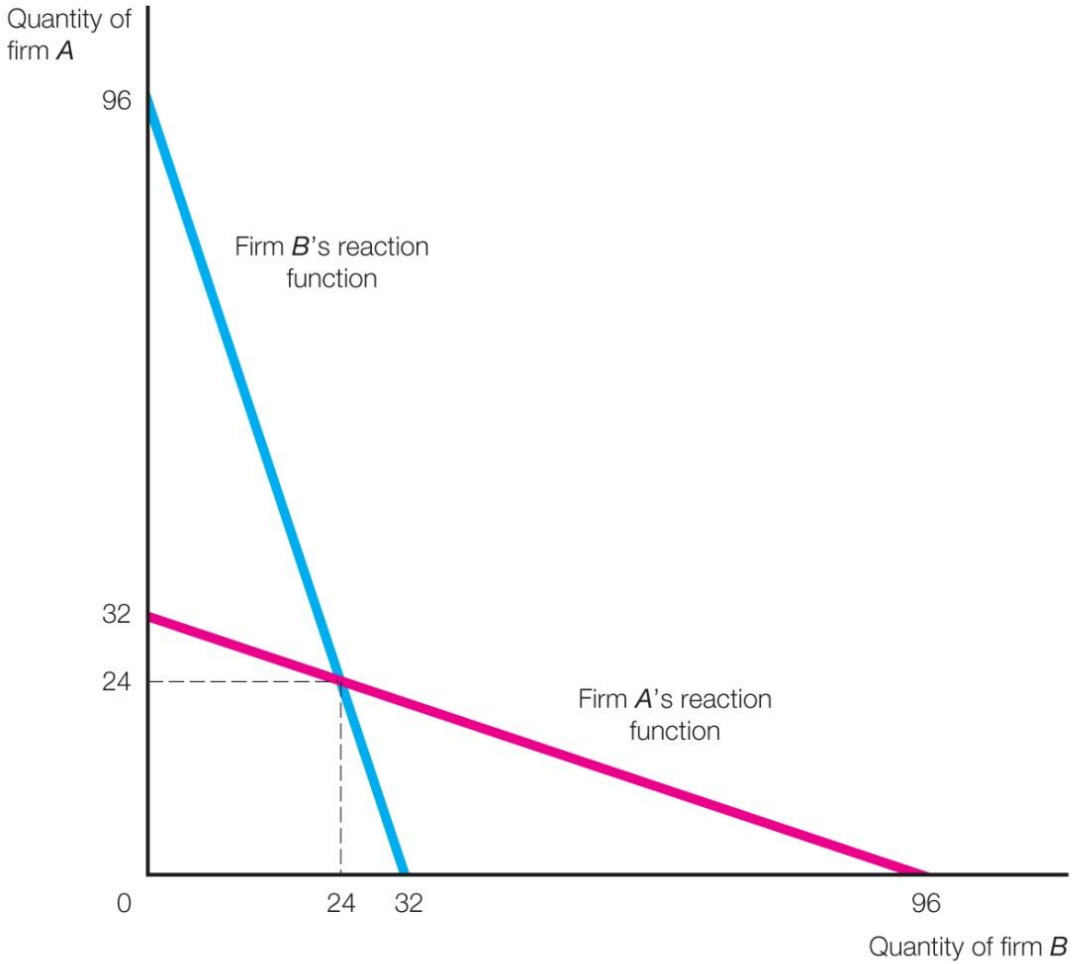
- Example 4: General solution
  - Market demand: $P = 100 – Q = 100 – q_A – q_B$
  - Marginal revenue for firm A: $MR = 100 – 2q_A – q_B$
  - Marginal cost for firm A: $MC_A = 4 + q_A$
  - MC = MR yields firm A's reaction function:

    $4 + q_A = 100 – 2q_A – q_B \Rightarrow q_A = 32 – (1/3)q_B$
  - Firm B's reaction function: $q_B = 32 – (1/3)q_A$
  - Nash equilibrium: Solving the two reaction functions simultaneously yields $q_A = q_B = 24$, and each firm earns a profit of $364.
  - Figure 11.4: Cournot Reaction Functions for Firms A and B

COURNOT REACTION FUNCTIONS FOR FIRMS *A* AND *B*

FIGURE 11.4

Cournot Reaction Functions for Firms *A* and *B*



POSSIBLE BEHAVIOR IN MARKETS WITH FEW RIVALS

- The Cournot Scenario with More than Two Firms
  - Example
    - Market demand: $P = a - b\Sigma Q_i$
    - Marginal revenue: $MR = a - (N + 1)bQ_i$
    - $MC = c + eQ_i$
    - $MC = MR$: $c + eQ_i = a - (N + 1)bQ_i$

      $\Rightarrow Q_i = (a - c)/[(n + 1)b + e]$

POSSIBLE BEHAVIOR IN MARKETS WITH FEW RIVALS

- The Cournot Scenario with More than Two Firms
  - Example (Continued)
    - Table 11.2: Price, Output, and Profits with Multiple Cournot Competitors (with a = 100, b = 1, c = 4, and e = 1)
    - The addition of a small number of entrants in a Cournot situation can result in significant price competition and erosion of profits.

TABLE 11.2

Price, Output, and Profits with Multiple Cournot Competitors

Number of Competitors	Price	Percentage Decrease	Quantity/ Firm	Profit/ Firm	Total Quantity	Percentage Increase
Cartel	61.6		19.2	421.6	32	
2	52	15.58	24	364	48	25
3	42.4	31.17	19.2	52.96	57.6	50
4	36	41.56	16	−116	64	66.67
5	31.43	48.98	13.71	−217.88	68.57	78.57
6	28	54.55	12	−284	72	87.50
7	25.33	58.87	10.67	−329.33	74.67	94.44
8	23.2	62.34	9.6	−361.76	76.8	100
9	21.45	65.17	8.73	−385.75	78.55	104.55
10	20	67.53	8	−404	80	108.33
n	$\frac{4n + 200}{n + 2}$		$\frac{96}{n + 2}$	$(11{,}824 - 2{,}000n - 500n^2)/(n + 2)^2$	$\frac{96n}{n + 2}$	
∞	4	93.51	0	−500	96	150

POSSIBLE BEHAVIOR IN MARKETS WITH FEW RIVALS

- When Managers Move First: Stackelberg Behavior
  - When, in a Cournot environment, one firm moves first and optimizes production based on knowledge of its rival’s reaction function, there is a first-mover advantage.

POSSIBLE BEHAVIOR IN MARKETS WITH FEW RIVALS

- Stackelberg Behavior (cont'd)
  - Example
    - Market demand: $P = 100 – Q = 100 – q_A – q_B$
    - Marginal revenue for firm A: $MR_A = 100 – 2q_A – q_B$
    - Marginal cost for firm A: $MC_A = 4 + q_A$
    - Firm B's reaction function: $q_B = 32 – (1/3)q_A$
    - MC = MR given firm B's reaction function: $4 + q_A = 100 – 2q_A – [32 – (1/3)q_A] \Rightarrow q_A = 27.43$, $q_B = 22.86$, firm A's profit is \$377.71, and firm B's profit is \$283.67.
    - The first-mover advantage (additional profit) over the Cournot solution for firm A is \$13.71.

POSSIBLE BEHAVIOR IN MARKETS WITH FEW RIVALS

- Stackelberg Behavior (cont'd)
  - Example: When firm A has a lower cost, its first-mover advantage is increased.
    - Firm A's cost function: $TC_A = 500 + 4q_A + 0.5q_A^2$
    - Firm B's cost function: $TC_B = 500 + 10q_B + 0.5q_B^2$
    - Firm A's reaction function: $q_A = 32 – (1/3)q_B$
    - Firm B's reaction function: $q_B = 30 – (1/3)q_A$
    - If firm A goes first: P = \$51.143, q_A = 28.286, π_A = \$433.429, q_B = 20.571, and π_B = \$134.776.
    - If firm B goes first: P = \$51.429, q_A = 23.714, π_A = \$343.551, q_B = 24.857, and π_B = \$220.857.

DUOPOLOLISTS AND PRICE COMPETITION WITH DIFFERENTIATED PRODUCTS

- Bertrand model
- Example: Two producers who sell differentiated but highly substitutable products (Compare with total competition MC=P, note demand function not inverse)
  - Assume MC = 0 for both firms
  - Demand for firm 1's product: $Q_1 = 100 - 3P_1 + 2P_2$
  - Demand for firm 2's product: $Q_2 = 100 - 3P_2 + 2P_1$
  - Total revenue for firm 1:

$$TR_1 = P_1(100 - 3P_1 + 2P_2) = 100P_1 - 3P_1^2 + 2P_1P_2$$

$$TR_1 = TR_{11} + TR_{12}$$

where $TR_{11} = 100P_1 - 3P_1^2$ and $TR_{12} = 2P_1P_2$

DUOPOLOLISTS AND PRICE COMPETITION WITH DIFFERENTIATED PRODUCTS

- Example: (cont'd)
  - Marginal revenue for firm 1: $MR_1 = \Delta TR_1/\Delta P_1 = (\Delta TR_{11}/\Delta P_1) + (\Delta TR_{12}/\Delta P_1)$
    $MR_1 = 100 – 6P_1 + 2P_2$
  - Bertrand reaction function for firm 1: $MR = MC_1 = 0$: $100 – 6P_1 + 2P_2 = 0$
    $\Rightarrow P_1 = (50/3) + (1/3)P_2$

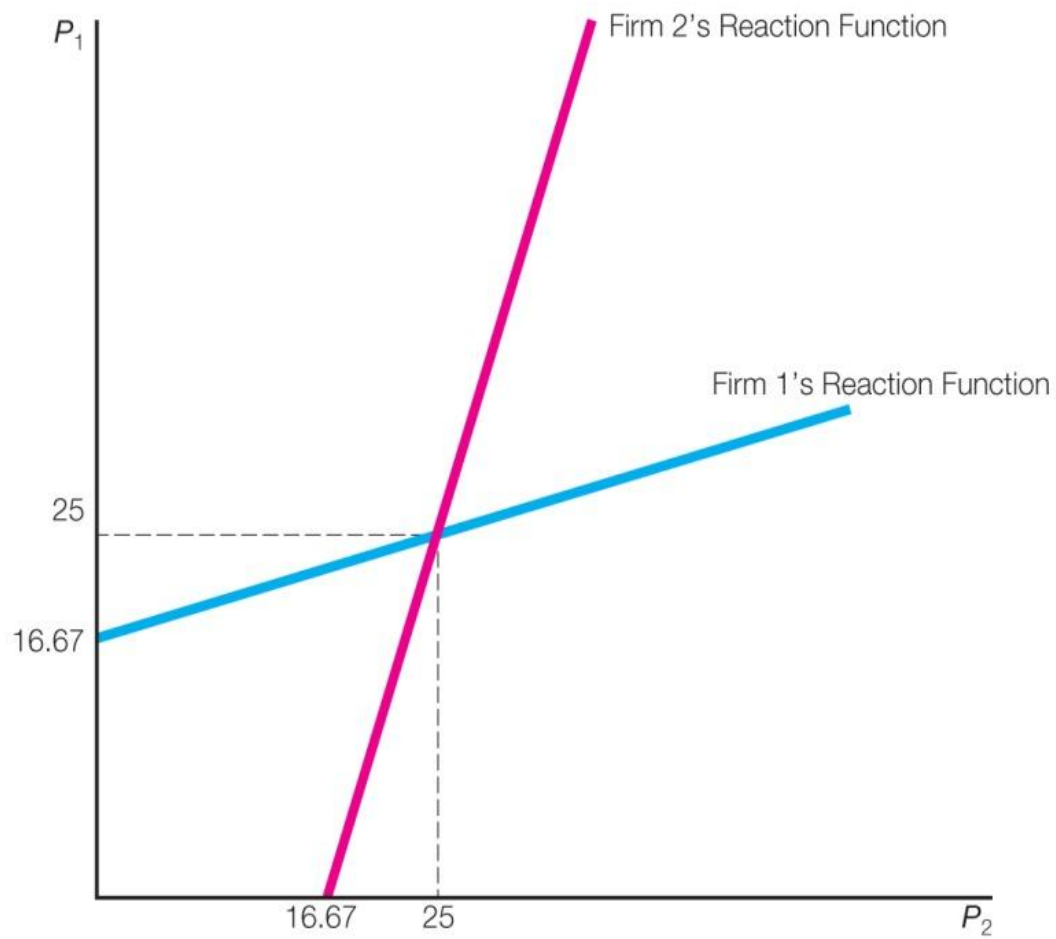
DUOPOLOLISTS AND PRICE COMPETITION WITH DIFFERENTIATED PRODUCTS

- Example: Two producers who sell differentiated but highly substitutable products (cont'd)
  - Bertrand reaction function for firm 2: MR = MC_2 = 0: 100 – $6P_2 + 2P_1 = 0 \Rightarrow P_2 = (50/3) + (1/3)P_1$
  - Solving the two reaction functions simultaneously yields: $P_1 = P_2 = \$25$, $q_1 = q_2 = 75$, $\pi_1 = \pi_2 = \$1{,}875$.

BERTRAND REACTION FUNCTIONS AND EQUILIBRIUM FOR FIRMS 1 AND 2

FIGURE 11.5

Bertrand Reaction Functions and Equilibrium for Firms 1 and 2



DUOPOLOLISTS AND PRICE COMPETITION WITH DIFFERENTIATED PRODUCTS

- Example: Two producers who sell differentiated but highly substitutable products and collude or merge
  - $TR = TR_{11} + TR_{22} + TR_{12} = 100P_1 – 3P_1^2 + 100P_2 – 3P_2^2 + 4P_1P_2$
  - $MR_1 = 100 – 6P_1 + 4P_2$
  - $MR_2 = 100 – 6P_2 + 4P_1$

DUOPOLOLISTS AND PRICE COMPETITION WITH DIFFERENTIATED PRODUCTS

- Example: Two producers who sell differentiated but highly substitutable products and collude or merge (cont'd)
  - Reaction function for firm 1 ($MR_1 = 0$):

    $P_1 = (50/3) + (2/3)P_2$
  - Reaction function for firm 2 ($MR_2 = 0$):

    $P_2 = (50/3) + (2/3)P_1$
  - Solving the two reaction functions simultaneously yields: $P_1 = P_2 = \$50$, $q_1 = q_2 = 50$, $\pi_1 = \pi_2 = \$1,875$.