**CHAPTER 9**

**MONOPOLISTIC COMPETITION AND OLIGOPOLY**

Chapter Outline

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Chapter Summary

Questions

1. Product differentiation enables an individual firm in a monopolistically competitive industry to have some control over price.

2. The oligopoly firm with a kinked demand curve believes that if it raises price to a level above that at which the kink occurs, no other firms in the industry will follow with corresponding price increases. However, if the firm were to lower price to a level below that at which the kink occurs, it believes all other firms in the industry would respond with price cuts. The monopolistically competitive firm believes that no other firms in the industry will respond if it changes price. However, most firms in a monopolistically competitive industry tend to raise or lower prices at about the same time. Thus, the monopolistically competitive firm usually does not perceive its true or actual demand curve, at least according to the Chamberlin theory.

3. Some examples of monopolistically competitive industries would probably include car washes, beauty salons, restaurants, and printing shops. Entry into the industry is relatively easy in each case and products are differentiated.

4. The models generate different conclusions because they have different assumptions regarding the behavior of the firms. Chamberlin and the price leadership theory both argue that firms recognize their mutual interdependence and settle on an industry price. However, the Chamberlinian result of a monopoly price is not always obtained in cases of price leadership.
5. An oligopolistic firm in this situation would charge a different price if its marginal cost curve intersected its marginal revenue curve at an output level different from that corresponding to the kink.

6. Probably so. General Motors has at times supplied as much as 50 to 60 percent of the automobiles produced domestically and sold in the U.S., and it retains a leadership position in the industry.

7. Industry output should be allocated among the firms in a cartel so that the marginal cost for each firm is equal to industry marginal revenue and marginal cost at the optimal level of industry output. Because one or more firms are economically or politically more powerful than the others and may, therefore, successfully demand a larger share of the market than would be economically optimal for the industry as a whole, the cartel might choose to do otherwise.

8. Entry into a monopolistically competitive industry is relatively easy. Therefore, when firms in this type of industry are making economic profits, other firms enter and drive down the price. In an oligopolistic industry, there are substantial barriers to entry, thus preventing the entrance of many firms.

9. A price war often develops when an individual gasoline station lowers price, whereas other service stations will not necessarily follow a price increase.

10. The dominant firm estimates the quantities that the small firms would supply at each possible price, assuming that they behave as purely competitive firms, accepting the price which it sets as a “given” and producing where \( P = MC \) (as long as price is greater than average variable cost). The demand curve for the dominant firm can then be obtained by subtracting the aggregate quantity supplied by the small firms at each price from the total quantity demanded in the market at the corresponding price.

Problems

1. (a.–c.)

The intersection of \( M \) with \( d \) must occur at the same quantity where \( SMC = MR_d \).
2. The above diagram is the correct one for the long run. In the given diagram, \( d \) intersects the \( LAC \) curve, indicating that the firm’s managers believe that lowering price will yield \( \pi > 0 \). The \( d \) curve must be tangent to \( LAC \) in order to have a stable long-run situation.

3. \( Q_K = 5,000 - 25,000P_K \)
\[ -25,000P_K = Q_K - 5,000 \]
\[ P_K = \frac{-0.00004Q_K}{.2} \]

Total revenue is maximized where \( MR_K = MC = 0 \).

Since \( MR_K \) will have twice the negative slope of \( P_K \),
\[ MR_K = -0.00008Q_K + .2 = 0 \]
\[ -0.00008Q_K = -.2 \]
\[ Q_K = 2,500 \]

a. \( P_K = -0.00004(2,500) + .2 \)
\[ P_K = -.1 + .2 = .10 \]

b. Under the Cournot assumption, the two firms together will produce \( 2/3(Q^*) \), where \( P_K = 0 \) at \( Q^* \). At \( P_K = 0 \),
\[ -0.00004Q_K + .2 = 0 \]
\[ -0.00004Q_K = -.2 \]
\[ Q_K = 5,000 \]

Total quantity produced = \( (2/3)(5,000) = 3,333 \) units, approximately. Each firm will produce
\( (1/2)(3,333) = 1,667 \) units, approximately. The price will be \( P_K = -0.00004(3,333) + .2 = -.13 + .20 = .07 \). Revenue of each firm = \( .07(1,667) = 116.69 \).

c. Yes, if the firms were to cooperate and each produce one-half the monopoly output (where \( TR \) is maximized, at \( Q = 2,500 \) units). Thus, each firm should produce 1,250 units at a price of \( .10 \). Total revenue for each firm is \( 1,250(.10) = 125 \), an increase of \( 8.31 \) for each firm.
4. **(a.–c.)** The completed diagram follows.

![Completed Diagram]

Note that $OQ_L = OQ_T - OQ_S$.

5. \( Q_M = 81,000 - 200P \)
\( Q_s = 1,000 + 50P \)
\( MC_L = 100 + .014Q \)

The large firm's demand function is given by \( Q_M = Q_s \):
\( Q_L = 81,000 - 200P - 1,000 - 50P \)
\( Q_L = 80,000 - 250P_L \)

The large firm will maximize profit where \( MR_L = MC_L \).

\[
Q_L = 80,000 - 250 P_L
\]
\[-250P_L = Q_L - 80,000\]
\[P_L = -.004Q_L + 320\]
\[TR_L = (-.004Q_L + 320)Q_L\]
\[MR_L = \frac{dTR_L}{dQ_L} = -0.008Q_L + 320\]

When \( MR_L = MC_L = .008Q_L + 320 = 100 + .014Q_L \)
\[.022Q_L = -220\]
\[Q_L = 10,000 \text{ units}\]
\[P_L = -.004(10,000) + 320\]
\[P_L = -40 + 320 = \$280\]

**a.** \( P_L = \$280 \)

**b.** \( Q_L = 10,000 \text{ units} \)

**c.** \( Q_s = 1,000 + 50(280) = 15,000 \text{ units} \)
6. The completed diagrams follow.

\[\begin{array}{c|c|c|c}
\text{MR} & Q & P & \text{TVC} \\
\hline
115 & 0 & 120 & 0 \\
105 & 10 & 115 & 1150 \\
95 & 20 & 110 & 2200 \\
85 & 30 & 105 & 3150 \\
75 & 40 & 100 & 4000 \\
65 & 50 & 95 & 4750 \\
55 & 60 & 90 & 5400 \\
45 & 70 & 85 & 5950 \\
35 & 80 & 80 & 6400 \\
25 & 90 & 75 & 6750 \\
\end{array}\]

b. Setting each member’s MC equal to 25 yields the following outputs, which sum to 50,000.

\[Q_1 = \frac{23}{.001} = 23,000\]
\[Q_2 = \frac{23.1}{.012} = 19,250\]
\[Q_3 = \frac{15.5}{.002} = 7,750.\]

7. From the given demand curve and profit-maximizing price we have a total cartel output of

\[Q = 200,000 - 4,000(37.5) = 50,000.\]

The marginal revenue curve for the given demand curve is

\[MR = 50 - .0005Q.\]

At \(Q = 50,000\), the \(MR\) will be 25. Setting each member’s MC equal to 25 yields the following outputs, which sum to 50,000.

\[Q_1 = \frac{23}{.001} = 23,000\]
\[Q_2 = \frac{23.1}{.012} = 19,250\]
\[Q_3 = \frac{15.5}{.002} = 7,750.\]

8. a. Beyond the 50 output level, \(SMC > MR\).

b. \(P_e = $95.\) \(\text{TR} = (TR - TC) = 4,750 - 1,500 - 600 = $2,650.\)
9. The completed diagram follows. Note that for prices above the one at the kink \( MR \) is a line that bisects any horizontal line drawn between the flat portion of \( D \) and the vertical axis. For prices below the one at the kink, \( MR \) bisects any horizontal line drawn between the vertical axis and the steep portion of \( D \). There is a gap in \( MR \) at \( Q_e \). For the firm to wish to remain at price \( P_e \) and quantity \( Q_e \), requires that \( SMC \) pass through the gap. That way, for quantities less than \( Q_e \), \( MR > MC \), while for quantities greater than \( Q_e \), \( MR < MC \). (We have not shown \( SAC \) or \( AVC \) below. However, operation at \( Q_e \) would require that \( P_e > AVC \).)

10. Profit maximization or loss minimization at \( Q > 0 \) for this firm will require three conditions: (1) that its demand and market share curves intersect where \( P = $400 \), (2) that \( SMC = MR \) at the output value consistent with \( P = $400 \), and (3) that \( P \geq AVC \).

For the first condition, we have \( 5,000 - 10P = 3,000 - 5P \). Solving, we obtain \( 5P = 2,000 \), and \( P = $400 \). For the second condition, we first substitute \( P = 400 \) into the demand curve equation, \( Q = 5,000 - 10P \), and obtain \( Q = 1,000 \). From the demand curve, \( P = 500 - 0.1Q \), and \( MR = 500 - 0.2Q \). Thus, \( MR = 500 - 200 = 300 \). We compare this with marginal cost at \( Q = 1,000 \). \( SMC = 100 + 0.2Q = 300 \). Thus, \( SMC = MR \), and the firm is maximizing profit (minimizing loss) if its \( AVC \) is covered.

Note: Some students may observe that since \( SMC \) is the derivative of \( TVC \), which has no constant term, the equation for \( TVC \) must be \( TVC = 100Q + 0.1Q^2 \). Therefore, \( AVC = TVC/Q = 100 + 0.1Q \). At \( Q = 1,000 \), \( AVC = 200 \). Since \( P = 400 \), the firm definitely should operate.

11. To answer this problem it is first necessary to determine the range of the gap in \( MR \) that occurs at the quantity value where the demand curve is kinked. There, \( 1,400 - 20P = 800 - 10P \). \( 10P = 600 \), \( P = 60 \), and, by substitution into either demand curve equation, \( Q = 200 \).

For the more elastic portion of the demand curve, at output equal to 200, \( P = 70 - .05Q \), and \( MR = 70 - 0.1Q = 50 \). For the less elastic portion of the demand curve, \( P = 80 - 0.1Q \), and \( MR = 80 - 0.2Q = 40 \). Therefore, \( MC \) must be between 40 and 50 at \( Q = 200 \) in order for the firm to rationally choose that output. However, \( MC = 60 \), so the firm should raise price even though rivals will not follow.

To find the correct quantity and price, set the \( MR \) equation for the more elastic portion of the demand curve equal to the \( MC \) of 60. (This will be the demand curve with the lowest price and \( MR \) intercept.) Thus, \( 70 - 0.1Q = 60 \), and \( Q = 100 \). \( P = 70 - .05Q = $65 \). (In this case, we know the firm should operate since the constant \( MC \) is also \( AVC \), and the price of $65 exceeds the \( AVC \) of $60.)
C1. $Q = 25,000 - 2,000P$
$AVC = $5

a. Profit will be maximized where $MR = MC$. Since $AVC$ is constant, $AVC = MC = $5.

$Q = 25,000 - 2,000P$

$-2,000P = Q - 25,000$

$P = -.0005Q + 12.5$

$TR = P(Q) = (-.0005Q + 12.5)(Q) = -.0005Q^2 + 12.5Q$

$MR = \frac{dTR}{dQ} = -.001Q + 12.5$

At the profit-maximizing output,

$-.001Q + 12.5 = 5$

$-.001Q = -7.5$

$Q = 7,500$ homes

$P = -.0005Q + 12.5 = -3.75 + 12.5 = $8.75

b. Total revenue = $8.75(7,500) = $65,625

Less: Total cost = $12,000 + 5(7,500) = $49,500

Total profit = $TR - TC = $16,125

c. $Q' = 22,000 - 2,000P$

$-2,000P = Q' - 22,000$

$P = -.0005Q' + 11$

$TR = P(Q') = (-.0005Q' + 11)Q' = -.0005Q'^2 + 11Q'$

$MR = \frac{dTR}{dQ'} = -.001Q' + 11$

Profit is maximized where $MR = MC$:

$-.001Q' + 11 = 5$

$-.001Q' = -6$

$Q' = 6,000$

$P = -.0005Q' + 11 = -.0005(6,000) + 11 = $8.00

d. Profit in Part c is found as follows:

Total revenue = $8.00(6,000) = $48,000

Less: Total cost = $12,000 + 5(6,000) = $42,000

Total profit = $6,000

Total profit with the original demand curve and $5,000 per month additional advertising expenditures would be the total profit in Part b less $5,000 or

$16,125 - 5,000 = $11,125$

Thus, profit is decreased by $5,125 when advertising expenditures are cut by $5,000.

e. Restore advertising expenditure to its original level.
C2. This problem illustrates the situation faced by an oligopolistic firm with a kinked demand curve.

\[ Q = 700 - 50P \]  
\[ -50P = Q - 700 \]

\[ P = 0.02Q + 14 \]

\[ TR = P \cdot Q = (-0.02Q + 14)Q \]  
above the kink

\[ MR = \frac{dTR}{dQ} = -0.04Q + 14 \]  
above the kink

\[ Q' = 200 - 10P \]  
below the kink

\[ -10P = Q' - 200 \]

\[ P = 0.1Q' + 20 \]

\[ TR = P \cdot Q' = (-0.1Q' + 20)Q' \]  
below the kink

\[ MR = \frac{dTR}{dQ'} = -0.2Q' + 20 \]  
below the kink

To find the profit-maximizing level of output, we first find the level of output at which the kink occurs, obtained by substituting \( P = 12.50 \) into either of the following demand functions:

\[ Q = 700 - 50(12.50) = 700 - 625 = 75 \]

or \( Q' = 200 - 10(12.50) = 200 - 125 = 75 \).

We must also locate both the upper and lower values of \( MR \) at this point:

\[ MR = -0.04Q + 14 = 11 \]  
upper value

\[ MR' = -0.2Q' + 20 = 5 \]  
lower value

a. With a marginal cost of \$8, profit is maximized at \( Q = 75 \) units and \( P = 12.50 \) (\$8 is between \( MR = 11 \) and \( MR' = 5 \)).

b. A marginal cost of \$11.50 will equal \( MR \) at a level of output less than 75 units, so we must use the upper \( MR \) function to solve for the profit-maximizing level of output (where \( MR = MC \)).

\[ MR = -0.04Q + 14 = 11.50 \]

\[ -0.04Q = -2.50 \]

\[ Q = 62.5 \text{ or approximately 62 units of output} \]

\[ P = -0.02Q + 14 = -0.02(62) + 14 = -1.24 + 14 = \$12.76. \]

C3. a. \( MR = 160 - Q, \)

\( SMC = 40 - 3Q + Q^2 \)

Where \( MR = SMC, \ 160 - Q = 40 - 3Q + Q^2; Q^2 - 2Q - 120 = 0. \)

Factoring, we obtain \((Q + 10)(Q - 12) = 0, \)

\( Q = -10 \) or \( Q = 12, \) so 12 is the correct root.

\( AR = P = 160 - 6 = 154 \)

b. \( TR = 154(12) - 500 - 40(12) + 1.5(12)^2 - 1/3(12)^3 \)

\( = 1,848 - 500 - 480 + 216 - 576 = \$508. \)

C4. a. This is a kinked demand curve, and the kink is located by solving for the intersection of the two given linear demand curves:

\( 400 - 4P = 250 - 2P \)

\( 2P = 150; \) and \( P = 75. \)

Therefore, \( Q = 400 - 4P = 400 - 300 = 100. \)

Also, \( Q = 250 - 2P = 250 - 150 = 100. \)
b. Here one must determine whether $MC$ will pass though the gap in $MR$ that results from the kink in the demand curve. Let $MR_u$ be the upper $MR$ and $MR_L$ the lower. From the demand curve $Q = 400 - 4P$, we have the following:

\[ P = 100 - 0.25Q \text{ and } MR_u = 100 - 0.5Q. \]

At $Q = 100$, $MR_u = 100 - 50 = 50$

From the demand curve $Q = 250 - 2P$, we have:

\[ P = 125 - 0.5Q \text{ and } MR_L = 125 - Q \]

At $Q = 100$, $MR_L = 125 - 100 = 25$.

For the given $STC$, $MC = 20 + 0.2Q$ and at $Q = 100$, thus $MC = 20 + 20 = 40$. Since the $MC$ value lies within the gap between $MR = 25$ and $MR = 50$, the firm will maximize profit (min. loss) at $Q = 100$ and $P = 75$. This assumes, of course, that $P > AVC$, which is true in this case ($75 > 30$).

c. Now $MC = 30 + 0.5Q$ which at $Q = 100$ is $30 + 50 = 80$. Since 80 is greater than 50, the value of $MR_u$ at the kink, the firm will maximize profit (min. loss) at a quantity lower than 100. The relevant $MR$ will be $MR_L$.

Thus, $MC = MR_L; 30 + 0.5Q = 100 - 0.5Q$.

\[ Q = 70; \text{ and } P = 100 - 0.25(70) = 100 - 17.50 = $82.50. \]

Profit will be be greater than normal, since

\[ (TR - STC) = 70(82.50) - 60 - 30(70) - 0.25(70)^2 \]

\[ = 5,775 - 60 - 2,100 - 1,225 = 2,390. \]

C5. a. The firm is a dominant price leader, and its demand curve is found by subtracting the small firms’ supply curve from the market demand curve. Let quantity demanded for the large firm be $Q_L$. Thus, $Q_L = 7,520 - 75P - 120 - 25P = 7,400 - 100P$, and $P = 74 - 0.01Q_L$. It follows that $MR_L = 74 - 0.02Q_L$ and that the large firm will maximize profit where its own $MC$ equals $MR_L$. Thus,

\[ 8 + 0.002Q_L = 74 - 0.02Q_L; \]

\[ 0.022Q_L = 66, \text{ and } Q_L = 3,000. \]

\[ P = 74 - 0.01Q_L = 74 - 30 = $44. \]

b. $Q_L = 120 + 25(44) = 1,220$. Note also that $Q_d = 7,520 - 75(44) = 4,220$, which is the sum of the smaller firms’ quantity supplied and that of Aqualor.

c. For Aqualor, $TR = 3,000(44) = $132,000. Its total cost is

\[ TC = 85,000 + 8(3,000) + 0.001(3,000)^2 = $118,000. \]

So, profit will be $14,000.

C6. a. Starcom has a kinked demand curve. From the given demand curve equations ($Q = 3,000 - 20P$ for price increases and $Q = 1,800 - 10P$ for price decreases) we obtain current price and quantity:

\[ 3,000 - 20P = 1,800 - 10P; 1,200 = 10P; P = $120. \]

By substitution into either demand curve, $Q = 600$.

b. For this section and the next one, we must determine the upper and lower limits of the gap in $MR$ at $Q = 600$. From the demand curve for price increases, $P = 150 - .05Q$ while $MR = 150 - .5P$, and from that for price decreases, $P = 180 - .1Q$ while $MR = 180 - .2Q$. Substituting 600 for $Q$ into the $MR$ equations yields

Upper limit of gap: $MR = 150 - 60 = $90;

Lower limit of gap: $MR = 180 - 120 = $60.

From the given cost function, $MC = 3 + .1Q = $63 when $Q = 600$. This value lies within the gap, so Starcom is maximizing profit.
c. For the new cost function, \( MC = 7 + .16Q = $103 \) when \( Q = 600 \). This is above the upper limit of the \( MR \) gap, so we must set the new \( MC \) equal to the \( MR \) curve for price increases:
\[
7 + .16Q = 150 - .1Q; .26Q = 143; Q = 550.
\]
Substituting into the relevant demand curve,
\[
P = 150 - .05Q = 150 - .05(550) = $122.50.
\]
Finally,
\[
\pi = 122.50(550) - 20,000 - 7(550) - .08(550)^2
= 67,375 - 20,000 - 3,850 - 24,200 = $19,325.
\]

C7. For the given demand curve, \( P = 38 - .01Q \), and \( MR = 38 - .02Q \). If the correct price is $29, then:
\[
29 = 38 - .01Q; Q = 9/.01 = 900.
\]
We can now calculate the relevant \( MR \) and set it equal to the \( MC \) for each plant to determine the allocation.
\[
MR = 38 - .02Q = 38 - .02(900) = 20.
\]
\[
MC_d = 10 + .02Q_d = 20; Q_d = 10/.02 = 500.
\]
\[
MC_T = 8 + .03Q_T = 20; Q_T = 12/.03 = 400.
\]

C8. Since Ajax knows that lowering price will precipitate a price war and, therefore, an inelastic response in quantity, this answer turns on the relation between the firm’s \( MC \) at the $82 price and the \( MR \) from the price increase demand curve. For that demand curve, \( Q = 1,260 - 10P \), so that \( P = 126 - 0.1Q \) and \( MR = 126 - 0.2Q \). Substituting \( P = 82 \) into the \( Q \) equation yields
\[
Q = 1,260 - 10(82) = 440.
\]
At this quantity, \( MR = 126 - 0.2(440) = 38 \). From the given total cost function, \( STC = 10,000 + 34Q \), short-run marginal cost is \( SMC = 34 \). Since \( MR > SMC \) and lowering \( Q \) does not affect \( SMC \) but causes \( MR \) to rise, profit will only fall if price is raised. Also, since there is an implied discontinuity in the demand curve (kink at \( P = 82, Q = 440 \)) and cutting price will produce an inelastic quantity response, a price decrease will yield \( MR < 0 \). This also will reduce profit, so $82 is the optimal price.

Note: that some students may set the marginal revenue equation for the price increase demand curve equal to the \( SMC \) of 34. This will yield \( Q = 460 \) and \( P = 80 \), an incorrect answer since the given demand curve does not apply to prices below $82.