PART 3

MARKETS AND THE BEHAVIOR OF THE FIRM

CHAPTER 8

PERFECT COMPETITION AND MONOPOLY: THE LIMITING CASES

Chapter Outline

I. Perfect Competition and Its Setting
   A. Market Demand Versus Firm Demand
   B. Profit Maximization Under Perfect Competition
   C. The Long Run Under Perfect Competition
   D. Overview of Perfect Competition

II. Monopoly and Its Setting
   A. Profit Maximization Under Monopoly
   B. The Long Run Under Monopoly
   C. Overview of Monopoly

Chapter Summary

Questions

1. A firm may earn greater than normal profit for a short time following an increase in market demand (which raises price). The above-normal profit will last only for as long as it takes the new firms to enter the industry.

2. The firm may expect normal profits in the long run. Entry and exit of firms will result in a market price such that a normal profit (but *only* a normal profit) will be obtained.

3. The supply curve for an individual firm is that portion of its short-run marginal cost curve above minimum average variable cost. The individual firm short-run supply curves are then summed horizontally (the quantities that each firm would supply at a given price are added) to obtain the short-run supply curve of the industry. If short-run marginal costs for an individual firm increase as output increases, the firm and industry short-run supply curves will have a positive slope.

4. None. There is no characteristic which distinguishes one firm's product from that of another firm, and no individual firm is large enough to have any market power resulting from sheer size.

5. The characterization of the agricultural sector as a perfectly competitive industry was probably more nearly correct in the past when entry into the industry was easier and there was not such a large degree of government intervention in the market. Perhaps small farms still approximate perfectly competitive enterprises. The success of farmers' organizations depends on the cooperation and participation of most, if not all, of the affected farmers. At this point, they have had a mixed record of successes and defeats.

6. The monopolistic firm will have the entire market demand to itself, since it is the only firm in the industry. Normally, it will face a downward-sloping demand curve as consumers, in general, will buy larger quantities at lower prices only.

7. No, its costs and revenue at its profit-maximizing level of output could be such that it makes only a normal profit or even an economic loss.

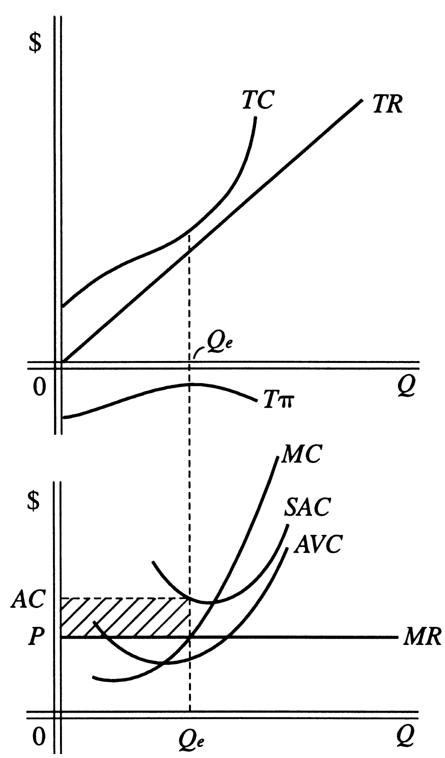
8. If the demand for the firm's product and its long-run average costs were such that at the profit-maximizing level of output, price was equal to long-run average cost.

9. Because barriers to entry prevent other firms from entering the market and driving down the price.

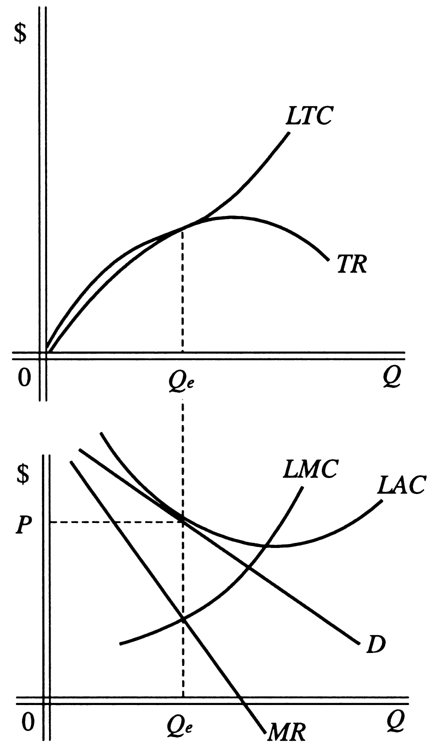
10. A normal profit result at minimum long-run average cost requires that price be equal to minimum LAC. Since the slope of LAC is zero there, the demand curve would have to be horizontal to obtain $MR = MC$ at the same quantity. Without regulation, however, the monopoly firm is normally expected to face a downward-sloping demand curve, and that could only *intersect* minimum LAC, rather than be tangent to it. This would imply that greater-than-normal profit exists and $MR = MC$ at some quantity less than the one where minimum LAC occurs. Finally, if the monopoly were to operate at $MR = MC$ with only normal profit, it would be at a point where, with a downward-sloping demand curve, quantity is *less* than the minimum LAC output. (See Figure 8-11 in the text.)

Problems

1.



a.



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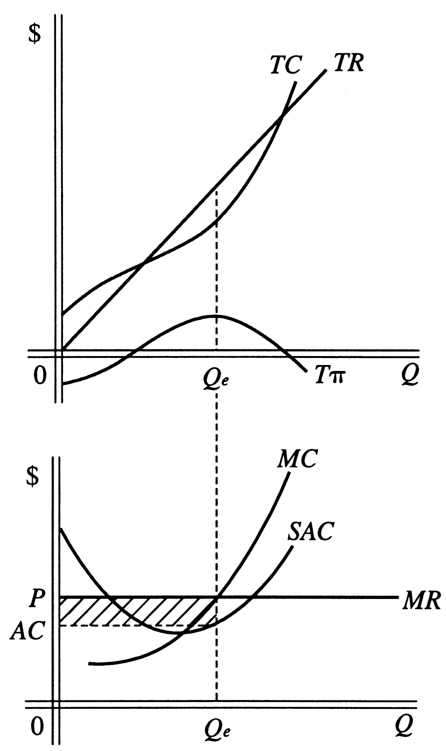

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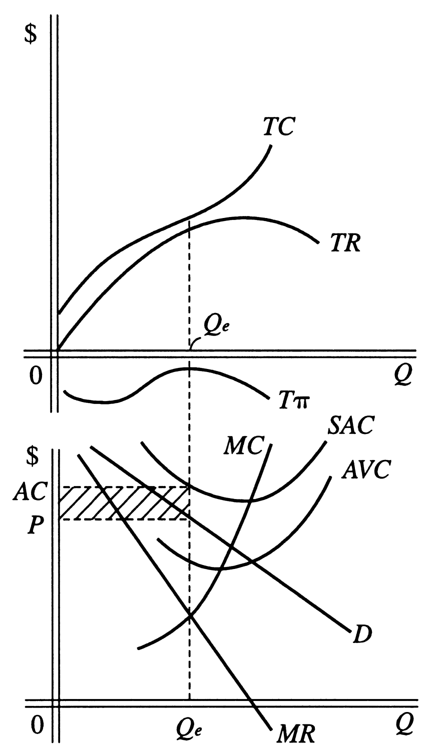


d.

2. **a.** Given that b is the only variable input and that P_b is fixed, $AVC = (1/AP_b)(P_b)$. At $Q = 100$, we have $AP_b = 100/2 = 50$, and $AVC = 0.40 = (1/50)(P_b)$. Thus, $P_b = 0.40(50) = 20$. At that same output, we can solve for TFC, since $TVC = b(P_b) = 2(20) = 40$. Then $STC - TVC = TFC = 240 - 40 = 200$. The completed table follows.

SMC	MP_b	Output of X	Input of b	AP_b	AVC	STC
		0	0	–	–	200
0.40	50					
		100	2	50.00	0.40	240
0.27	75					
		250	4	62.50	0.32	280
0.40	50					
		350	6	58.33	0.34	320
0.53	37.5					
		425	8	53.13	0.38	360
0.80	25					
		475	10	47.50	0.42	400
1.60	12.5					
		500	12	41.67	0.48	440

b. It would be best for the firm to operate at an output of 425. If output is increased to 475, $MC > MR$, or $0.80 > 0.78$, and marginal profit will be negative. At $Q = 425$, $TR = 0.78(425) = 331.50$. Subtracting the STC of 360 leaves a profit of -28.5, a loss minimum. However, the firm should operate in the short run, since $TFC = 200$, or alternatively, since $P > AVC$.

3. At $MR = MC$,

$60 = 204 - 6Q + .06Q^2$

$.06Q^2 - 6Q + 144 = 0$

Multiply by 100: $6Q^2 - 600Q + 1{,}440 = 0$

Divide by 6: $Q^2 - 100Q + 2{,}400 = 0$

$(Q - 60)(Q - 40) = 0$

$Q - 60 = 0$ or $Q - 40 = 0$

$Q = 60$ or $Q = 40$

At $Q = 40$, $T\pi = (TR - TC) = 2{,}400 - 4{,}000 - 8{,}160 + 4{,}800 - 1{,}280 = -\$6{,}240$.

At $Q = 60$. $T\pi = (TR - TC) = 3{,}600 - 4{,}000 - 12{,}240 + 10{,}800 - 4{,}320 = -\$6{,}160$. The firm should shut down.

4. $P_x = \$260 = MR$, since price is constant

$MR = MC$ at profit-maximizing output

$260 = 80 - 12Q_x + .6Q_x^2$

$.6Q_x^2 - 12Q_x - 180 = 0$

$(Q_x + 10)(.6Q_x - 18) = 0$

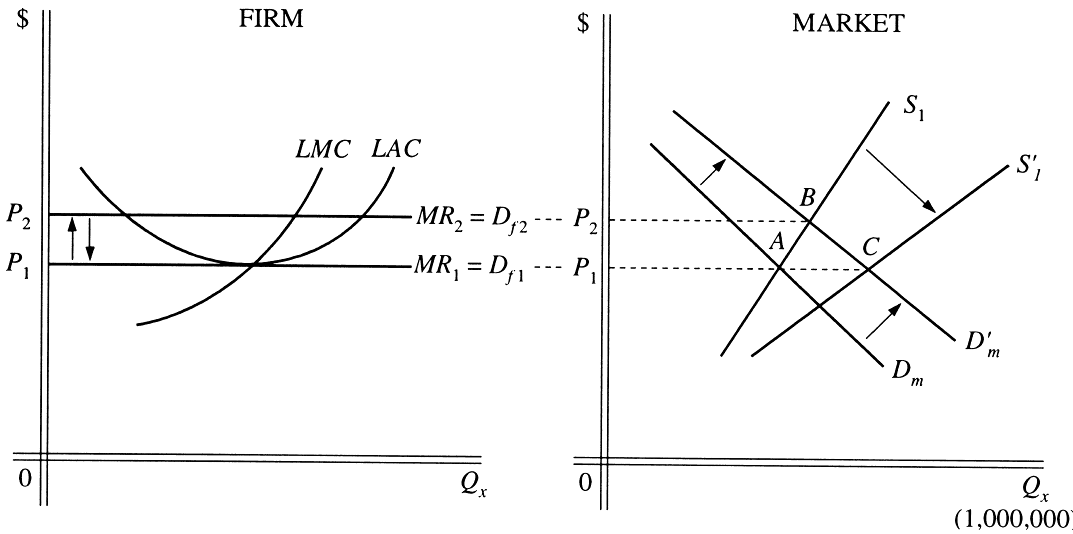
$Q_x = -10$, $\quad .6Q_x = 18$

Not economically meaningful $\quad Q_x = 30$ units per month

$T\pi = TR - TC = \$260(30) - 1{,}000 - 80(30) + 6(30)^2 - .2(30)^3$

$= 7{,}800 - 1{,}000 - 2{,}400 + 5{,}400 - 5{,}400 = \$4{,}400$

5. The market demand curve will shift upward, causing a price increase and temporarily greater than normal profit for the firm. *Entry* of new firms will shift the industry supply curve, S_i, rightward along the *new* market demand curve until price again is equal to minimum LAC. If entry is excessive, a temporary price below minimum LAC is possible, but exit by some firms will lead to an equilibrium price equal to minimum LAC. Assuming constant costs, we can see that the illustration below shows the sequence of market events from point A, to point B, and finally to point C.



6.

Q	P	TR	Arc MR	TVC	Arc MC
0	\$20	\$ 0		\$ 0	
			\$ 18		\$20
5,000	18	90,000		100,000	
			14		4
10,000	16	160,000		120,000	
			10		12
15,000	14	210,000		180,000	
			6		14
20,000	12	240,000		250,000	
			2		16
25,000	10	250,000		330,000	
			−2		18
30,000	8	240,000		420,000	
			−6		20
35,000	6	210,000		520,000	
			−10		24
40,000	4	160,000		640,000	

The firm will maximize profit by producing as close to the point where $MR = MC$ but MR is not less than MC. This point is where $Q = 10{,}000$ units and $P = \$16$. Total profit $= TR - TC = \$160{,}000 - \$130{,}000 = \$30{,}000$.

7.

TC	AFC	AVC	AP_L	Input of L	TP_L Output	MP_L	SMC
900.00	–	–	–	0	0		
						10	6.00
960.00	90.00	6	10.0	1	10		
						18	3.33
1,020.00	32.14	4.29	14.0	2	28		
						20	3.00
1,080.00	18.75	3.75	16.0	3	48		
						8	7.50
1,140.00	16.07	4.29	14.0	4	56		
						4	15.00
1,200.00	15.00	5.00	12.0	5	60		
						3	20.00
1,260.00	14.29	5.71	10.5	6	63		

a. $Q_e = 56$ units, since beyond this output, $SMC > MR$.

b. $T\pi = (TR - TC) = 12(56) - 1{,}140 = 672 - 1{,}140 = \$-468$ (loss).

8. The completed table follows.

MR	*P*	*Q*	*TR*	*STC*	*AVC*	*TVC*	*MC*
	110	10	1100	1400	60.00	600	
90	100	20	2000	1500	35.00	700	10
70	90	30	2700	1700	30.00	900	20
50	80	40	3200	2000	30.00	1200	30
30	70	50	3500	2400	32.00	1600	40
10	60	60	3600	2900	35.00	2100	50
−10	50	70	3500	3500	38.57	2700	60

a. $Q = 40$, $P = \$80$. Increasing Q to 50 would decrease profit since for that change, $MC > MR$.

b. Profit $= \$3200 - \$2000 = \$1200$.

c. Since the franchise fee is a fixed cost, MC is unaffected. Therefore, the profit-maximizing quantity and price remain the same, although profit will decline by \$200.

9. a. For the given demand curve, $Q = 1200 - 10P$, we have $P = 120 - 0.1Q$ and, therefore, $MR = 120 - 0.2Q$. Setting $MR = MC$, one obtains

$$120 - 0.2Q = 18$$

$$Q = \frac{102}{.2} = 510.$$

b. $P = 120 - 0.1(510) = \$69$. Since $AVC = \$18$, total profit contribution from the concrete will be $(69 - 18)(510) = \$26{,}010$.

10. a. For the given demand curve, $Q = 10{,}000 - 40P$, $P = 250 - .025Q$, and $MR = 250 - .05Q$. Where $MR = 0 = 250 - .05Q$, $Q = 5{,}000$, and $P = 250 - .025(5{,}000) = \$125$. Maximum TR is $(125)(5{,}000) = 625{,}000$.

b. Where $MR = MC$, $250 - .05Q = 50$. $Q = 4{,}000$, and $P = 250 - .025(4{,}000) = \$150$.

c. With total fixed cost of 300,000,
at $Q = 5{,}000$, $T\pi = (125 - 50)(5{,}000) - 300{,}000 = \$75{,}000$.
at $Q = 4{,}000$, $T\pi = (150 - 50)(4{,}000) - 300{,}000 = \$100{,}000$.

11. a. $MR = SMC$, or $275 = 50 + 0.5Q$. $Q = 225/.5 = 450$.

b. $SAC = 17.78 + 50 + 112.50 = 180.28$ at $Q = 450$. $P > SAC$, so total profit will be greater than normal. It will be $T\pi = (275 - 180.28)(450) = \$42{,}624$.

c. In the long run, there will be entry because of the greater than normal profit. Entry will increase supply and cause price to fall until only normal profit prevails.

C1. The long-run equilibrium price will be where P = minimum LAC.

$$LAC = \frac{LTC}{Q_x} = 240 - 6Q_x + .08\,Q_x^2$$

We find minimum LAC where

$$\frac{dLAC}{Q_x} = -6 + .16Q_x = 0$$

$$.16Q_x = 6$$

$$Q_x = 37.5 \text{ units}$$

This problem can also be worked by setting $LAC = LMC$.

$$240 - 6Q_x + .08Q_x^2 = 240 - 12Q_x + .24Q_x^2$$
$$.16Q_x^2 - 6Q_x = 0$$
$$Q_x = 37.5 \text{ or } Q_x = 0 \text{ (not relevant)}$$
$$LAC \text{ at } Q = 37.5 = 240 - 6(37.5) + .08(37.5)^2$$
$$= 240 - 225 + 112.5 = \underline{\underline{\$127.50}}$$

Thus, long-run equilibrium price = $\underline{\underline{\$127.50}}$.

C2. a. To max profit, $MR - MC = 0$.
$180 - 90 + 9Q - Q^2 = 0$; $(-Q + 15)(Q + 6) = 0$;
$Q = \underline{\underline{15}}$.

b. $TR = 180(15) = 2700$
$STC = 700 + 90(15) - 4.5(225) + 3375/3 = 2162.50$
Profit $= 2700 - 2162.50 = \underline{\underline{537.50}}$.

C3. a. From the given demand curve, $P = 80 - .04Q$ and $MR = 80 - .08Q$
To max profit, $MR - MC = 0$;
$80 - .08Q - 8 - .07Q = 0$
$72 - 0.15Q = 0$; $Q = \underline{\underline{480}}$, $P = 80 - .04(480) = \underline{\underline{60.80}}$.

b. $TR = 60.80(480) = 29{,}184$
$STC = 500 + 8(480) + .035(480)^2 = 12{,}404$
Profit $= 29{,}184 - 12{,}404 = \underline{\underline{16.780.}}$

C4. $TR = P_x \cdot Q_x$. To get TR in terms of Q_x so that we can find MR, we solve the demand function for P_x.

$$Q_x = 4{,}000 - 20\,P_x$$

$$-20P_x = Q_x - 4{,}000$$

$$P_x = -.05Q_x + 200.$$

$$TR_x = (-.05Q_x + 200)Q_x = -.05Q_x^2 + 200Q_x$$

$$MR_x = \frac{dTRx}{dQ_x} = -.1Q_x + 200.$$

Profits are maximized where $MR = MC$:

$$-.1Q_x + 200 = 20$$

$$-.1Q_x = -180$$

$$Q_x = \underline{\underline{1{,}800}} \text{ units per month}$$

$$P_x = -.05(1{,}800) + 200 = \underline{\underline{\$110.}}$$

C5. a. From the solution to Problem C4,

$MR_x = -.1Q_x + 200$

Maximize profit where $MR_x = SMC_x$, or

$-.1Q_x + 200 = 176 - 5.86Q_x + .06Q_x^2$

$.06Q_x^2 - 5.76Q_x - 24 = 0$

Multiply by 100: $6Q_x^2 - 576Q_x - 2{,}400 = 0$

Divide by 6: $Q_x^2 - 96Q_x - 400 = 0$

$(Q_x - 100)(Q_x + 4) = 0$

$\underline{\underline{Q_x = 100}}$; $Q_x = -4$, not economically meaningful

$P_x = -.05Q_x + 200 = -5 + 200 = \underline{\underline{\$195}}$.

b. Total profit $= TR - TC$

$TR = \$195 \times 100 = \$19{,}500$

$TC = 8{,}750 + 176(100) - 2.93(100)^2 + .02(100)^3$

$= 8{,}750 + 17{,}600 - 29{,}300 + 20{,}000 = \$17{,}050$

So, $TR - TC = \$19{,}500 - \$17{,}050 = \underline{\underline{\$2{,}450}}$ profit.

C6. a. To maximize TR, $MR = 100 - 2Q = 0$. $Q = 50$. $P = 100 - Q = \underline{\underline{\$50}}$.

b. To maximize profit, marginal profit must be zero. From the given demand and cost functions, we have:

$M\pi = (MR - MC) = 100 - 2Q - 180 + 26Q - Q^2 = 0$

$-Q^2 + 24Q - 80 = 0$; $(-Q + 20)(Q - 4) = 0$; $Q = 20$ or $Q = 4$. The second derivative of profit is $d^2T\pi/dQ^2 = -2Q + 24$. This will be negative, indicating a maximum, if $Q = 20$. Since $P = 100 - Q$, the profit-maximizing price is $\underline{\underline{\$80}}$.

c. At the total revenue maximum with $Q = 50$ and $P = \$50$:

$T\pi = 50(50) - 250 - 180(50) + 13(50)^2 - (1/3)(50)^3$

$= 2{,}500 - 250 - 9{,}000 + 32{,}500 - 41{,}667 = \underline{\underline{\$-15{,}917}}$.

At the total profit maximum, with $Q = 20$ and $P = \$80$:

$T\pi = 80(20) - 250 - 180(20) + 12(20)^2 - (1/3)(20)^3$

$= 1{,}600 - 250 - 3{,}600 + 5{,}200 - 2{,}667 = \underline{\underline{\$283}}$.

In this case, maximizing total revenue leads to a loss, while there is positive economic profit at the profit maximum.

C7. a. In perfect competition, $P = MR$, and we can set the MC from the given STC function equal to the market price of \$330:

$150 - 24Q + Q^2 = 330$

$-Q^2 + 24Q + 180 = 0$

$(-Q + 30)(Q + 6) = 0$

$Q = \underline{\underline{30}}$.

b. $T\pi = (TR - STC)$

$= 330(30) - 5{,}000 - 4{,}500 - 150(30) + 12(30)^2 - (1/3)(30)^3$

$= 9{,}900 - 5{,}000 - 4{,}500 + 10{,}800 - 9{,}000 = \underline{\underline{\$2{,}200}}$.

c. i. $LAC = LTC/Q = \underline{\underline{660 - 9Q + .05Q^2}}$

ii. To find minimum LAC, $dLAC/dQ = 0 = -9 + .1Q$; $Q = 90$.

$P = LAC = 660 - 810 + 405 = \underline{\underline{\$255}}$. Since $P = LAC$, $\pi = 0$.

C8. If Stanley's cost is $STC = 800 + 0.2Q = 0.0001Q^2$, his marginal cost will be $SMC = 0.2 + 0.0002Q$.

a. When the Board restricts his price to \$0.80, this will be MR, so for profit maximization we have

$$0.2 + 0.0002Q = 0.80$$

$$Q = \frac{0.6}{0.0002} = \underline{\underline{3000}}$$

Stanley's profit will be $\$0.80(3000) - STC$, or

$$T\pi = 2{,}400 - 800 - 0.2(3000) - 0.0001(3000)^2$$
$$= 2{,}400 - 800 - 600 - 900 = \underline{\underline{\$100}}.$$

b. For the given demand curve $Q = 5{,}000 - 2{,}500P$, a price of \$0.80 yields $Q = 5{,}000 - 2{,}000 = 3{,}000$. Thus, Stanley will, in fact, be able to sell 3,000 drinks at the \$0.80 price.

c. If Stanley can set his own price and demand remains the same, then from the given demand curve $Q = 5{,}000 - 2{,}500P$ we can obtain $P = 2 - 0.0004Q$ and $MR = 2 - 0.0008Q$. Profit will be maximized where this MR equals SMC.

$$2 - 0.0008Q = 0.2 + 0.0002Q$$

$$Q = \frac{1.8}{0.001} = \underline{\underline{1{,}800}}$$

Thus, $P = 2 - 0.0004(1{,}800) = \underline{\underline{\$1.28}}$.

Profit is $\$1.28(1{,}800) - STC$, or

$$T\pi = \$2{,}304 - 800 - 0.2(1{,}800) - 0.0001(1{,}800)^2$$

$$T\pi = \$2{,}304 - 800 - 360 - 324 = \underline{\underline{\$820}}.$$