CHAPTER 8
PROFIT MAXIMIZATION AND COMPETITIVE SUPPLY

EXERCISES

1. From the data in the following table, show what happens to the firm's output choice and profit if the price of the product falls from $40 to $35.

The table below shows the firm's revenue and cost information when the price falls to $35.

Q	*P*	*TR* *P* = 40	*TC*	π *P* = 40	*MC* *P* = 40	*MR* *P* = 40	*TR* *P* = 35	*MR* *P* = 35	π *P* = 35
0	40	0	50	-50	___	___	0	___	-50
1	40	40	100	-60	50	40	35	35	-65
2	40	80	128	-48	28	40	70	35	-58
3	40	120	148	-28	20	40	105	35	-43
4	40	160	162	-2	14	40	140	35	-22
5	40	200	180	20	18	40	175	35	-5
6	40	240	200	40	20	40	210	35	10
7	40	280	222	58	22	40	245	35	23
8	40	320	260	60	38	40	280	35	20
9	40	360	305	55	45	40	315	35	10
10	40	400	360	40	55	40	350	35	-10
11	40	440	425	15	65	40	385	35	-40

At a price of $40, the firm should produce eight units of output to maximize profit because this is the point closest to where price equals marginal cost without having marginal cost exceed price. At a price of $35, the firm should produce seven units to maximize profit. When price falls from $40 to $35, profit falls from $60 to $23.

2. Again, from the data in the above table, show what happens to the firm's output choice and profit if the fixed cost of production increases from $50 to $100, and then to $150. What general conclusion can you reach about the effects of fixed costs on the firm's output choice?

The table below shows the firm's revenue and cost information for Fixed Cost, *FC* of 50, 100, and 150.

Q	*P*	*TR*	*TC* *FC* = 50	π *FC* = 50	*MC*	*TC* *FC* = 100	π *FC* = 100	*TC* *FC* = 150	π *FC* = 150
0	40	0	50	-50	__	100	-100	150	-120
1	40	40	100	-60	50	150	-110	200	-160
2	40	80	128	-48	28	178	-98	228	-148
3	40	120	148	-28	20	198	-78	248	-128
4	40	160	162	-2	14	212	-52	262	-102
5	40	200	180	20	18	230	-30	280	-80

6	40	240	200	40	20	250	-10	300	-60
7	40	280	222	58	22	272	8	322	-42
8	40	320	260	60	38	310	10	360	-40
9	40	360	305	55	45	355	5	405	-45
10	40	400	360	40	55	410	-10	460	-60
11	40	440	425	15	65	475	-35	525	-85

In all of the given cases, with fixed cost equal to 50, then 100, and then 150, the firm will produce 8 units of output because this is the point closest to where price equals marginal cost without having marginal cost exceed price. Fixed costs do not influence the optimal quantity, because they do not influence marginal cost.

3. Suppose you are the manager of a watchmaking firm operating in a competitive market. Your cost of production is given by $C = 100 + Q^2$, where Q is the level of output and C is total cost. (The marginal cost of production is 2Q. The fixed cost of production is $100.)

a. If the price of watches is $60, how many watches should you produce to maximize profit?

Profits are maximized where marginal cost is equal to marginal revenue. Here, marginal revenue is equal to $60; recall that price equals marginal revenue in a competitive market:

$$60 = 2Q, \text{ or } Q = 30.$$

b. What will the profit level be?

Profit is equal to total revenue minus total cost:

$$\pi = (60)(30) - (100 + 30^2) = \$800.$$

c. At what minimum price will the firm produce a positive output?

A firm will produce in the short run if the revenues it receives are greater than its variable costs. Remember that the firm's short-run supply curve is its marginal cost curve above the minimum of average variable cost. Here, average variable cost is $\frac{VC}{Q} = \frac{Q^2}{Q} = Q$. Also, *MC* is equal to 2*Q*. So, *MC* is greater than *AVC* for any quantity greater than 0. This means that the firm produces in the short run as long as price is positive.

4. Use the same information as in Exercise 1 to answer the following.

a. Derive the firm's short-run supply curve. (Hint: you may want to plot the appropriate cost curves.)

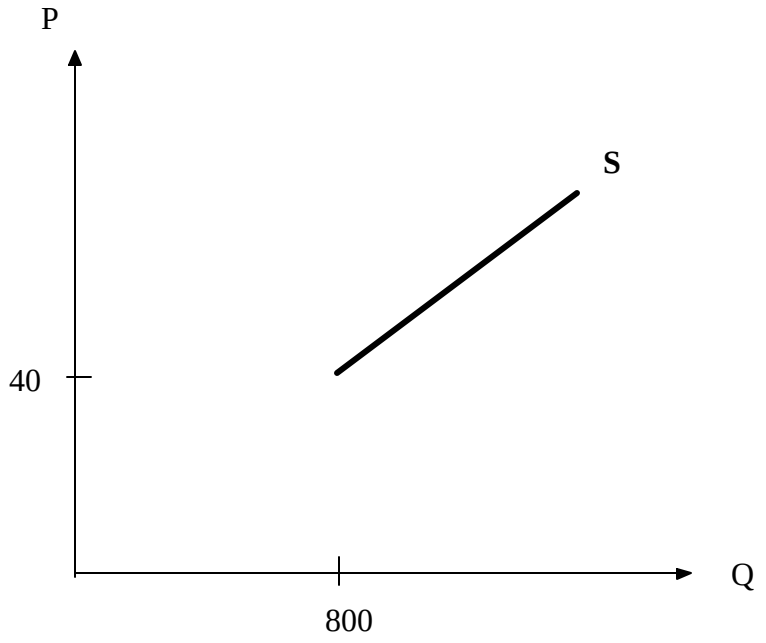
The firm's short-run supply curve is its marginal cost curve above average variable cost. The table below lists marginal cost, total cost, variable cost, fixed cost, and average variable cost. The firm will produce 8 or more units depending on the market price and will not produce in the 0-7 units of output range because in this range AVC is greater than MC. When AVC is greater than MC, the firm minimizes losses by producing nothing.

Q	*TC*	*MC*	*TVC*	*TFC*	*AVC*
0	50	___	0	50	___
1	100	50	50	50	50.0
2	128	28	78	50	39.0
3	148	20	98	50	32.7

4	162	14	112	50	28.0
5	180	18	130	50	26.0
6	200	20	150	50	25.0
7	222	22	172	50	24.6
8	260	38	210	50	26.3
9	305	45	255	50	28.3
10	360	55	310	50	31.0
11	425	65	375	50	34.1

b. If 100 identical firms are in the market, what is the industry supply curve?

For 100 firms with identical cost structures, the market supply curve is the horizontal summation of each firm's output at each price.



6. Suppose that a competitive firm's marginal cost of producing output q is given by MC(q) = 3 + 2q. Assume that the market price of the firm's product is $9:

a. What level of output will the firm produce?

To maximize profits, the firm should set marginal revenue equal to marginal cost. Given the fact that this firm is operating in a competitive market, the market price it faces is equal to marginal revenue. Thus, the firm should set the market price equal to marginal cost to maximize its profits:

$$9 = 3 + 2q, \text{ or } q = 3.$$

b. What is the firm's producer surplus?

Producer surplus is equal to the area below the market price, i.e., $9.00, and above the marginal cost curve, i.e., $3 + 2q$. Because MC is linear, producer surplus is a triangle with a base equal to $6 (9 - 3 = 6). The height of the triangle is 3, where $P = MC$. Therefore, producer surplus is

$$(0.5)(6)(3) = \$9.$$

See Figure 8.6.b.

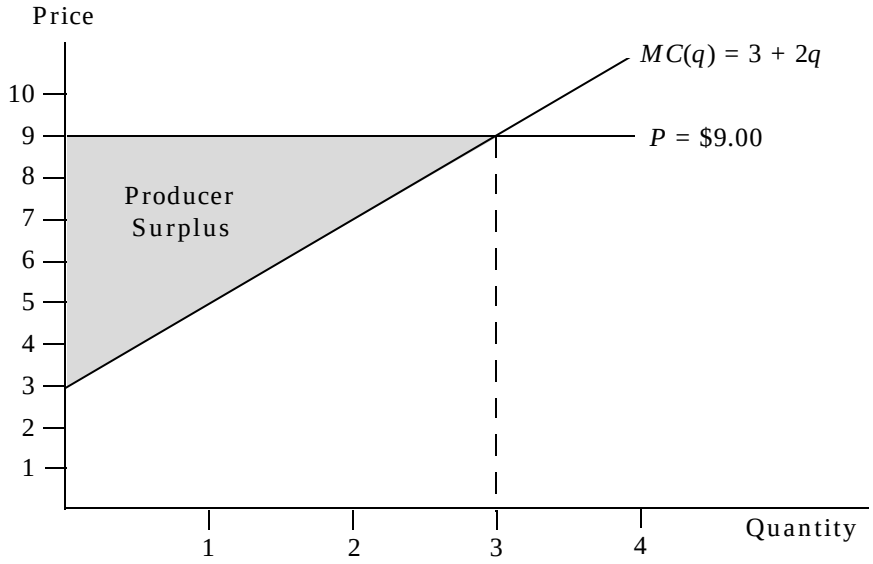


Figure 8.6.b

7. Suppose that the average variable cost of the firm in Exercise (6) is given by AVC(q) = 3 + q. Suppose that the firm's fixed costs are known to be \$3. Will the firm be earning a positive, negative, or zero profit in the short run?

Profit is equal to total revenue minus total cost. Total cost is equal to total variable cost plus fixed cost. Total variable cost is equal to $(AVC)(q)$. Therefore, at $q = 3$,

$$TVC = (3 + 3)(3) = \$18.$$

Fixed cost is equal to \$3.

Therefore, total cost equals *TVC* plus *TFC*, or

$$TC = 18 + 3 = \$21.$$

Total revenue is price times quantity:

$$TR = (\$9)(3) = \$27.$$

Profit is total revenue minus total cost:

$$\pi = \$27 - \$21 = \$6.$$

Therefore, the firm is earning positive economic profits.

More easily, you might recall that profit equals surplus minus fixed cost. Since we found that surplus was \$9 in question 6, profit equals 9-3 or \$6.